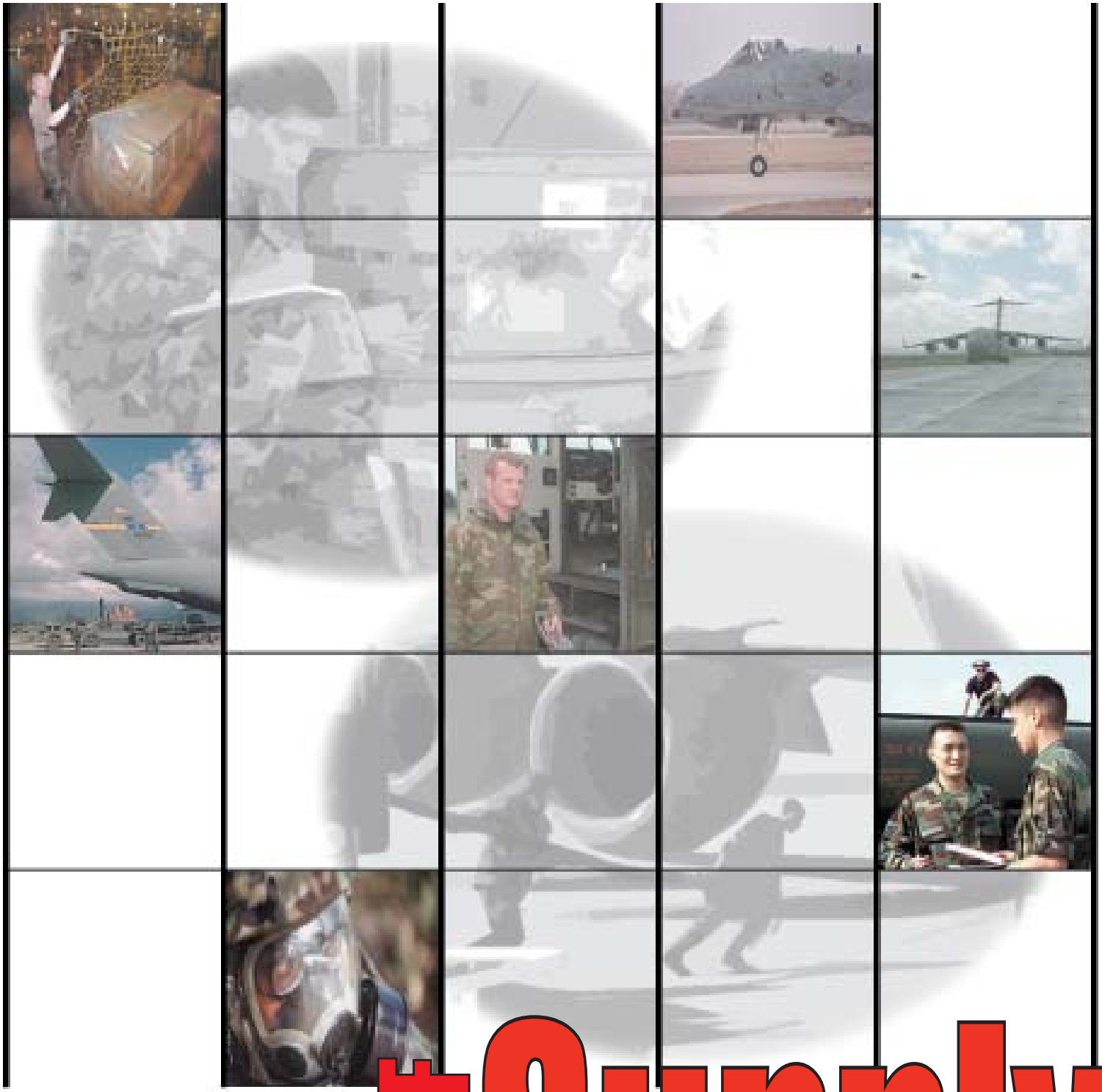

USAF Supply

Pride, Dedication, Professionalism

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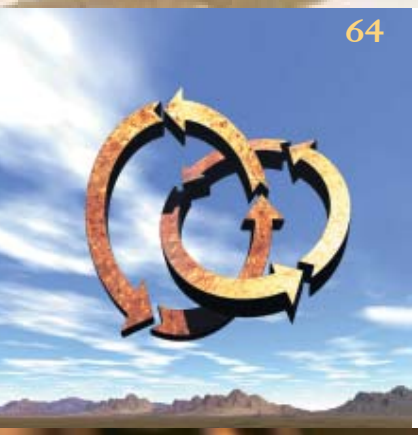
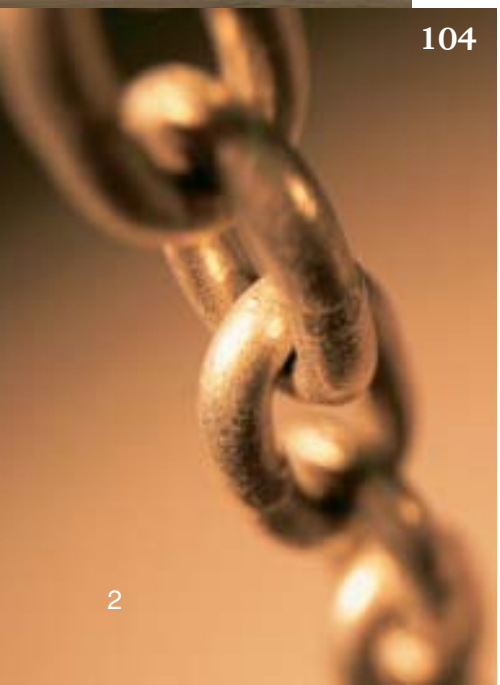
USAF Supply





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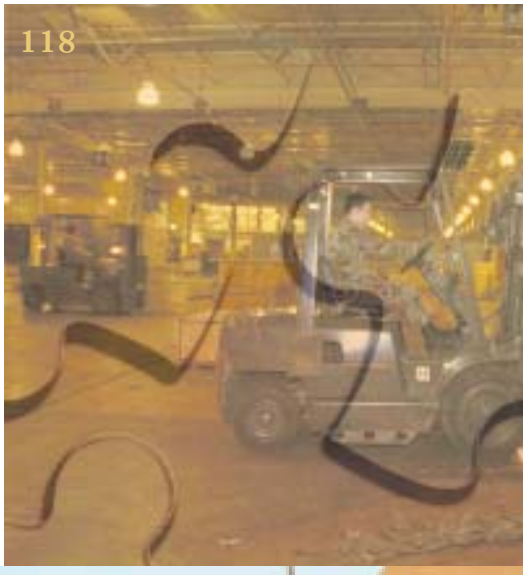

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Finally, a debt of gratitude goes to Lieutenant Colonel James C. Rainey, Beth F. Scott, and Lieutenant Colonel Gail Waller. Their help on this project was invaluable and greatly appreciated.

Nobody Flies without Supply

For the last 50 years, wherever the United States has fought, has reached out a helping hand, or has established a presence of peace, US Air Force Supply has been there.

Foreword

When the National Security Act of 1947 formally established the United States Air Force as a separate Service, it also created the need for an entity known as Air Force Supply. For more than 50 years, the men and women of the supply community have sought to provide outstanding support to both our pilots and support personnel. And for those 50 years, they have succeeded. Supply troops played an integral role in supporting the Berlin Airlift. Their efforts indirectly saved millions of lives as tons of food were delivered to a city under siege. Supply and fuels troops were there to support the American forces in Korea, nearly half a world away. Accomplishments such as furnishing external fuel tanks for our F-86 aircraft meant that the United States would be able to stem the flow of Communist aggression in that far corner of the world.

In Vietnam, it was the supply structure that sent millions of tons of support equipment and spare parts to support our fighting forces. It was also in Vietnam that the POL community continued its standard of excellence; nowhere was POL mentioned as a major concern in the scope of operations. More recently, the supply community fueled the efforts to thwart the expansionist efforts of Saddam Hussein in the Persian Gulf, and they also fed scores of hungry children in Somalia. In Kosovo, supply excelled again, as the Air Force successfully conducted the longest aerial campaign ever. So, as you can see, in the last 50 years, wherever the United States has fought, has reached out a helping hand, or has established a presence of peace, US Air Force Supply has been there.

The future of supply presents new and interesting challenges. For example, we are fully online with regionalization, an effort that will result in better support to the warfighter. These new challenges mean that we will be faced with one constant: change. We have been changing, and we will continue to change as we improve our processes. Our bottom line will not be supply, but it will be supporting the warfighter's weapon systems. We *cannot* and *should not* fear change. We should *embrace* it, for it will improve our support to the United States Air Force.

This monograph is designed to highlight our past and our future. As a community, we have much to be proud of. We were there when the Berlin Wall came down. We were there when the Cold War ended. As a community, we also have a lot to look forward to. New initiatives, new programs, and new challenges exist that will carry the supply-fuels family into the next millenium. As we seek to become a truly expeditionary Air Force, supply must be there to provide the same outstanding support that has become our trademark.

I am proud to be a supply troop. I am proud to be part of such a special group of outstanding professionals, patriots, and individuals. Three words in the title of this book say it all: Pride, Dedication, Professionalism. Let's not forget who we are. Remember where we've been and look forward to where we're headed.

ROBERT E. MANSFIELD, JR.
Brigadier General, USAF
Director, Supply
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Support in a Time of

Crisis

Supply and Maintenance during the Berln Airlift

Roger G. Miller, PhD

Colonel Frank Howley, the tough, irrepressible commander of the American military garrison in Berlin, watched with wonder the first Douglas C-47 Skytrains land with food for the people of Berlin. "They wobbled into Tempelhof," he later wrote,

> Coming down clumsily through the bomb-shattered buildings around the field . . . the most beautiful things I had ever seen. As the planes touched down, and bags of flour began to spill out of their bellies, I realized that this was the beginning of something wonderful—a way to crack the blockade. I went back to my office almost breathless with elation, like a man who has made a great discovery and cannot hide his joy.[2]

Colonel Howley had indeed witnessed something special. On 24 June 1948, the Soviet military had clamped a tight blockade on the land and water routes between the Western occupation zones of Germany and the Allied sectors in Berlin. Three air corridors also connected Berlin with the occupation zones. Taking advantage of these, Lieutenant General Curtis E. LeMay, Commander of the United States Air Forces in Europe (USAFE), had already begun flying supplies to the military garrisons in Berlin 2 days before the blockade. But something more was needed. General Lucius D. Clay, the American military governor in Germany, and General Sir Brian Robertson, his British opposite number, turned to airpower as the only means of feeding and supplying the 2.5 million German citizens in Berlin. The result was *Operation Vittles*, which, together with the Royal Air Force's *Operation Plainfare*, would soon become the greatest humanitarian airlift in history.

The airlift began as a short-term expedient to buy time for Western diplomats to negotiate an end to the blockade that threatened to starve 2.5 million Berliners, but it soon grew into a huge, well-oiled machine that delivered enough food, supplies, and above all, coal, to keep the city alive and ensure freedom for its people. At the beginning, the US Air Force had barely 100 weary C-47s in Germany. LeMay knew these were not enough, and he quickly requested strategic air transports, four-engine Douglas C-54 Skymasters. As these joined the airlift in increasing numbers, the amount of cargo delivered increased dramatically and continued to climb despite all obstacles.

On 28 July 1948, the US Air Force's premier air transport expert, Major General William H. Tunner, arrived in Rhein-

Main and took command of the airlift. Tunner and his staff of experienced air transport experts—who had learned their business on the *Hump* airlift to China during World War II—imposed order on all aspects of the airlift. Tunner required careful coordination of every aspect of the airlift, including detailed procedures and exact duplication and precise execution of each phase of the operation, from loading cargo to the return landing. Aircraft maintenance teams, aircrews, supply personnel and thousands of lesser known activities were sharply regimented. All personnel performed their duties according to strict directives, and statistical charts and tables tracked the process at every stage. Tunner demanded that all activities take place in a constant, unvarying cadence. "This steady rhythm, constant as the jungle drums, became the trademark of the Berlin Airlift."[3]

Ultimately, Skymasters flew the narrow southern corridor at carefully controlled, 3-minute intervals; landed in Berlin at the same intervals; and returned to their home bases through the center corridor around the clock, 7 days a week. This rate, Tunner noted, "provided the ideal cadence of operation with the control equipment available at the time." He explained:

> At three-minute intervals, this meant 480 landings at, say, Tempelhof, in a 24-hour period. Under ideal circumstances, this schedule could mean 1,440 landings daily at three air fields.[4]

There were simply too few parts to stock the supply pipeline and ensure a steady flow of parts so that they were immediately available when required.

Tunner viewed the corridors between Western Germany and Berlin as a conveyor belt with aircraft spaced evenly along the route. All the aircraft moved at the same speed, executed their maneuvers at the same spot and followed the predetermined schedule to the second. Like a conveyor belt, the airlift could be slowed down or sped up as necessary, but it was relentless in its regimentation.[5]

On 15 October 1948, the US Air Force and the Royal Air Force united Operation Vittles and Operation Plainfare under the Combined Airlift Task Force (CALTF) commanded by General Tunner, with Air Commodore John W. F. Merer as his deputy. Establishment of the CALTF gave Tunner complete operational control of the airlift. The results were unprecedented; tonnage continued to climb, even in the face of the winter of 1948-1949, which Soviet leaders—and not a few of their Western counterparts—believed would bring the airlift to a halt. By spring 1949, the airlift had won; its victory was punctuated by the *Easter Parade* in mid-April 1949 when it delivered 12,941 tons in 24 hours. This showcased airlift's capacity to deliver huge amounts of cargo and demonstrated conclusively the ability of Tunner's system to manage an unprecedented density of traffic. Thanks to the Berlin Airlift, the Soviet Union had no options. Its leaders had to negotiate the future of Germany with the Western powers on even terms. On 12 May 1949, the Soviet Union lifted the blockade. The Western powers continued to operate the airlift until 30 September 1949, stockpiling enough food and other necessities to forestall future Soviet threats to the city.

Maintenance and Supply for the Airlift

An enormous logistical endeavor in its own right, the Berlin Airlift was made possible by a massive logistical effort that stretched from the flight lines at the airfields in Germany, through depots in Germany and England, to maintenance and supply facilities across the United States. The effectiveness of this system was critical to the success of the airlift. The most serious problem faced by the airlift, other than

flying under inclement conditions, was the servicing and maintenance of the airplanes that performed the work.[6]

From the beginning of the airlift through the arrival of the first C–54s, C–47s were the air transport in Europe. While much beloved in Air Force (and Army Air Forces) lore, they were unpopular in the airlift role. USAFE's Skytrains were all more than 5 years old and had more than 2,000 flying hours, most under wartime conditions. Some still wore the black-and-white vestiges of D-day invasion stripes that dated from 1944. Their age and worn condition frustrated the maintenance and supply personnel who had to keep them in the air. In one example, intergranular corrosion and cracks in the landing gear bracing strut attachment fittings grounded many C–47s at a cost of some 850 hours in inspection and maintenance. Further, the severe shortage of parts threatened routine maintenance and technical order compliance despite every attempt to requisition the parts. The worst problem with the C–47s, though, was their inadequacy for the job expected of them. Their 3-ton cargo capacity was insufficient, and their operational performance was inferior to the larger, four-engine C–54s. The first Skymasters landed at Rhein-Main on 1 July 1948, and as additional numbers arrived, they gradually replaced the Skytrains. The last C-47 left the airlift on 30 September 1948. Reliance on a single, standard airplane not only enabled Tunner and his staff to streamline every aspect of operations on the airlift but also vastly simplified supply and maintenance.[7]

Maintaining the C–54s still presented serious problems. First, since the few Skymasters that had operated in Europe prior to the airlift were assigned to the Military Air Transport Service (MATS), USAFE lacked the means to support them. Supplies and parts for the aircraft were not part of the USAFE supply system, maintenance facilities capable of handling them were in short supply, and few mechanics had experience with the big birds. Second, the squadrons deployed from the United States brought only a limited number of mechanics and few parts with them; most ground personnel and stocks of supplies arrived by ship, taking several weeks to reach Europe. Conditions on the airlift compounded these problems. The Skymaster had been designed and built to fly passengers over long distances, a mission that featured few takeoffs and landings and long hours at a standard cruising speed. Now, Tunner called upon them to make a large number of short flights carrying extremely heavy loads. Frequent takeoffs under maximum power strained engines and wore out parts; repeated landings with 10 tons of cargo wore out tires, burned up brakes, and severely stressed the C–54's fragile nose gear. The airlift placed a tremendous burden on engines and airframes and ate up spark plugs, brakes, and tires at an incredible rate. The pounding caused by the frequent landings loosened bolts and rivets and fractured metal pieces. The Air Force determined its stock levels by calculating the wear and tear on aircraft flying a standard number of hours per year. Skymasters on the Berlin airlift used up a year's worth of flying hours in a few weeks, placing demands on the system far in excess of what it was capable of filling.[8]

The limited inventory of C–54 parts Air Force-wide compounded the situation. There were simply too few parts to stock the supply pipeline and ensure a steady flow of parts so they were immediately available when required. The shortage of parts in the pipeline system meant that standard practices, like delivery of parts by ship, were insufficient to maintain supply levels, and thousands of tons of parts, equipment, and supplies

had to be flown from the United States to Europe.[9]

USAFE Letter 65-60, published on 19 August 1948, established basic supply and maintenance procedures for the Airlift Task Force (Provisional). Essentially, all common items of Air Force supply came from USAFE's primary supply facility, Erding Air Force Depot. Erding also maintained the necessary stocks to support depot-level maintenance for the C–54 engine accessories, instruments, surfaces, and electronic components. Task Force Headquarters designated Rhein-Main as the specialized supply depot for C–54 support and directed it to establish a 60-day supply level for the big aircraft. Oberpfaffenhofen Air Force Depot in Bavaria established electronics maintenance for radios and radars. When American units were based at two airfields in the British zone of occupation—operations began at Fassberg in August and at Celle in November 1948—they requisitioned C–54 parts from Rhein-Main. Finally, Erding supplied equipment for the initial installation of AN/ARC–3 radios in the C–54s. Replacement parts and spares for the radio came from Rhein-Main.[10]

In addition to its functions as a supply depot, Erding also accomplished sheet metal work, repaired aircraft instruments, and performed special work impossible at other bases, like the elimination of fuel-line leaks. Erding's direct support of the airlift was especially important during the summer of 1948, when it had to send many of its enlisted mechanics to reinforce the shorthanded maintenance crews servicing the C–47s at Wiesbaden.[11]

Cycle maintenance on the C–54s called for preventive maintenance during standardized inspections at carefully determined points—daily and at 50 hours, 200 hours, and 1,000 hours—to ensure the integrity of the aircraft and its safe performance. Maintenance control personnel carefully scheduled these inspections and thoroughly documented the status of the airplane, the deficiencies identified, and the repair actions taken. Maintenance on the airlift was a continuous process that operated 24 hours a day, 7 days a week, and precise scheduling followed accurately was the key to keeping the airplanes flying. The maintenance control unit within the airlift headquarters constantly updated a color-coded control board, displaying the status of each aircraft and providing the overall status of the airlift fleet at a glance.[12]

Maintenance planning by the end of July 1948 called for field maintenance to be a theater responsibility conducted at the flying bases. The critical 200-hour inspections would take place at Oberpfaffenhofen until a World War II air depot at Burtonwood in England reopened for operations. The 1,000-hour inspections would be the responsibility of the Air Materiel Command in the United States.[13]

Mechanics at the bases and depots in Europe accomplished their work in terrible weather. Rain, fog, and cold—combined with poor facilities, long hours and shortages of tools and parts, and intensified by the tremendous pressure of keeping the airplanes flying—made maintenance a miserable, nasty job. And the lack of amenities in the form of proper housing and, often, poor food did little to inspire the men. Major Vance Cornelius, a veteran maintenance officer at Rhein-Main, reported the state of affairs was little different at his base than those Eighth Air Force mechanics had faced during World War II, except Eighth Air Force had a better supply of parts.[14]

Rain, fog, and cold—combined with poor facilities, long hours, and shortages of tools and parts, and intensified by the tremendous pressure of keeping airplanes flying—made maintenance a miserable job.

In addition to the living and working conditions, maintenance on the airlift suffered severely from deficiencies in the number, experience, and ability of the mechanics and technicians available, especially early in the

operation. Inexperienced personnel were a special problem. They not only were inefficient but also could double or triple the time required for even the simplest of repairs. Inexperience cost the airlift hundreds of hours of flying time. The situation improved over time, thanks to better screening of personnel sent to Germany and an intensive on-the-job training program established by the CALTF, but as late as April 1949, a newly arrived mechanic fresh from the C–54 course at Keesler Technical Training Center could encounter a sergeant mechanic who had never been taught to change the carburetor on the R-2000 engine. Further, the C–54 squadrons were not manned to support an around-the-clock operation, and the Air Force was unable to provide enough mechanics, especially trained ones, to provide all the support necessary. Ultimately, the personnel shortages forced USAFE to recruit German nationals, most former Luftwaffe mechanics, to serve with the airlift. Since few spoke English and all lacked experience with C–54s, this step required translating maintenance manuals, technical publications, and inspection checklists into German and establishing an intensive training program.[15]

The best evidence of the progress made in developing a strong maintenance capability came between April and July 1949 when the airlift averaged better than 190,000 tons of cargo per month, some 60,000 tons per month more than during the previous 4 months, although the number of aircraft assigned to Operation Vittles remained virtually unchanged.[16]

Field Maintenance

Airlift maintenance personnel tended to follow standard Air Force practices, but this often proved impossible. The shortage of personnel, especially early in the airlift, prevented the assignment of a crew chief and crew to each aircraft at Rhein-Main. Consequently, maintenance planners had to alter techniques to make the most of the scarce mechanics.

Maintenance at the field level was divided into three functions. First, each aircraft received a daily preflight check. Second, *turnaround* maintenance provided routine servicing when an aircraft landed. It also addressed pilot complaints. Third, maintenance personnel conducted routine checks at 50, 100, and 150 hours. To accomplish these checks, a squadron had 148 maintenance people assigned—often fewer were on hand—divided into three shifts working 12 hours on and 24 hours off. Each shift, in turn, was further divided into three crews. An *alert crew*, usually 12 to 16 men, carried out the preflight checks of the airframe, engines, landing gear, fluids, and electrical systems. They also inspected the radio and radar systems. The alert crews also conducted turnaround maintenance. In this process, aircraft pilots notified the tower of any complaints or problems before they landed. If the problem was minor, the alert crew called for fuel, oil, and another load and accomplished repairs on the flight line. If the work was beyond their capability, they turned the aircraft over to the appropriate crew that specialized in engines, electrical systems, hydraulics, radios, props, or other systems.[17]

The third maintenance function, 50-hour inspections, provided preventive maintenance designed to reduce the need for unscheduled maintenance by identifying and correcting problems before they became serious. This work included a thorough cleaning of the aircraft; replacement of spark plugs; an oil change; and an inspection of the airframe, engines, and aircraft systems. The 50-hour inspection usually took about 5 hours to complete.[18]

200-Hour Inspections

With each aircraft flying an incredible number of hours, the Skymasters reached the 200-hour inspection mark quickly. This inspection was critical to the performance of the C–54 and the life of its airframe. It could not be omitted. And since the aircraft had to be removed from the operation for several days, it rapidly became a major concern for airlift planners. To standardize and accelerate the process, USAFE planners decided to concentrate 200-hour inspections at one location. They reopened a former World War II air depot at Burtonwood in northern England for that purpose because it had sufficient space and facilities for a complete inspection line. Opening Burtonwood and readying the facilities took time, however, and on 6 August, Tunner wrote Major General Laurence S. Kuter, Commander of MATS, that 200-hour inspections would take place at Oberpfaffenhofen near Munich until Burtonwood was ready.[19]

The aircraft thus emerged from the 200-hour inspection with a payload some 2,500 pounds greater than before

The 1421st Maintenance Squadron (Provisional) began operations at Oberpfaffenhofen during the first week of August, and by the 15th, the unit had 7 officers and 236 men. The first C–54 arrived at Oberpfaffenhofen on 7 August. The 200-hour inspection was much more than a casual evaluation of the airplane. It was a thorough inspection and repair of the aircraft that included a complete cleaning, overhaul, reconditioning, and replacement of worn parts and equipment. First, depot personnel removed all loose equipment, drained the oil, and conducted a general inspection. Second, the aircraft exterior was thoroughly washed down with a chemical solution, scrubbed, and rinsed with water, while other workers swept and vacuumed the inside of the aircraft. Third, personnel conducted the 200-hour inspection tasks and completed all work necessary on props, engines, ignition, and other systems ahead of the firewall. Fourth, they accomplished the same tasks on all other airplane systems. Fifth, maintenance personnel inspected the hydraulic system, wheels, brakes, and tires. Finally, they serviced the aircraft, replaced all equipment removed earlier and conducted a last inspection. USAFE also took the opportunity provided by the 200-hour inspection to make modifications to the aircraft beyond the work done during the inspection. For example, Tunner ordered all unnecessary navigation equipment removed from the C–54s during the inspection in order to save weight. In another case, beginning in September, depot personnel installed new deicer boots on all C–54s.[20]

The demand for 200-hour inspections soon forced Oberpfaffenhofen to divert 95 percent of its work force to the C–54s. Even this number proved insufficient, a problem compounded by conflicting instructions from the airlift headquarters, which set the depot's quota at the completion of four inspections per day but would only allow 13 C–54s at the depot at one time. Since the time required to repair deficiencies uncovered during the inspection varied substantially from airplane to airplane, the wash racks either had a line of aircraft waiting for service or stood empty. The work force, accordingly, might have to work many overtime hours or might have to be laid off for several days. Recognizing the wash racks as the main problem, Oberpfaffenhofen hired sufficient local German workers in September to handle any influx of aircraft.[21]

In October, Airlift Task Force Headquarters increased the daily quota of aircraft from four to six and assigned Major Jules A. Prevost, a retired maintenance expert from Pan American Airlines recalled to active duty for 60 days, to Oberpfaffenhofen. Major Prevost

established a *block system* that slightly increased production; however, at the same time, the depot began preparation to close down the 200-hour inspection program and transfer it to Burtonwood. In all, Oberpfaffenhofen completed 43 aircraft inspections in August, 108 in September, 137 in October, and 96 in November. The last C–54 completed inspection at Oberpfaffenhofen on 22 November 1948.[22]

During World War II, Burtonwood served as one of the largest modification and repair centers in England. Reduced to a storage area for mothballed RAF bombers after the war, the facility had been allowed to deteriorate: roofs leaked, buildings sagged, equipment rusted. and facilities decayed. A USAFE survey team went to England in August to inspect the installation, and by the end of the month, the Air Ministry had informally agreed to the establishment of the depot. The construction necessary for reopening Burtonwood began on 1 September, and Colonel Paul B. Jackson, Director of Supply and Maintenance at Oberpfaffenhofen, transferred to the 303[d] Air Repair Squadron at Burtonwood on 2 November. Oberpfaffenhofen also built 13 wooden maintenance docks and 6 wing docks and then sent them off to England. Oberpfaffenhofen supplied experienced men who applied, in the enclosed hangars at Burtonwood, the methods and techniques established at the depot in Germany.[23]

One measure undertaken at Burtonwood was a weight-stripping program for the D, E, and G series of the C–54s. When weighed, most C–54s were found to be about 300 pounds lighter than the data books listed them. Then, the maintenance crews removed roughly 2,200 pounds of excess equipment during the renovation process. The aircraft thus emerged from the 200-hour inspection with a payload some 2,500 pounds greater than before. The payoff for the airlift lay not only in increased cargo capacity but also in less complicated maintenance, thanks to the removal of equipment.[24]

The transfer of operations from Oberpfaffenhofen to Burtonwood, however, severely impacted the production program at a critical time. In November, when Oberpfaffenhofen produced 45 inspections, Burtonwood completed only 18. The difference was made up by conducting 200-hour inspections at the flying bases: 9 at Fassberg, 6 at Wiesbaden, and 24 at Rhein-Main—a total of 102 for the month. This situation, however, was highly unsatisfactory since the bases had to use scarce equipment and facilities, and the work was a severe drain on maintenance crews who should have been doing daily maintenance. The situation remained unsatisfactory for several months. In December, Burtonwood accomplished 49 inspections, just over a quarter of those required by the airlift fleet, causing Tunner and his staff considerable worry. Again, the flying bases had to make up the difference: Rhein-Main performed 47 inspections, Wiesbaden 16, and Fassberg 9. Worse, in January, Rhein-Main had to conduct 70 of the 155 200-hour inspections required that month. Additional personnel and equipment subsequently improved the situation at Burtonwood. The depot conducted 85 inspections in February, then more than doubled the total to 177 in March, enabling USAFE to end 200-hour inspections at the flying bases in April, although Rhein-Main continued to do a small number each month. Production at Burtonwood peaked in July 1949 at 256 inspections.[25]

1,000-Hour Inspections

Behind the Berlin Airlift stood the worldwide maintenance and supply capability of the United States and,

in particular, Air Materiel Command, headquartered at Wright-Patterson AFB, Ohio, with its system of depots at Sacramento, California; Ogden, Utah; San Antonio, Texas; Oklahoma City, Oklahoma; Mobile, Alabama; Middletown, Pennsylvania; and Warner Robins, Georgia. A steady stream of airplanes, engines, and subsystems flowed in and out of the depots as the airlift grew. The depot at San Antonio overhauled Pratt & Whitney engines, while those at San Antonio, Middletown, Mobile, and Sacramento reconditioned starters. Generators were reworked at Sacramento, Ogden, Oklahoma City, and Mobile, and propellers were overhauled and reworked at Sacramento, San Antonio, and Warner Robins. San Antonio, Warner Robins, and Sacramento overhauled communications equipment, and all of the depots repaired instruments.[26]

The C–54s had to return to the United States periodically for cycle maintenance. Cycle maintenance involved a major inspection and reconditioning accomplished at 1,000-hour intervals. At 1,000 hours, for example, personnel conducted a basic inspection of the airframe and systems. The 2,000-hour inspection repeated the basic inspection but included flaps, corrosion prevention, and tightening all bolts. At 3,000 hours, personnel repeated the basic inspection and added reconditioning of valves and integral tank sealing. The 1,000-hour cycles continued through 8,000 hours, with changes in the components and systems addressed.[27]

Early in August, the Air Force made about $11M available to the Air Materiel Command for contracts to civilian maintenance firms for cycle reconditioning of all C–54s assigned to the airlift, except the Navy R5Ds. The contracts went to three civilian firms—Texas Engineering and Manufacturing Company in Dallas, Texas; Lockheed Aircraft Service Company in Burbank, California, and Sayville, New York; and Aircraft Engineering and Maintenance Corporation in Oakland, California. The first of these began operation around 20 August. Until then, the depot at Middletown accomplished the work. The Navy performed cycle maintenance on its transport aircraft at Moffett Naval Air Station near San Francisco, California. Two C–54s arrived at Middletown on 11 August, and eight more were on hand by the 20th.[28]

The airlift's initial plans, based on 126 aircraft, called for 22 to be in the pipeline for the 1,000-hour inspection and 15 for 200-hour inspections at any one time, and all would be carefully scheduled regularly. The plan worked for the most part, but in November, it became apparent that aircraft that had completed their inspections were not being returned to Europe as scheduled. Inspections that had been expected to take an average of 22 days had actually averaged 57. Shortages of spare parts, changing requirements for installation of equipment, and the generally poor condition of the aircraft were principal reasons for interruptions in the flow of aircraft through the inspection pipeline. Further, the shortage of aircrews also affected the return of aircraft. As of 8 October, for example, eight C–54s that had completed inspection were waiting for crews to fly them to Europe. The demands of the airlift precluded releasing crews for ferrying operations. As of 26 November, 67 C–54s had been sent to US depots, and only 18 returned. In the same time period, Skymasters on the airlift had flown 126,344 hours, meaning that 126 should have returned to the United States. Fifty C–54s had arrived in theater, along with the 18 returned, so the airlift had not suffered significantly. But the situation was still a grave concern.[29]

The depot maintenance system gradually caught up with the demand for 1,000-hour inspections. By early 1949, the arrival of additional mechanics and parts in Europe increased the number of aircraft on operational status, permitting a more efficient utilization of aircraft and the prompt release of those scheduled for return to the United States. Tunner and his staff also brought the problem with delays in 1,000-hour inspections in the United States to Secretary of the Air Force Stuart Symington's attention. Symington focused high-level attention on the backlog. As a result, efficiency in processing the aircraft and accomplishing the repair work increased dramatically, while the training of additional pilots and aircrews ensured that the C–54s returned to Germany on schedule. These measures began showing results by mid-February, and by May, the difficulties of attending 1,000-hour maintenance had been largely solved.[30]

Aftermath and an Epitaph

Statistics on the Berlin Airlift vary from source to source. The official USAFE summary of the airlift, *Berlin Airlift: A USAFE Summary*, provides perhaps the most complete and accurate data available. According to that source, the Berlin Airlift delivered a total of 2,325,509.6 tons of cargo to Berlin. Of this amount, Operation Vittles delivered a total of 1,783,572.7 tons, while Operation Plainfare delivered 541,936.9 tons. US deliveries included 1,421,118.8 of coal, 296,319.3 tons of food, and 66,134 tons of miscellaneous cargo. British deliveries included 164,910.5 tons of coal, 240,386 tons of food, and 136,640.4 tons of miscellaneous cargo. Among other commodities, the miscellaneous category included 92,282 tons of liquid fuels, mostly delivered by British civilian aircraft operating under contract. British civilian aircraft also delivered 146,980 tons of the cargo included in the British statistics. In terms of percentages, the US Air Force contributed 76.7 percent of the total tonnage, the Royal Air Force transported 17 percent, and the British civil airlift made up the difference with 6.3 percent.

In addition to the cargo flown into the city, the CALTF transported 81,730.8 tons of cargo out of Berlin during the airlift. Of this freight, 45,887.7 tons went in US aircraft while the British flew out 35,843.1 tons. Much of the outbound cargo comprised small manufactured items produced by Berlin industry under incredibly difficult conditions and labeled "Hergestellt im Blockierten Berlin" ("Manufactured in Blockaded Berlin"). The airlift also carried a total of 227,655 military and civilian passengers in and out of the beleaguered city.

The total number of flights made by the airlift also varies somewhat from source to source. The USAFE summary concluded that the total was 277,569 flights, 189,963 flown by the US Air Force and 87,606 by the Royal Air Force. The total number of flights certified the intensity of the Berlin Airlift and the efficiency with which it operated.

The Berlin Crisis of 1948 was the West's first great victory of the Cold War, and it had profound consequences. The Berlin blockade proved a disaster for Joseph Stalin and his foreign policies by providing graphic evidence of Soviet ruthlessness and inhumanity. Frightened by Soviet cynicism and brutality, Western Europe took a long close look at the *red menace* and turned to each other and the United States for protection. Soviet policies drove these nations to seek safety within a unified defense

system, and the Berlin Crisis, thus, led directly to the creation of the North Atlantic Treaty Organization. Further, Soviet threats and pressure failed to prevent the establishment of a free and independent West Germany and, in fact, accelerated the process. By mid-1949, the West Germans adopted a democratic constitution, proclaimed the Federal Republic of Germany, and elected a free parliament.

For the US Air Force, the Berlin Airlift demonstrated the need to throw off the *milk-run* mentality of the airlines and earlier military air transport operations. Modern airlift required professional organization and exceptional precision in all aspects of transportation, communications, maintenance, contracting, and supply. Above all, the airlift validated the need for large transports designed specifically for use as military transport. The Lockheed C–130 Hercules, Lockheed C–141 Starlifter, Lockheed C–5 Galaxy, and McDonnell Douglas C–17 Globemaster III of today's Air Force are the direct descendants of the C–47s and C–54s of the Berlin Airlift and the lessons learned during that great endeavor.

The most appropriate epitaph for the Berlin Airlift flew into Berlin by airplane. On 23 September 1949, an RAF C-47 Dakota landed at Gatow. On its nose, were the words: "Psalm 21, verse 11."[31] For those who knew their Bible, or those who took the time to look, the message with its reference to Stalin's blockade proclaimed victory:

> For they intended evil against thee: They imagined a mischievous device, which they are not able to perform.

Notes

1. Except where noted, the following narrative is based upon Roger G. Miller, *To Save a City: The Berlin Airlift, 1948-1949,* Washington, DC: Air Force History and Museums Program, 1998.
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14. "A Special Study of Operation Vittles", 78.
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17. "A Special Study of Operation Vittles", 78-81.
18. *Ibid*.
19. Ltr, Major General William H. Tunner, Cmdr, Airlift Task Force (Prov), to Major General Laurence S. Kuter, Cmdr, MATS, 3 August 1948, Berlin Airlift Files, History Office, Air Mobility Command.
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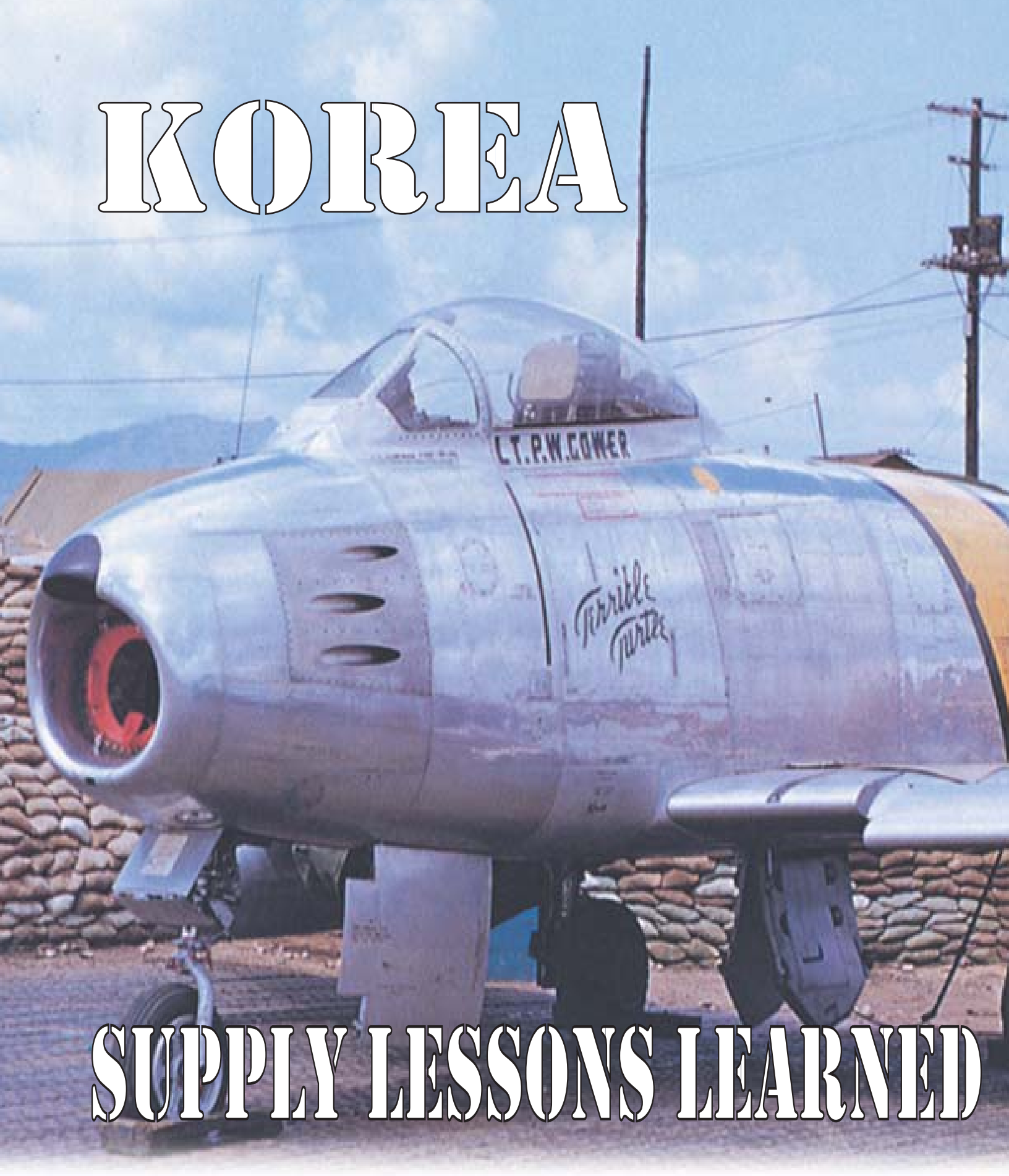
C-54s on the ground at Templehof

notable *quotes*

My logisticians are a humorless lot . . . they know if my campaign fails, they are the first ones I will slay.

Alexander

KOREA



SUPPLY LESSONS LEARNED

After World War II, many in the United States thought it would be a long time before the country would be involved in another military conflict. This lull lasted only until 29 August 1949. When the Soviet Union exploded its own nuclear weapon, the 4-decade long, politicomilitary endgame, known as the Cold War, began in earnest. The United States could no longer play the role of the innocent isolationist since it now had a rival on the nuclear stage.

In 1948, the Korean Peninsula was divided into two distinct zones of occupation. North Korea was the Soviet zone, while South Korea was under US protection.

The fragile but tense peace in Korea was shattered on 25 June 1950, as the Communist-backed North Korean Army stormed across the 38th parallel. It did not take long for the invaders to completely overrun their foes, and a token United Nations (UN) peacekeeping force was dispatched to settle the situation. President Truman quickly dispatched air, land, and sea forces under the control of General Douglas MacArthur, who later became the supreme UN commander. Friendly forces were swept down to the tip of the peninsula, holding on to a small section of Pusan. MacArthur devised a daring amphibious landing at Inchon, and the tide swung in favor of the allied forces.

For nearly a year, the momentum shifted between sides, until, in mid-1951, the character of the conflict changed. Allied forces had driven the enemy to the northern section of the country, near the Yalu River. The allies executed airstrikes, at times into southern China, and the war became a standoff air campaign. In 1953, the two sides met at the negotiating table, and a ceasefire agreement was reached. However, no truce was declared.

Experience factors not available to prime depots, gained as a result of sudden combat operations, necessitated constant revisions of requirements.

The Korean War placed the newly formed Air Force in its first combat environment and presented planners with support challenges much like those faced by the Army Air Forces in the Pacific theater. The geographic separation made the existence of a well-managed supply pipeline essential. However, the logisticians faced a challenge that was not present in 1945: supporting jet aircraft. This new technology caused some interesting support problems. In the official *lessons learned* report issued by the Air Staff in 1954, Brigadier General W. T. Hudnell, Assistant for Logistics Plans, Deputy Chief of Staff, Materiel, stated, "New equipment was introduced into this theater without the necessary supporting items being made available."[1]

The following paragraphs address some of the challenges and lessons learned by the logistics (specifically supply) community during the 3-year conflict.

Spare Parts

Logisticians faced some interesting examples of the spare parts problems during the war. The introduction of a new gunsight for the aircraft posed a specific problem. The A-1 GBR, fitted for the F-86 Sabre, was totally different from anything that was or had been in use. While it was a marked improvement over previous sights, it was introduced into the theater before any supporting equipment or spare parts were available. As a result, if the sight malfunctioned, it took a minor miracle to get it operational again. In 1952, the Air Force began use of another, improved gunsight, the A-4, which was installed on the F-84G Thunderstreak. This again marked an improvement in sight technology. However, the Air Force made the *same* mistake with this sight as it did with the A-1. For 4 months, a severe lack of spare parts, spare components, and special test equipment plagued the theater. This lack of initial support for new items would prove to be a common theme in Air Force logistics during the conflict.

Aircraft Spares Situation. There was a lack of foresight by the logistics planners. Before hostilities began, the system used to replenish the spare parts needed (based on sortie profiles) was sufficient. Nevertheless, when combat operations began, a:

> . . . maximum sortie rate was sustained . . . this depleted existing stocks so rapidly that combat operations were supported on a hand-to-mouth basis.[2]

The extreme lack of experience and consumption data for jet aircraft under combat conditions and rapid fluctuations in the number of assigned aircraft further worsened the support. Hudnell discusses problems caused by the lack of experience:

> In many instances, the ZI (Zone of Interior) depots challenged our requisitions with statements to the effect that past consumption neither reflects nor supports quantities of items on requisition. Experience factors not available to prime depots, gained as a result of sudden combat operations, necessitated constant revisions of requirements. Requisitions must, of necessity, reflect these changes in experience factors; therefore, past consumption cannot arbitrarily be used as an inflexible rule to determine approval of quantities on requisition.[3]

Even though the United States still had a warm industrial base after World War II, the types of parts needed were not often readily available from the production centers. Most aviation support companies had specialized in building parts for propeller-driven aircraft. However, new parts were required to support the jets. The long production lead times associated with the new parts further compounded the spare parts problem. These lead times, along with faulty or unrealistic consumption data, led to long delays in receiving the parts needed in the theater.

The Air Materiel Command and the Far East Air Forces (FEAF) took steps to remedy this problem. Project Bull's Eye was designed to ship critical spares from the ZI depots (located in the Philippines and Japan) to FEAF units in Korea and maintain a 15-day stockpile of these critical items. Additionally, Project Tango Papa sought to ensure FEAF depot stock levels could adequately support a "sudden and sustained increase in operations."[4] However, as of 1954, these projects had done little to improve supportability rates. In fact, FEAF aircraft in-commission rates were barely acceptable throughout the war.

Depot Structure

Tactical units stationed in Korea had to requisition an overseas depot for spare parts. Each depot was responsible for certain parts in certain zones. In this respect, the whole depot structure had not changed markedly from the one employed during World War I. If the *zonal* depot did not have a part, it was sourced from a different depot or supply source. According to Hudnell, the "requisitioning and extraction" created a supply maze that made followup actions difficult. This is strikingly similar to the complaints about the Army Air Service's depot system 33 years earlier. (In case it has not become apparent, it seems that the Air Force did not do a good job of learning the previous lessons from earlier combat situations.)

As with the spare parts problem, the lack of trained and experienced depot personnel made things difficult. While experienced personnel were localized at the ZI depots, personnel at the overseas theater supply facilities were not as experienced. Control and stock levels were often wrong, which led to requisition errors. These errors resulted in overages of some items and shortages of others. Therefore, Project Level Off was designed to identify and redistribute the excesses.[5]

Some of the difficulties encountered in obtaining adequate supply support from the ZI were a direct result of the ineffectiveness of the overseas requisitioning facilities. For example, the delay in posting property on hand, lack of accurate stock record cards at overseas depot, and delay in handling and effecting positive movement of property by overseas depot to a destination affected the FEAF commander's ability to accomplish the mission prior to an actual crisis.[6]

Supply support to the Far East theater progressed from a fairly routine procedure in 1950 to an almost complete, special priority and emergency one by 1 August 1954. The requirement for airlift increased as the effectiveness of the requisitioning procedure decreased. Some items were in short supply because the requirement was not foreseen by the provisioning agencies

so procurement could have been established. While the shortage of other items was not determinable from this theater, the airlift requirement for their delivery existed. Therefore, jet aircraft, tailpipes, B-29 engines, and so on were airlifted to the theater.[7]

After examining these problems and shortfalls, Hudnell proposed some recommendations. Overseas theater support should be on an automatic supply basis. All ZI personnel should be competent and able to provide the necessary level of support to the overseas theater supply facilities. Perhaps most important, there should be supply tables containing the most accurate consumption data based on the overseas activities. There should be a series of 18 different types of tables, from a 15-day supply of high-demand, low-cost items to maintenance parts for hangars and flying fields. These tables should be revalidated every 90 days during a contingency.

Most planning involved conducting operations from occupied countries. Little attention was given to the fact there might be a need to refuel jet aircraft in other areas. As a result, there was little firsthand knowledge of the types of materials or POL systems required.

Interservice Supply

A major source of contention during the war was the issue of interservice supply. According to regulations, the resupply of common items was the responsibility of the Army. Air Force, Navy, and Marine forces were to draw upon the Army depots for these items. However, the Army asserted Air Force units deployed to the theater with shortages of items, should be resupplied through Air Force channels. Therefore, a unit, under this scenario, might be required to requisition the items through two channels (one Army, one Air Force).

Other problems surfaced because of the operational differences between Services. At times, the Army refused to fill certain Air Force requisitions since the table of allowance was not cited. However, Air Force units did not even use tables of allowance for expendable supplies.[9] While these problems were *remediable*, they led to a lack of standard procedures for keeping firm levels and pipelines at the depots and supported bases.[10]

One of the biggest supply triumphs of the Korean War dealt with the issue of jettisonable fuel tanks. The installation of these tanks greatly increased the combat range of the jet aircraft. The first tanks used by US Air Force aircraft were *drop* tanks—gravity drew them off the wings. While this was better than not having external tanks, these tanks were not flawless. Aircraft suffered damage to wingtips, pitot tubes, and other items as a result of the unstable aerodynamics of the tanks. There were also release problems with the shackles.[11]

As a result, the Air Force sought to provide new, jettisonable tanks to jet organizations in Korea. This proved to be a greater problem than anticipated. Several systems were studied, and it was finally decided that automatic supply, controlled by the depot in Japan and monitored by Fifth Air Force, would be the best solution to the problem. All jettisonable fuel tanks were delivered there for storage and issue to Korean bases. The stock control levels were based on the average monthly sortie rate and the average drop rate of tanks per sortie.

The Air Staff concluded that inventories of tanks could be reduced if one tank were available that would fit all three stations on an aircraft. They also concluded, if there were an unlimited war, the existence of different types of external fuel tanks would cause severe logistical problems. As a result of these conclusions, Hudnell made several recommendations. One suggestion focused on prepositioning the necessary tank parts and supplies in the foreign theater to allow for immediate production, should the need arise. Another recommendation called for the standardization of all jettisonable fuel tanks, which would ease the burden on the logistics structure.[12]

POL Support

While supply support seemed to get progressively worse throughout the war, petroleum, oil, and lubricants (POL) support got better. However, one must note that the nature of warfare from 1951 to 1953 favored stabilized POL operations. The last 2 years of the war saw aerial operations staged from fixed locations; therefore, practices and procedures were fine-tuned. Nevertheless, there were some vital lessons learned in the realm of POL.

The F-6 fueling unit was limited exclusively to center-point refueling of cargo planes at Seoul City Airport. Their size and that of the support equipment was too large to be of any use to tactical units, and their immobility prohibited them from being a true tactical asset. Two portable hydrant systems were installed and operational during the war. These systems adequately fulfilled the requirement for fast refueling. Like the F-6, these items could not (as they were) be classified as tactical since they could not realistically be moved quickly. This is where the battlefield geography comes into play. Operations were carried out from fixed bases, and it was determined that this was the *only* environment that would suit the hydrants.[13]

The use of portable hydrant systems was, from a maintenance standpoint, advantageous to the use of mobile tractors and trailers. According to the Hudnell report, the hydrant system could be configured for *combat turn refueling* (refueling during the rearming phase) since only minor vapors were present.[14] The hydrant systems could also be fitted for either conventional or single-point refueling very quickly.

The receipt and distribution of POL was a major logistics operation. The Army was tasked to provide all POL logistics support for the Fifth Air Force. One key lesson learned was the insufficient availability of rail cars to deliver the maximum amount of fuel for more than 3 days.[15] Weather conditions, water levels, and mechanical failures also limited deliveries by barge or tanker. As a result, the most favorable method of delivery was the pipeline. While not immune to mechanical failure or sabotage, pipelines were faster and more efficient than any other mode of transfer.

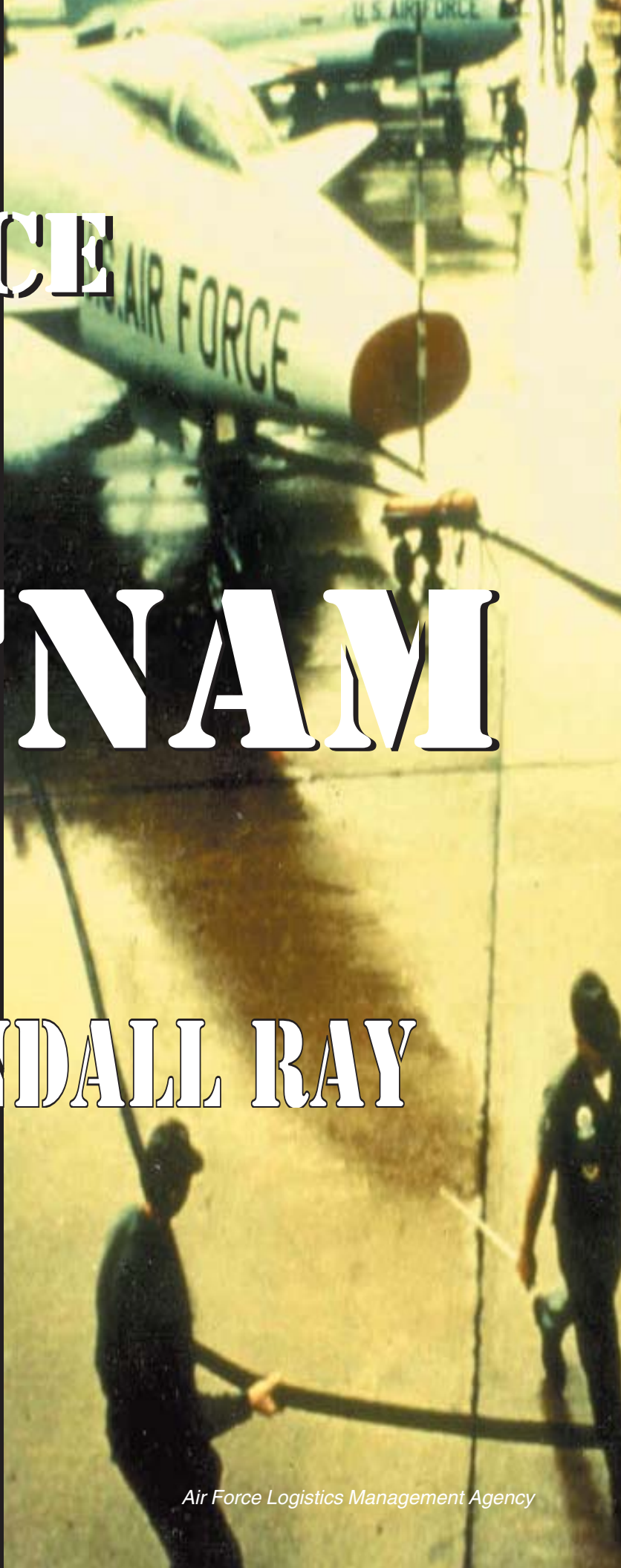
POL Facilities

At the outbreak of hostilities, there was a severe shortage of POL facilities. The depletion of excess World War II construction materials meant little or no material was on hand to build the necessary facilities. Additionally, planning for certain scenarios was lacking. Most planning involved conducting operations from occupied countries. Little attention was given to the need to refuel jet aircraft in other areas. As a result, there was little firsthand knowledge of the type of materials or POL systems required.

Getting these materials was another obstacle. If the necessary items were actually in the theater, it took 45 days to process the correct requisition. If, on the other hand, the items had to be back ordered, it took even longer, and the orders were almost always either wrong or incomplete. Other material problems existed as well. Different manufacturers used different materials that were not standardized, which really bogged down both construction and repair operations. The pipeline system used to deliver the fuel complicated operations as well. Using individual pipelines for single products was considered wasteful and thought to reduce the efficiency of the distribution system. Recommendations were made to train individuals on multiproduct pipelines to allow the receipt of "maximum quantities of products."[16] Additionally, the pipeline size was inadequate to handle the necessary amount of product, and recommendations were made to increase pipeline diameters.

(Continued on page 159)

AIR FORCE SUPPLY VIETNAM



MAJOR RANDALL RAY

There was an extremely limited Air Force supply system in South Vietnam prior to the troop buildup beginning in mid-1965. Ultimately, the change and growth of that system encountered a myriad of problems as a result of the *reactive* measures taken to provide continuous combat support. However, the push type of resupply programs designed to move large quantities of supply items into South Vietnam based on anticipated requirements gave the Air Force several valuable *lessons learned*.

Geographical Characteristics and Supply Infrastructure

A number of factors combined to make the logistics support of US forces in South Vietnam a major challenge. Primary was the development of a responsive and effective pipeline that extended 10,000 miles from the air materiel areas (AMA) in the continental United States (CONUS) to airbases in the Republic of Vietnam. Although extensive supply pipelines were developed during both World War II and the Korean War to support combat forces in East Asia and the Pacific, the requirements in Southeast Asia were decidedly different. As it turned out, the war in Vietnam lasted longer than both World War II and the Korean War. And overall supply requirements, especially in terms of greatly increased munitions usage and far more personnel service provisions (large base exchanges, gyms, pools, and so forth), placed a tremendous burden on that lifeline.[1]

Other factors that severely hampered development of an effective logistics support infrastructure were the harsh terrain and climate found in South Vietnam. The topography—swamps, jungles, deltas, plains, and mountains—made it extremely difficult to develop a logistics support structure capable of supporting combat operations. According to Lieutenant General A. T. McNamara,

> The country's primary internal transportation system consisted of 1,400 miles of primary and 700 miles of secondary canals that could accommodate canal barges, small motor junks, and sampans carrying freight and passengers. Two-thirds of South Vietnam's 15,000 miles of roadway were paved, but the remainder were in poor condition. The system was bottlenecked by its narrowness, many ferry crossings, sharp curves, steep grades, and low bridge clearances.[2]

Two-thirds of South Vietnam's 15,000 miles of roadway were paved, and the remainder were in poor condition. The system was bottlenecked by its narrowness, many ferry crossings, sharp curves, steep grades, and low bridge clearances.

The climate—hot and dry or hot and rainy with seasonal monsoons—further exacerbated conditions for logistics planners in terms of providing supply storage and security for stored items.

In the early 1960s, Vietnam was a primitive country with a mainly agrarian population, lacking even the most basic national logistics infrastructure. This further complicated support efforts. The local economy had little support capability for US forces to draw from.

Supply Support—Initial Operating Concept

Before President Johnson's commitment of combat forces, these factors were more inconveniences than deterrents to Air Force supply support in Vietnam. There were slightly more than 10,000 Air Force members in all of Southeast Asia in January 1965. In terms of weapon system support, Air Force tactical units in country operated small numbers of conventional (reciprocating engine) aircraft from unsophisticated airfields in South Vietnam. These units were permanently assigned to the Republic of Vietnam and:

> . . . possessed their own maintenance capability and received supply support through the one base supply in Vietnam, located at Tan Son Nhut Air Base in Saigon.[3]

This supply account, established in 1962 with approximately 1,000 line items, had grown to 50,000 line items by 1965 and, using a manual accounting system, was rapidly becoming unmanageable.[4]

Under the operative concept employed at the time, tactical units with jet aircraft rotated from Pacific Air Forces (PACAF) and CONUS locations to forward operating bases (FOB) in Southeast Asia on a temporary basis for 30 days. As of 1 January 1965, there were three forward operating bases in Vietnam—Bien Hoa, Da Nang, and

Tan Son Nhut Air Bases.[5] In order to function at a forward operating base, the unit deployed with an entire complement of operational and support personnel, weapons system support equipment, and supplies (the war readiness spares kit [WRSK]). These kits were air transportable and designed to sustain 2 flying hours per day per aircraft for 30 days. During the 30-day rotation, only minor maintenance, principally *remove and replace,* was performed at the forward operating base.[6] There was no in-country supply point for the forces flying jet aircraft. Tan Son Nhut Air Base supply could support only conventional reciprocating engine aircraft.

Therefore, various methods were employed to replace items used from the WRSK. One of these methods, Speed Through Air Resupply (STAR), was devised in 1955 to support Tactical Air Command mobility plans, which called for logistics support of units engaged in rotational operations. STAR allowed deployed units to requisition items directly from a dedicated system manager in the Air Force Logistics Command (AFLC), who would ship the desired items by air.

> The STAR concept continued into this period but did not have the capacity nor was it intended to support the magnitude of effort into which the situation in Southeast Asia developed.[7]

The remaining maintenance requirements, which were substantial, were performed by the main operating base (MOB) at Clark Air Base in the Philippines.

> The main operating base, further removed from combat than the forward operating base, was equipped and manned to provide greater support. The main operating base was responsible for the total organizational/field-level maintenance of all wing aircraft deployed to the forward operating base, including periodic inspections on aircraft and cold section repair on jet engines.[8]

The idea was to perform the more involved maintenance functions away from the combat environment, where more sophisticated and expensive test equipment was available. At the time, there was no logistics support base any closer than Clark, which was designated the "hard core support base for Southeast Asia."[9] In addition to Clark, main operating bases were located at Kadena and Naha Air Bases in Okinawa and at Tachikawa, Yokota, and Misawa Air Bases in Japan.

By the end of 1965, it became increasingly evident the FOB/MOB concept was not achieving the results envisioned, which severely jeopardized Air Force combat capability in Vietnam.

> Shuttling aircraft between main operating bases and forward operating bases was time consuming and wasteful of operational flying hours. But more important, limited supply stockage at the forward operating bases was causing not operationally ready for supply (NORS) rates to reach unacceptable levels.[10]

During the mid-1960s, four important events resulted in greater US involvement in Vietnam and, consequently, a continual increase in logistics support requirements. The first occurred in late January 1965 when General William Westmoreland, commander of the US Military Assistance Command, Vietnam, requested and obtained approval to use jet aircraft against Vietcong concentrations in South Vietnam. This was in response to increased Vietcong guerrilla activity and subversion in the area. The second event involved the decision by President Johnson in March 1965 to strike targets in North Vietnam. Unlike earlier attacks in the north, which had been retaliatory in nature, the decision to launch limited offensive airstrikes against North Vietnam was a

move designed to "defeat the Communist plague at its point of origin" and bring about a negotiated settlement.[11] The third event, which drew the United States further into the war, was the June 1965 decision to use B-52 aircraft to bomb North Vietnam. Although the B-52s were to operate from Guam, there would be additional requirements for logistics support and a subsequent increase in the parts, equipment, and supply pipeline to the Pacific area. Finally, in late 1965, the Air Force decided to change the personnel deployment policy from 30 days of temporary duty to a 1-year permanent change of station for tactical unit personnel. This move provided the impetus for establishing main operating bases in South Vietnam.[12]

Each of these decisions contributed to a greater feeling of permanence regarding US involvement in Vietnam. Collectively, the decisions signaled a change in the mindset of top government and military officials that the war in Vietnam was not going to be a quick victory. The events also signified a marked escalation in US involvement in Southeast Asia.

From November 1965 through early 1967, AFLC assembled and shipped more than 1,500 functional packages, aircraft specific equipment, and initial supply support packages involving more than 29 million units and 380,000 line items.

US Force Buildup and Associated Supply Problems

The escalation of the war in Vietnam and rapid increase in force levels and weapons systems in country caused a number of significant problems for logisticians. The Air Force changed its personnel deployment policy from a temporary duty assignment to a permanent change of station. This resulted in the need for additional and improved supply and maintenance at the deployed locations, which was not available under the existing FOB concept. In addition, the unacceptably high NORS rate was being blamed on the tactical units' reliance on distant main operating bases for all types of maintenance, other than remove and replace. To eliminate the deployed units' reliance on geographically separated main operating bases, in late 1965 and into 1966, PACAF began establishing more main operating bases in Southeast Asia. The roles of certain bases were expanded to take on the added responsibility of a main operating base. This transition added to the problem of providing adequate supply support to the region.[13] When the Air Force decided to establish main operating bases in Southeast Asia, no move was made to stock the selected bases with the new authorized stock levels. As a result, initial supply support from these new main operating bases did not improve; in fact, it got worse. The change in the maintenance concept, from a remove-and-replace to a pseudo three-level system, also taxed the supply support. Since these bases were authorized to perform more complicated and intensive maintenance functions, they needed more parts and more people to do the work. The demands placed on supply as a result of the rapid influx of people and equipment burdened an already undermanned, outdated, manual supply system.

Push Supply Programs

To alleviate the impact of supply shortfalls and maintain an acceptable level of combat capability, a number of creative logistics programs were implemented. One such program was the STAR program. Although initially effective in supporting long pipeline operations, STAR's total dependence on airlift made it impractical, as supply demands quickly outpaced airlift capability. Toward the end of 1965, two programs jointly developed by the Pacific Air Forces and AFLC surfaced. Designated Projects Bitterwine and Gray Eagle, these

initiatives were intended to reduce supply shortages through *push* resupply. The term *push* applies to packages of materiel developed, assembled, and shipped by CONUS supply activities to provide automatic supply to deployed forces. Automatic supply is defined as a system by which certain supply requirements are automatically shipped or issued for a predetermined period of time without requisition from the using unit (as opposed to a *pull* system, which requires requisition actions). It is based on estimated or experience usage factors.[14]

Both programs were activated to:

> . . . expedite the transition from the main operating base/forward operating base concept to mainland main operating bases and to properly equip the new bases being constructed.[15]

The push concept also provided immediate supply support where the in-place logistics structure could not—or had not—accurately forecast demand requirements. In the case of Vietnam, the decision to transition to a MOB maintenance repair function in country was not preceded by the necessary supply requisitions to obtain the minimum item levels commensurate with the new maintenance structure.

Project Bitterwine was designed to push the facilities, equipment, supplies, and spare parts needed to maintain a weapon system. The push packages, developed to provide the organizational needs of a 4,000-person combat wing, included field maintenance, armament, electronics, communications, and munitions maintenance shops, along with equipment and supplies peculiar to a particular weapon system.[16] AFLC, with cooperation from PACAF, developed a variety of Bitterwine packages tailored to the needs of the recipient base. Examples included packages developed to support maintenance shops, civil engineering organizations, food services, and a host of other activities. These kits were put together at the Sacramento Air Materiel Area (SAMA) with inputs from the Defense Supply Agency (DSA), the General Services Administration (GSA), AFLC, and each of the other four AMAs, using standard Air Force supply requisition techniques.[17]

Once assembled, the packages were placed aboard ships at Oakland, California, and transported to Vietnam. It is important to note that the responsibility for the push packages remained with AFLC, which initiated all action without requiring any requisition action on the part of the receiving base's supply functions.

The volume of base support materiel pushed to Southeast Asia during Project Bitterwine was impressive. From November 1965 through early 1967, AFLC assembled and shipped more than 1,500 functional packages, aircraft-specific equipment, and initial supply support packages involving more than 29 million units, 380,000 line items, and more than 150 million pounds of materiel with an associated cost of more than $81M.[18] These accomplishments take on an even greater significance considering a national emergency had not been declared, which would have automatically invoked the provisions of emergency war plans priority upgrading. In some estimations, Project Bitterwine was the greatest single supply effort ever accomplished by the Air Force.[19]

The second push program, designated Gray Eagle (known as Harvest Eagle after 1968), operated concurrently with Project Bitterwine. This program was designed to provide initial housekeeping, messing, and electrical support until fixed facilities were completed. The kits were employed on bare bases (bases with only a runway and water supply) and as facility

augmentation on established bases in the theater.[20]

Gray Eagle was the first phase of a three-phase program that established permanent Air Force bases in Southeast Asia. The three phases were:

- Gray Eagle action (also known as *Tent City*).
- Temporary buildings, prefabricated structure, and shelters.
- Construction of permanent facilities, runways, and support systems.

Initially, Gray Eagle camps were to be built and aluminum runways and parking areas constructed. Next, temporary buildings—such as prefabs, inflatable shelters, and Butler buildings—were to be erected to house the field maintenance shops and support activities. At the same time, contractors were to build concrete runways, buildings, and support systems for more permanent use. The total actions were scheduled to take from 2 to 3 years to accomplish.[21]

As with Project Bitterwine, AFLC coordinated anticipated requirements for Gray Eagle with PACAF and then pushed the required items to users without requiring requisition actions. The program was especially critical in providing the essential and basic survival supply requirements (shelter and messing) for Air Force bare-base operations. In all, the Air Force deployed ten Gray Eagle packages to eight different bases in Southeast Asia.[22] Four of these packages were immediately available, having been prepositioned in the Pacific Command area prior to the beginning of US involvement in Vietnam. The remaining six were assembled in the United States using CONUS resources. As the primary user of Gray Eagle packages, the Tactical Air Command maintained the resources as war readiness materiel at Robins AFB, Georgia, deploying the packages as requirements in Vietnam dictated.[23]

Gray Eagle packages consisted of four 1,100-man kits, which constituted a combination of station and housekeeping sets. Station sets were comprised of basic subsistence items intended to supplement existing supplies or, in the case of bare-base sites, provide initial rations for a period of 30 days. Housekeeping kits provided basic housing, messing, and administrative facilities, along with the respective stock items for those facilities.

As bases using Gray Eagle kits progressed into subsequent phases of buildup, the remaining assets from the Gray Eagle packages were used to augment the base operating stocks or were returned to war reserve materiel. In fact, as fixed facilities became established, Gray Eagle assets were reconstituted to replace the prepositioned PACAF packages used in the early stages of the program. Again, packages were available for future combat exercises or other contingencies, as in January 1968, when three packages were deployed to Korea in support of arriving units responding to the *USS Pueblo* incident.[24]

Problems Associated with *Push* Programs

Even though Projects Bitterwine and Gray Eagle were generally perceived as successful, there were certainly a number of problems with each program. The contents of Gray Eagle packages had to be lightweight, durable, functional, and completely air transportable. However, in reality, the kits were generally comprised of vintage World War II Army equipment that was heavy, bulky, and not intended to be air transported. Gray Eagle packages alo contained a wide variety of items, many of which did not meet the specific needs of bare-base operations in Vietnam. In

addition, the shipment of unneeded items (such as heating stoves) in these packages resulted in excesses at the destination and ineffectual use of critical tactical and strategic airlift resources.

To rectify the problems with Gray Eagle packages, the Air Force Systems Command activated a new management organization (the Bare Base Project Office) to support requirements for tactical and strategic mobility.[25] The Bare Base Project Office was to develop and identify, by command, the equipment necessary for Air Force operational and support forces to deploy rapidly and operate from bare-base sites anywhere in the world.[26] Under the concept, Air Force combat forces could deploy bases with no facilities—other than a runway, parking space, and water supply—and with the newly designed kits have an almost instant operating environment.[27] The packages were also engineered to be lightweight and air transportable. By 1968, aluminum and plastic shipping containers were being developed, which provided protection for enclosed supply items during transport. Upon arrival at the designated receiving base, these containers expanded to several times their original size to become supply shops and living quarters. The items shipped inside these containers were also redesigned to better withstand the deterioration effects of climatic conditions for all but arctic weather.

A number of problems were also associated with Project Bitterwine, which detracted from its overall responsiveness in supporting immediate supply needs in Vietnam. By mid-1966, the need for immediate supply support began to level off as stock levels reached acceptable standards and normal supply requisitioning procedures were reinstituted. One problem pertained to the deployment of Project Bitterwine packages by the Sacramento Air Material Area. Initially, Project Bitterwine materiel flowed incrementally to the port at Oakland, where it was loaded on the next ship bound for Southeast Asia, resulting in the arrival of incomplete packages at various times at various ports in Vietnam. Such random arrivals made it difficult, if not impossible, to reconstitute all components of a particular Bitterwine package for inland shipment to the programmed destination base. Thus, a great deal of materiel was lost or misdirected, and vital timing was destroyed. The problem was resolved, quite simply, by consolidating Project Bitterwine packages for a one-ship-unit move to Vietnam. In one case, more than 4 million pounds of Bitterwine materiel were processed and moved on a single ship to the airbase being constructed at Tuy Hoa.[28]

The sheer volume of materiel shipped under Project Bitterwine created extensive reception and handling problems at the destinations. The cumbersome manual supply accounting system, unsuitable storage facilities, and lack of adequate reception capabilities at the forward locations severely hampered effective supply management.

Air Force Supply Structure and Supply Subsystem

Two major components of the Air Force supply structure, wholesale supply and base supply, directly related to the logistics support of the Vietnam War. Within that structure, the subsupply element of petroleum, oil, and lubricants (POL) was also analyzed in terms of effectiveness of operational problems encountered in Vietnam.

Wholesale Supply Versus Base Supply

The logistics support of Air Force personnel and equipment in Vietnam, beginning with the force buildup in 1965, presented a major

challenge to logistics planners and placed a heavy burden on the existing logistics infrastructure. Much of the credit for successfully meeting the Air Force logistics challenges of the Vietnam War has been attributed to the ability of planners to tailor the logistics structure to satisfy operational requirements. At the heart of the Air Force logistics structure was the supply distribution system. The Air Force internal supply distribution system essentially consisted of two echelons: a *wholesale* level, comprised of AFLC and five air materiel areas, and a *retail* level, comprised of base supply activities, which provided supply support at US bases in the CONUS and overseas. Further, the worldwide supply support of DSA and GSA formed an element of the wholesale level.

By the end of June 1969, the DSA was managing approximately 48 percent of the 4.1 million items used by the military Services.

Wholesale Supply

AFLC was primarily responsible for providing supply support policies, procedures, and technical supervision for all supply activities in the Air Force in accordance with Air Force Manual 67-1.[29] In addition, AFLC, DSA, and GSA represented the three primary wholesale suppliers to Air Force base supply organizations worldwide. In this role, AFLC was responsible for determining supply requirements and procuring, storing, and distributing supply items and spares associated with Air Force weapon systems. AFLC support encompassed a variety of management processes, including identifying and classifying support items, computing of buy and repair requirements, preparing and defending budgets, performing or contracting for depot overhaul or modification, and directing disposition of base excesses.[30] Thus, AFLC provided centralized control of the logistics supply support function for the entire Air Force. In effect, the command strove to ensure the highest level of Air Force combat capability by providing the *right part*, to the *right place*, in the *right quantity*, at the *right time*.

As the rapidly expanding force structure in Vietnam placed greater demand on all levels of the logistics infrastructure, AFLC responded. AFLC development and implementation of logistics support programs designed to enhance combat capability in Vietnam were unprecedented. Push resupply programs, such as Projects Bitterwine and Gray Eagle, provided initial support to US forces in Southeast Asia. When the problem of supply excesses was identified, the command introduced Commando Ripe and Commando Easy, along with the necessary manpower, to rectify the problem.

The development of rapid area supply support (RASS), rapid area maintenance (RAM) teams, and rapid area transportation support teams were all AFLC initiatives to assist units worldwide. These teams were set up and organized to go anywhere at any time, without a lot of advanced preparation.[31] The effectiveness of these teams was exemplified in a letter to AFLC in late 1966 by Lieutenant General William W. Momyer, commander, Seventh Air Force (PACAF), regarding RAM team actions for aircraft damaged in an enemy attack on Tan Son Nhut Air Base:

> Your people did a terrific job following the attack on Tan Son Nhut. As you know, we had some fifteen aircraft damaged to some degree. Except for two CH-3 helicopters and an RF-4C, every one of these damaged aircraft was back in the air in less than a week. Parts held up the chopper and RF-4C, or they would have been in the air also. Your people worked around the clock, and I am very appreciative of the way they have played on the combat team.[32]

Another very highly successful and dynamic AFLC program was Operation Turnkey, in which AFLC, working through the AMA at Sacramento, supplied all the base

support materiel necessary to build and ready the airbase at Tuy Hoa. The one-ship-unit move of 4 million pounds of materiel sailed from the Sacramento Water Port in September 1966 and arrived in Vietnam the following month.[33] Project Pacer Oar was established by AFLC to replace approximately 10,000 line items of critical communications and electronic equipment lost when enemy action destroyed a warehouse at Da Nang.[34] It was yet another successful AFLC effort to support forces in Vietnam. Each of these programs and operations reflected the innovative and responsive character of AFLC as it provided the logistics support necessary in Southeast Asia during times of peak workload or as combat requirements dictated. AFLC's supportive actions improved the logistics posture in Vietnam with the resultant effect of enhancing US combat capability.

AFLC supply responsibilities were decentralized in the five CONUS AMAs: Sacramento, California; Ogden, Utah; Oklahoma City, Oklahoma; San Antonio, Texas; and Warner Robins, Georgia.

> The five air materiel areas performed traditional worldwide distribution functions in addition to having responsibilities for inventory control purchase and disposal of stocks.[35]

The AMAs, along with DSA and GSA, provided the full range of backup stock required by bases to support combat operations. The AMAs also acted as the major repair depots for the overhaul of complete aircraft, aircraft engines, and related aircraft components beyond the maintenance capability of the home base repair facilities.

Each of the AMAs became directly involved in the implementation of AFLC logistics support programs. For example, the concept of RASS teams, used in country to help reduce supply bottlenecks, originated in the headquarters. However, the teams consisted primarily of civilian volunteers from the various AMAs. The same was true of all other AFLC programs supporting operations in Vietnam. SAMA maintained responsibility for a number of AFLC-sponsored programs supporting Air Force operations in Vietnam. For example, SAMA was primarily responsible for procuring (from other AMAs or commercial sources) and assembling the various components for Project Bitterwine packages and arranging transportation to Southeast Asia. DSA and GSA each had a specific commodity responsibility for providing timely and adequate logistics support to the US military forces. This concept of integrated materiel support, tested under combat conditions for the first time in Southeast Asia, did experience some difficulties, especially in the early days of the force buildup.[36] DSA provided direct logistics support to the Air Force worldwide.

During the Vietnam buildup, DSA item responsibility increased from 1,305,000 to a total of 1,964,000 by the end of the decade—a 50 percent increase. A portion of the increase was due to the transfer of AFLC responsibility for a number of line items in its inventory. By the end of June 1969, DSA was managing approximately 48 percent of the 4.1 million items used by the military Services.[37] Because DSA had no supply activities outside the CONUS (they had no control over transportation or port handling), supply effectiveness was based on the availability of requisitioned items at the CONUS DSA supply location. DSA supplied requisitioned items to the Air Force AMAs, which, in turn, handled the distribution of DSA-procured items to Air Force bases throughout the world.[38]

During the initial force buildup in Vietnam, DSA inventories dropped to critical levels due to the

enormous demand surge. In January 1965, at the beginning of the Vietnam War, DSA filled 91.5 percent of customer demands upon receipt by the center. Supply availability steadily dropped, reaching a low point of 82.7 percent in October 1966.[39] This resulted in reduced logistics responsiveness and, in some cases, persistent supply shortages, which remained until fiscal year 1967. The essential reasons for the critical supply shortages of DSA-managed items were fourfold:

- Program and planning data furnished to DSA by the Joint Chiefs of Staff and the Services were neither adequate nor timely.
- Peacetime stocks were not adequate to meet the initial demand surge.
- Mobilization reserve stocks were inadequate; for thousands of items selected for mobilization reserve stockage, there was no mobilization reserve stock at all.
- The production base and expansion capability proved inadequate to meet the initial demand surge.[40]

Despite the shortages, DSA maintained a favorable image as a reliable supplier among the Services.[41] GSA was responsible for the management of government property and records, procurement and distribution of supplies, disposal of surplus, and stockpiling of strategic and critical materials.[42] Although established by the Federal Property and Administrative Act of 1949, GSA did not begin providing significant supply support to the military until 1963. By 1970, GSA was managing more than 68,000 military supply items.[43] The majority of these were housekeeping or station-keeping items, not weapons system or combat supplies. GSA supply effectiveness in Vietnam was not regularly reported. Supply officers used a management-by-exception reporting process in which only supply problem areas were reported. Problem areas received concentrated management attention until resolved. Based on available data, GSA *on-time* fill rates (percent of supply requests satisfied by GSA) throughout the Vietnam War remained at acceptable levels. Overall, GSA supply availability never went below 84 percent.[44] In fact, the feeling among Air Force supply personnel in Vietnam was that GSA support was excellent.[45]

Base Supply

The retail level or base supply is generally considered to represent the first echelon of supply support. It is this first echelon, consisting of Air Force base supply organizations, that provides the supply support necessary to maintain weapon systems and forces in a high state of combat readiness.

The retail supply element is centered as a single supply activity under the base chief of supply and is managed by the base supply officer.[46] In this capacity, the base supply officer requisitions from a depot and stocks, receives, stores, and issues supplies as needed to support combat operations. In addition, base supply provides housekeeping, repair and maintenance support, operational clothing requirements, and a myriad of other support services. As the original point of demand, base supply is the point where supplies are issued for consumption or, in the case of equipment, end use.[47] In this role, base supply is the critical link between the wholesale supply function (AMAs, DSA, and GSA) and the supply customer or end-user. During the Vietnam War, Air Force base supply organizations in Southeast Asia encountered a multitude of problems that impacted the logistics support combat capability—especially the NORS rate of combat. Four major factors that degraded supply item availability were the:

- Inadequate logistics bases and facilities in Vietnam
- Difficulty in accurately predicting combat supply requirements (since no basis existed for those statistics)
- Delay in changing supply accounts from a peacetime priority requirement to a wartime priority requirement (due to the fact that war had not been declared and a state of emergency was not in effect)
- Unwillingness of industry to respond to procurement requests for military requirements over their civilian oriented manufacturing[48]

The combination of these four factors, plus a tremendous increase in customer demands, as a result of the commitment of Air Force forces to Vietnam beginning in 1965, caused a downward trend in supply availability beginning in fiscal year 1966.[49]

In terms of base supply personnel in Southeast Asia, there were shortfalls in both quantity and quality, especially in the initial stages. Inadequate manning levels were a consequence of politically established in-country force levels. Because the initial emphasis was on deployment of combat forces, logistics support personnel were not deployed until after the introduction of the combat forces. In addition, PACAF based Southeast Asia supply manning levels on CONUS standards, which applied to bases that purchased many items of supply on the open market. Inability to purchase items on the open market, plus the need to stock Southeast Asia-peculiar items (generators, water purification material, and runway matting), resulted in a far larger inventory and, thus, the requirement for more manpower. Finally, the lack of automated equipment (until the installation of the UNIVAC 1050-II) to manage the mountains of supply items being pushed into Southeast Asia under programs such as Bitterwine and Gray Eagle created a tremendous burden on the undermanned supply organizations.[50]

Supply effectiveness was also degraded by a decision in 1965 by the Air Training Command to train all supply personnel in computerized (UNIVAC lO50-II) procedures. Since supply accounts in Vietnam were managed using either manual procedures or the punchcard accounting machine system, supply personnel arriving in Southeast Asia required retraining in those systems.[51] Retraining caused the effective loss of a portion of the person's tour of duty in Southeast Asia. The decision not to call up Reserves effectively eliminated that source of trained personnel. The decision also indicated the Services' contingency planning for future conflicts should provide manpower alternatives that did not include the Reserve forces.[52] These factors combined to produce an abnormal workload as viewed from a stable peacetime base situation.[53]

As Air Force equipment and personnel supply requirements stabilized Southeast Asia, base supply effectiveness steadily increased. A measure of improved supply effectiveness was the continual decline in the NORS rate from 1965 through 1969, with a low of 2.4 percent in the first half of 1969.[54]

Petroleum, Oil, and Lubricants

The POL products to US forces in Southeast Asia proved to be a complicated logistics effort requiring the coordinated efforts of each of the Services. This task was made more difficult by the lack of adequate facilities to receive, store, and distribute bulk fuels and by the long supply lines. The methods employed, although sometimes costly, effectively provided essential POL resources throughout the Vietnam conflict. In fact, when asked to list logistics problem areas

during their tour of duty in Vietnam, field commanders did not include POL.[55]

Prior to the buildup of forces in Vietnam in 1965, the United States had little in-country POL logistics support capability. Coastal, inland waterway, and overland transportation of bulk products, drummed fuels, packaged lubricants, greases, and commercial suppliers provided all into-plane services.[56] At the time, it was more economical to obtain POL support from the three major oil companies—Esso, Shell, and Caltex—since those companies could satisfy military requirements.[57] The main source for this supply was at Nha Be, located 9 miles south of Saigon, which had approximately 80 percent of the in-country POL. Another 12 percent was stored at Da Nang, while the remaining 8 percent was at various other locations in Vietnam. A major limitation of these commercial POL sources was their inability to receive fully loaded fuel tankers. Although most storage facilities were located on intercoastal waterways, draft depths of 27 feet or less meant fuel delivery had to be made by shallow-water tankers or partially loaded T-2 tankers.

By mid-1965, it was clear that the POL system in country would not be able to support the fuel requirements of the rapidly expanding military operations in Vietnam.

By mid-1965, it was clear that the POL system in country would not be able to support the fuel requirements of the rapidly expanding military operations in Vietnam. To augment commercial sources, the Army, Navy, and Marine Corps used 10,000-gallon collapsible tanks with 4-inch rubber hoses and 350-gallon-per-minute pumps to store and dispense fuels. Offshore tankers using ship-to-shore pipelines filled these tanks. In addition:

> . . . 500 gallon air-transportable collapsible drums, amphibious assault fuel systems (Marine), and the Army's 60,000-gallon Fuel System Supply Point (FSSP) equipment provided supplemental storage capability.[58]

Small tankers (AOGs) were also used to transport fuel in country to locations not accessible to larger tankers. The Air Force used a portable hydrant fuel system, consisting of four 50,000-gallon collapsible tanks, capable of servicing two aircraft simultaneously at a rate of 300 gallons per minute. As operations increased, 25 of these systems were deployed to Vietnam to handle aircraft refueling.[59] In July 1965, the Commander in Chief, Pacific, assigned common responsibility for in-country POL support to the Army and Navy. The objective was to increase overall effectiveness and economy. The Army was given POL responsibility for the II, III, and IV Corps Tactical Zone (CTZ), while the Navy was assigned POL responsibility for the I CTZ. The Air Force was assigned on-base POL support at Air Force bases in Southeast Asia.

> A major portion of the fuels used by the Air Force at fixed installations was delivered from marine terminals by Army and Navy inland distribution systems using available pipelines, tank trucks, rail cars, barges, and collapsible tanks.[60]

The Air Force POL storage policy in Southeast Asia required an on-base storage capacity of 30 days of anticipated usage plus 30 days' additional supply in the commercial and/or military storage complex supporting the base.[61] Although not assigned a geographical area of POL responsibility, airlift forces did support US and allied forces at bare-base locations with air-transportable, fuel dispensing systems; aerial bulk-fuel delivering systems; rubber fuel-storage tanks; 55-gallon drums; and various other collapsible fuel tanks. As stated by Lieutenant General McNamara, "The 55-gallon drum still remains one of the tactician's best friends, along with the C-123, C-130, and CV-2."[62]

The Plei Me operation in 1965 typifies the POL support provided by airlift forces. During a 10-day

period, 700,000 gallons of JP-4 fuel were airlifted in 500-gallon collapsible drums, requiring 156 C-130 sorties. (The C-130 *Flying Tanker* was capable of delivering 4,000 gallons of fuel per sortie).[63]

Marginal POL storage facilities in Southeast Asia remained a problem throughout most of the Vietnam War. The numerous (mostly temporary) methods employed to store POL products, included offshore tankers (floating storage), rubber bladders of various shapes and sizes, and any other container that could store fuel. Attempts to construct more permanent POL storage facilities during the early phase of the conflict met with little success. The cost was high, and key political and military people thought the war would be short. As a result:

> The overall costs of providing petroleum products were far higher than would have been necessary if an early decision had been made to construct sufficient steel military storage tanks for the economic utilization of tankers.[64]

Fuel requirements for Southeast Asia, especially aviation fuel, placed significant demands on the POL supply network. This was, to a large extent, due to the use of high-performance aircraft in Southeast Asia by the Navy, Marines, and Air Force and the extensive use of Air Force airlift (C-130 and C-123) and Army helicopters to resupply combat forces in country. Despite the poor storage facilities and a long POL pipeline, petroleum supply to combat forces must be viewed as a successful operation in Vietnam. As stated in the Joint Logistics Review Board report on logistics support in the Vietnam era;

> POL support of Air Force units and operations was effective, and no combat operations were curtailed because of a shortage of POL.[65]

Lessons Learned

There were many supply and fuels lessons learned during the Vietnam War. While many of these lessons are no longer applicable, their roles in forming the deployable Air Force supply systems are worth noting.

Push Supply Procedures

Pushing supplies and equipment into a combat theater is an effective means of providing immediate supply support to combat troops. This method is essential if, as in the case of the Vietnam War, a logistics infrastructure is not established prior to the deployment of troops into a combat area. Problems that can occur, as illustrated by Project Bitterwine, stem from placing an unmanageable workload on the receiving and accounting functions of the existing supply activity. Excesses occur when receipts are not properly accounted for, additional requisitions are processed, and duplicate shipments are received. Excesses also result when the contents of push packages are not tailored to the specific requirements of combat troops (based on geography, climate, and type of conflict).

If *push* shipments are necessary in future conflicts, the Air Force Materiel Command must ensure the receiving supply activity has the capacity (in terms of manpower and computer capability) to receive pushed shipments and maintain accurate materiel status records. This will reduce excesses by increasing item visibility and reducing requisitions for items already in stock. Tailoring push packages through improved communication between the wholesale supplier (AFMC and the AMAs) and the end-users can significantly improve package contents and reduce excesses. Finally, combat supply operations should revert to *pull* resupply as soon a practical.

Supply Storage Facilities

The lack of adequate warehouse space in Vietnam caused inventory to be stored outdoors or in temporary, inflatable shelters. Losses resulted from pilferage and the deteriorating effects of the weather. The Air Force must develop essential, dedicated supply storage facilities. In addition, command priority for their movement and erection must be given during initial buildup in any contingencies or exercises. These facilities must be lightweight, air transportable, and capable of being erected and outfitted in a minimum amount of time.

Excesses

A number of AFLC initiatives were designed to deal with the supply excesses in Southeast Asia that resulted from push supply programs and inadequate inventory management procedures. Two such programs, Commando Ripe and Commando Easy, were generally considered successful in redistributing unneeded supplies and equipment in Vietnam. However, avoidance of excesses through effective inventory management and provision of suitable storage facilities would have reduced excesses in Vietnam.

Excesses in future confrontations, although inevitable, can be reduced by more effective management of combat supply inventories (especially through use of computers), emphasis on providing adequate supply storage facilities, and tailoring of push packages based on actual requirements of deployed forces.

Wholesale Supply System

During the Vietnam War, wholesale supply support was provided through the five CONUS AMAs controlled by AFLC. This method of centralized control and decentralized operation provided effective support to combat forces in Vietnam. The Air Force should continue operation of the wholesale supply system under the centralized control/decentralized execution concept.

DSA/GSA Support

DSA and GSA provided integrated materiel support to US military forces during the Vietnam War. It represented the first time integrated materiel management of supply items had been tested in combat conditions. Both agencies had trouble maintaining sufficient levels of inventories as the rapidly escalating war placed greater supply demands on their inventories. The major cause of their reduced logistics responsiveness was the fact that neither agency was geared for wartime supply support.

Both DSA and GSA must maintain adequate supply reserves to support the initial requirements of current contingency plans.

POL

The supply of POL products for operational requirements in Southeast Asia, although sometimes very costly, effectively satisfied Air Force demands throughout the Vietnam War. Storage of resources represented a significant challenge to POL managers. A number of different (mostly temporary) storage methods were employed to store POL products, including offshore tankers, rubber bladders, and any other container capable of storing fuel. In the final analysis, the overall costs of providing petroleum products were far higher than they would have been had an early decision been made to construct sufficient permanent steel storage tanks. The use of offshore floating tankers for the storage of POL products was possible in Vietnam only because the United States possessed air and sea superiority. As a result, POL resources were never threatened by enemy actions. This method of POL storage cannot be depended on in

future conflicts since absolute control of offshore waters is less than likely. Also, future conflicts may not occur close to shorelines.

Logistics planners need to concentrate on developing more permanent POL storage containers that disassemble for ease of shipment and may be reassembled in minimal time in a combat zone. This will reduce the overall cost of POL storage and present a less vulnerable target than floating storage. In addition, a practical means of moving POL products from tankers to permanent storage must be developed.

This selection is taken, with permission, from "An Analysis of the United States Air Force Supply Support in Vietnam." A complete copy of this work is available through the Defense Technical Information Center. Maj Ray (USAF, Retired) completed this thesis in 1987 while a student at the Air Force Institute of Technology, Wright-Patterson AFB, Ohio.

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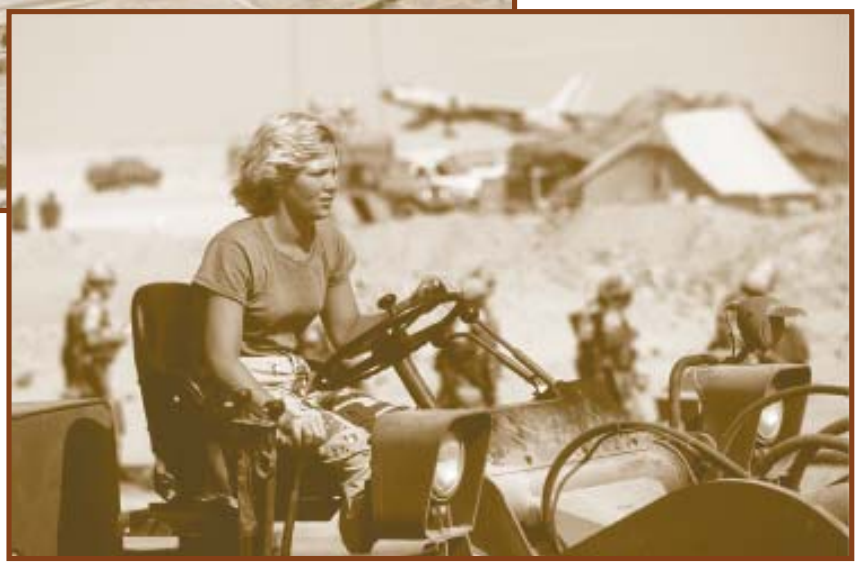
(Continued on page 159)

Supply Lessons from DESERT STORM

Colonel John Gunselman



Initial Support, 2 August-16 November 1990

At the start of the operation, all units deployed with their own war readiness spares kits (WRSK) and combat supply system (CSS) computers that were developed to maintain kit accountability and inventory accuracy. For the most part, initial stock replenishment and mission capability (MICAP) support was provided from the home station. Units did make lateral support checks within the area of responsibility (AOR) for MICAP support prior to going to the home station. In addition, numerous commodities—such as oil, hydraulic fluid, construction materials, furniture, and administrative equipment—were purchased on the local economy.

Initial support for tactical fighter squadrons was obtained from the home station. Deployed units were responsible for checking lateral support availability to resolve MICAP conditions since the Central Air Forces (CENTAF) supply staff, located at Riyadh, was not manned to search for parts. These units made maximum use of voice satellite communications since there was no connectivity between deployed CSS and home station computers. All MICAPs were ordered by voice methods, while floppy disks were either mailed or hand-carried to the home station for WRSK replenishment. This was not a very timely process. However, one unit improvised and used a Z-248 with a modem to transmit CSS transactions via commercial communications to home station—this worked better.

The Strategic Air Command's (SAC) initial approach was to set up a main operating base (MOB) concept with all deployed locations acting as forward operating locations (FOL). SAC created two MOBs, one located at Moron Air Base, Spain, which was a satellite of Torrejon Air Base, Spain, and one at Andersen AFB, Guam. Computer support was established at each MOB, and all WRSKs were loaded on these computers. Unlike the fighter units, all SAC MICAPs were called into the MOBs, versus going back to home station for support. Also, as the FOLs withdrew assets from the WRSKs, they notified the MOBs by phone since they did not have computer connectivity with them. However, this phone contact was marginal until additional AUTOVON links were installed at deployed locations just prior to the beginning of combat operations. The MOBs took the necessary action to replenish the WRSKs. The FOLs eventually became independent by connecting to a computer at Langley AFB. Additionally, the MOBs acted as theater depots, performing all intermediate level maintenance, similar to the way SAC performed regional maintenance in peacetime. Consequently, the continuous flow and repair of reparables was necessary to sustain SAC forces; however, movement of retrograde spares was slow. Prior to starting combat operations, SAC began to move its own retrograde and resupply using organic airlift called *Mighty Express*. The Moron Air Base intermediate repair site had to be built from scratch, whereas the one at Andersen AFB was 70 percent in place at the start of the operation.

The Military Airlift Command's (MAC) strategic airlift units were supported by its WRSKs and forward supply system. All MICAPs were called into the Twenty-First Air Force, McGuire AFB, New Jersey, for resolution via the MAC command and control system. Kits were replenished through the primary supply points: McGuire AFB for the C-141 and Dover AFB, Delaware, for the C-5. Because MAC was in a continuous surge, the repair of retrograde parts was very important for maintaining high utilization rates. Retrograde and repair and return times from the primary supply points were measured, and resupply took approximately 19 days for the C-5 and 21 days for the C-141. This was consistent with the 20-day repair cycle used to build WRSKs to support a remove, repair, and replace (RRR) maintenance concept, with repair being done at the primary supply points.

MAC tactical airlift units obtained their support similar to the way SAC supported its units. A MOB was established at Rhein Main Air Base, Germany, with a satellite account at Rhein Main that maintained all the WRSK computer records and performed the automated replenishment actions and inventory control functions. Units called in their spares usage, and Rhein Main supply processed the replenishment transactions. MAC units attempted to satisfy their MICAPs laterally within the AOR. If not successful, the MICAPs were passed to the Twenty-First for sourcing.

Additionally, all reparable items were sent to Rhein Main for repair or returned back to the depot.

Prior to Operation Desert Storm, wartime planning called for a majority of the units in the United States Air Forces in Europe (USAFE) to fight in place. Consequently, they only had six existing WRSKs, which were not enough to support the number of forces they provided. Therefore, using the Dyna-METRIC Microcomputer Analysis System (DMAS), the units computed high-priority mission support kits (HPMSK) to support the deployment and sourced the assets from within USAFE. A total of 13 HPMSKs were developed and deployed, costing more than $569M. Initially, their resupply support came from each deployed unit's home station.

The highly mobile special operations forces received virtually all their support from their home stations. WRSK replenishment was provided by the unit's home station based on daily situation reports that identified WRSK expenditures. Regionalized repair and supply support for MC-130, HC-130, and common C-130 spares was first established at Rhein Main Air Base but relocated to the theater operating base because of transportation problems. MICAP requirements were phoned to the Air Force Special Operations Command Logistics Readiness Center (LRC) at Hurlburt Field, Florida. The LRC sourced the requirements and tracked them from the source of supply to receipt in the desert.

Long-Term Support, 17 November 1990—End of Operations

Existing plans called for units to deploy with CSS capability to maintain accountability and inventory control of WRSKs, with kit replenishment action provided by a computer-support base mainframe computer. WRSK replenishment was dependent upon getting the CSS transaction files back to the computer-support base. Various media were available, but the one most preferred—the electronic—was not immediately available because of connectivity problems. Consequently, CSS transactions were updated at the computer-support base by either mailing or hand-carrying floppy disks. As US presence in the AOR was extended, a longer term approach to provide sustaining supply support had to be developed.

According to the plan, tactical shelter systems (TSS) with a full-up supply computer were to have been deployed; however, because they were fragile, they experienced considerable risk of damage during shipment. Also, there was no previous experience with deploying these systems. Their reliability was questionable, and their operating systems were not upgraded to the current configuration. Additionally, deploying the TSS would have increased the manpower requirements in the AOR as computer operators, stock control technicians, and financial materiel accounting personnel would have been required. Finally, there were not enough available TSS to support 21 active accounts, so they were not deployed.

CENTAF instead opted to regionalize computer support through the Headquarters Tactical Air Command (TAC) Development Center located at Langley AFB, which had a Unisys 2200/400 series computer. For communications connectivity, CENTAF obtained a channel on a dedicated military satellite. Data-processing center terminals, along with remote job entry terminals, were deployed to the AOR, allowing real-time access to the Langley computer for deployed units. Installation teams were sent to activate 21 individual supply accounts. Using tactical communications, data was transmitted to Thumrait, Oman, where it was sent via satellite to Fort Detrick, Maryland, and on to

Langley over a dedicated commercial line. The support unit at Langley AFB was called the CENTAF Supply Support Activity (CSSA). The CSSA had 130 people who performed all the stock control and file maintenance functions for all units deployed to the AOR. All WRSK and follow-on spares kit (FOSK) authorized quantities were uploaded on this computer. Deployed units no longer depended on the home station for support. They received new stock record account numbers (SRAN) and became independent. All financial accounting was done by the CSSA, which made it easy to track the cost of support. Deployed units continued to make lateral support checks within the AOR. Forty-five percent of all MICAPs were resolved through lateral support action. However, if the lateral support efforts were not successful, the units called the CSSA. The CSSA Mission Support Section then worked aggressively to resolve all MICAP requirements for most weapon systems in the AOR using the MICAP automated sourcing system to locate available assets worldwide.

The requirements for SAC units, except those located throughout Europe, as well as MAC units (except for strategic airlift forces) were also loaded on the CSSA. The CSSA computer routed all requisitions for SAC B-52 and KC-135 aircraft to Moron on a fill or back order basis. SAC MICAP requirements for units located in the AOR were called into the CSSA, which, in turn, called them into the regional repair center at Moron. If not available, B-52 MICAPs were resolved by Eighth Air Force, while KC-135 MICAPs were resolved by the CSSA. Requisitions for MAC C-130 requirements were routed through Rhein Main Air Base to the depot on a fill or pass basis. MAC C-130 MICAP requirements were reported directly to Rhein Main by the MAC airlift control element teams. Rhein Main personnel resolved these in lieu of passing them to the CSSA.

Because of the centralized support provided by the CSSA, the 300 to 400 supply people who would have been required to deploy using the TSS support concept were spared deployment to the AOR. The CSSA proved to be a viable concept and is being documented for future support.

The CSSA not only managed requirements but also performed the local purchase function for many nonaircraft spares, allowing CENTAF to take advantage of quick payment discounts. Additionally, all local purchase deliveries went to Langley AFB where they were inspected by CSSA personnel and put on MAC airlift to the AOR. This eliminated the difficulty of commercial vendors getting assets into MAC airlift channels.

Since combat did not start until approximately 6 months after the initial deployments, CENTAF wanted to keep the WRSKs as full as possible since they were built to support an initial wartime surge. Therefore, the emerging FOSK methodology was used to compute the additional spares necessary to support the prewar flying. The FOSK was built to support an RRR capability, which significantly increased the capability of many WRSKs built to support a remove-and-replace maintenance concept.

As war became imminent, another front was opened in Turkey, and USAFE provided the support to these forces under the code name Proven Force. From December 1990 to January 1991, five satellite accounts were established on the Ramstein account to support Proven Force units. All MICAP requirements and WRSK/HPMSK replenishments were ordered through these accounts and sourced from within USAFE by the Headquarters USAFE Logistics Supply Cell.

Because of the number of items and detail records involved with the Harvest Falcon kits deployed into the AOR, these records were not

transferred to the CSSA. They remained under the control of the Ninth Air Force at Shaw AFB, South Carolina. Replenishment actions for these housekeeping assets were made by message and telephone back to the remaining CENTAF staff at Shaw, who updated the computer records.

Spares Allocation and Distribution

Spares were allocated to the warfighting units based on the Uniform Military Movement and Issue Priority System and Joint Chiefs of Staff (JCS) project code *9BU*. The allocation sequence caused assets to be released to warfighting units ahead of nonwarfighting units with the same priority. For example, a priority 02 WRSK replenishment requisition, using project code 9BU, would release before a MICAP non-9BU priority 02 requisition. This was one of many factors that enabled the MICAP rates for the AOR to consistently average more than 90 percent.

Distribution of spares within the AOR was accomplished by dedicated C-130 flights called *Camel Run*. The flights moved spares from Riyadh and Dharan to the provisional wings. To support the C-130s, MAC built HPMSKs and placed them at these two locations. To support the materiel-handling equipment required throughout the AOR, MAC located HPMSKs at Rhein Main and Dhahran, which acted as central distribution points for these spares.

The regional repair center at Rhein Main was repairing assets on a first-come, first-serve basis in support of the five C-130 squadrons deployed to the AOR. To help maintenance prioritize repair and distribute the assets to the location with the most need, MAC installed the prototype Theater Repair and Distribution System (TRADES) at Rhein Main. TRADES was developed under the direction of the Air Force Directorate of Supply and enabled the prioritization of maintenance and the distribution of assets to maximize aircraft availability at deployed locations. The TRADES prototype worked well in support of the C-130s.

As replenishment supplies became backlogged in the flow at Dover AFB, it became apparent that an overnight delivery service was needed for high-priority cargo. Consequently, *Desert Express* was established. This was a daily C-141 flight from Charleston AFB, that flew direct to Riyadh and Dhahran, carrying only high-priority cargo identified by project code 9AU. For Air Force cargo, the MICAP designator identified the asset as Desert Express-eligible. All Desert Express shipments had to be approved by the airlift clearing authority prior to being moved to Charleston AFB. As hostilities heightened, this service was eventually expanded to two flights per day. A flight from Europe was also added in December 1991.

Retrograde Spares

The return of reparable spares became important since follow-on support calls for the repair and return of recoverable assets. Therefore, an orderly flow of retrograde assets must occur. Retrograde spares moved well from the AOR to consolidation ports. However, bottlenecks occurred at Rhein Main, Dover, and Charleston, as pallets had to be broken down to move property to end destinations. To alert transportation of priority Air Force cargo, Air Force Project Code 672, nicknamed Pacer Return, was developed to alert transportation of priority retrograde spares. Any pallets with cargo containing this project code were broken down ahead of other pallets. In the future, priority retrograde will be assigned by the computer based upon the availability of reparable carcasses at the technical repair centers. Those items that are in an *asset short* position will be afforded priority handling and can be manually

assigned if wartime assessments determine the item is mission critical.

Assessments

To support initial deployments, weapons system management information system (WSMIS) sustainability assessment model (SAM) assessments, as well as a prioritized list provided by the MAJCOMs, were used by the Air Force Logistics Command to help identify surge requirements. However, after deploying, WSMIS was essentially blind because parts availability at the deployed locations was not visible until the CSSA became fully operational. However, DMAS was used by TAC, using information updated from home station processing of CSS transactions. Once the CSSA came on line, WSMIS was again used to identify sustainability of deployed spares and identify problem parts. The first few output products required adjustments to the assessment parameters so they reflected the actual sortie rates and durations and logistics support concept (maintenance concept and FOSK availability) being experienced in the AOR. Once adjusted, an accurate assessment was made but was never used as the war ended so quickly. The problem parts output was to be used as a guide to prioritize depot repair.

We need express transportation for high-priority cargo as demonstrated by the Desert Express.

Lessons Learned

Numerous lessons learned evolved from this operation. One stemmed from the problems of transitioning supply operations from peacetime to wartime support. To be more efficient, the Air Force should institutionalize the CSSA concept and replace the CSS with a system that can provide support during the initial employment phase of no communications connectivity without mainframe support but capable of transitioning to regional mainframe support once connectivity is obtained. Additionally, there was a lack of adequate voice and data communications, which affected the timely transmission of supply requirements to sources of supply. To remedy this, early deployment of the voice and data communications nodes that will meet user requirements is necessary.

We also found that there is a need for overnight transportation service for critical cargo. We need express transportation for high-priority cargo as demonstrated by Desert Express. It is important to ensure this requirement is included in all planning documentation. Similarly, we must have visibility over retrograde movement, and high-priority cargo must be identified for expeditious movement. This will increase support to the warfighter. This asset visibilty is possible if the Air Force fields systems such as the cargo movement operations system and the Air Force logistics information file, which can identify where an asset is in the transportation system. Steps should be taken to automate the identification of priority retrograde assets as well.

There were major abuses of the priority requistion system. The Air Force flooded the system with priority requisitions, to include stock replenishment, that were inflated. The FOSK programs being developed will requisition stock replenishment as priority 05 versus priority 02. These should be available in 1992.

Capability assessments are vital to successful theater operations. In Desert Storm, it took too long to produce accurate theater assessments. As a solution, funding to develop an operations plan matrix within WSMIS/SAM will allow a swifter transition to aligning the database to perform theater level assessments on deployed forces.

As mentioned above, the transition from peacetime to

wartime operations needs attention. Spares were not available to support the prewar operations tempo. The development of the current FOSK concept will allow the kits to be deployed early to provide the support.

The supply community needs to assign a unique SRAN to all deployable squadrons. This will prevent numerous problems that could occur because requisitions may not transfer from one account to another.

Spares allocation was perceived as unequitable by other MAJCOMs not fighting the war, since the JCS project code released assets to the AOR first if they were equal priority. Consequently, stock replenishment was allocated to the AOR before a nonwarfighting MICAP was satisfied. The advent of DRIVE (distribution and repair in a variable environment) will resolve this allocation problem, as unit priorities must be identified. DRIVE will maximize aircraft availability based on the unit priorities and aircraft availability targets.

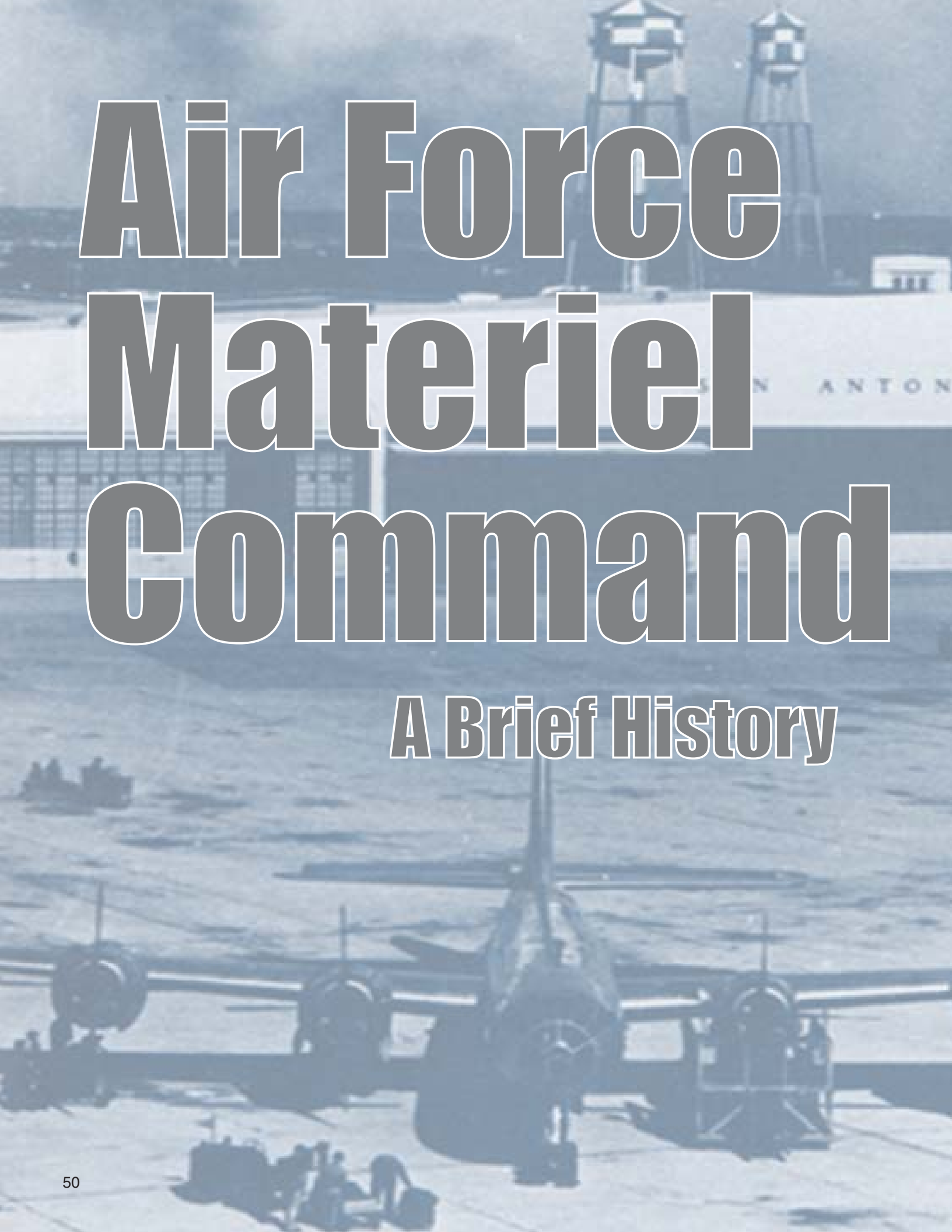
There was some good news. Regional maintenance activities work and can be supported by a dynamic supply system. We must agree upon transportation pipeline times to and from these regional repair centers to compute requirements for follow-on support. Additionally, TRADES development must continue from a prototype system to a standard Air Force system.

At the time of writing, Col Gunselman (USAF, Retired) served as the chief of Supply Policy and War Planning Readiness, Air Force Directorate of Supply, Washington DC. This article first appeared in the Air Force Journal of Logistics, Vol XV, No. 4.

notable *quotes*

To inquire if and where we made mistakes is not to apologize. War is replete with mistakes because it is full of improvisations. In war, we are always doing something for the first time. It would be a miracle if what we improvised under the stress of war should be perfect.

Admiral Hyman Rickover



Air Force Materiel Command

A Brief History

Since the inception of combat aviation as a viable warfighting instrument, aviation logistics has been a constant presence in the support arena. During World War I, the nascent Army Air Service created an innovative multi-echelon depot system designed to provide quality logistics support to the aero squadrons. Considering the fact that aviation was a relatively new phenomenon in 1917, the ability to sustain aerial operations in a foreign country is an outstanding testament to the pioneers of aviation logistics.

In the years following World War I, American military aviation quickly regressed to its decrepit state. In 1939, prior to US involvement in World War II, the Army Air Corps was using outdated equipment and lagged behind the major European powers in aviation technology. While there was a rudimentary logistics structure in the Air Corps, most of the responsibility rested on the Materiel Division. This division was primarily responsible for procurement and development programs and did not give adequate attention to the maintenance, repair, and supply support of the Air Corps. So in October 1941, in conjunction with a massive reorganization of the Army's air arm, the Air Service Command (ASC) was created to provide aviation logistics support. ASC was tasked with a broad range of functions, which suggests that the practice of aviation logistics was still relatively new. ASC was directed to manage all continental United States (CONUS) aviation storage and distribution activities. Additionally, it was given the authority to purchase all supplies and equipment for aviation operations and maintenance activities. Still, the command had a bit of an identity crisis. Even though ASC fell under the Office of the Chief of the Air Corps, it did not possess the power of a command, but more of a division. This changed in 1942 when all air arms of the Army were consolidated

into the Army Air Forces. With this change, ASC became a legitimate command.

ASC was responsible for all CONUS depots and subdepots. During the first 3 years of the command's existence, the number of main depots increased from 4 to 11, and the subdepot system reached 238 units by 1944. Additionally, ASC was in charge of providing combat logistics support to overseas units. With the establishment of air depot groups, ASC was able to exercise a measure of logistics control not seen in the First World War. While ASC did not have actual oversight of an air depot group when deployed, it was in charge of its organization and training. Overseas, air depot groups handled all major depot-level work, while minor work was completed at a subdepot level.

During the first full year of US involvement in World War II, ASC grew, in both personnel and physical assets, to a level that rivaled General Motors.[1] The command experienced significant reorganization during the war years, including a change in the overseas shipping functions that spawned the East and West Coast offices that oversaw all in-transit shipping functions. Other organizational changes included spinoff of the subdepots and control of those operations being given back to the base. ASC decided the command should focus on depot-level operations.

ASC developed a slew of innovative processes. When confronted with the problem of determining requirements for units deploying overseas, ASC was forced to conquer both the uncertainty and time criticality of the support. As a result, they devised a rudimentary *kit* system where the command would issue a "preassembled set of organizational equipment just before the units were ready to move overseas."[2] This plan saved both money and time and proved very successful. Another innovation was the development of a more efficient distribution system. Early in the war, spare parts were distributed based on expected consumption. This system was deemed unsatisfactory, and ASC devised a new method where overseas commands would requisition the parts directly.

Though the Air Service Command and the Materiel Command retained separate identities, there was a confusing overlap in the responsibilities of both organizations. They established their headquarters at Wright and Patterson Fields respectively, and both often undertook the same tasks. Accordingly, the commands were merged in 1944 to create the Air Technical Service Command. This command had responsibilities for procurement, research and development, and logistics support functions. One year later, the command was renamed again. This time, it was dubbed the Air Materiel Command (AMC).

After the cessation of hostilities in 1945, the role of the Air Materiel Command was that of a logistics caretaker. The Army downsized to levels lower than even the those of prewar 1939. As a result, AMC was forced to deal with large amounts of used, and now excess, materiel. Unfortunately for the command, the end of the war signaled a decrease in available storage facilities. Depots were closed, and certain government-leased buildings were returned to their owners. The lack of warehousing space forced AMC to find suitable outdoor storage. The excess airplanes were eventually moved to a section of Davis-Monthan AFB, known today as the Aerospace Maintenance and Regeneration Center.

During the years immediately following the end of World War II, AMC had its share of successes

The end result was that, by November 1950, AMC overhauled, modified, and restored more than 400 aircraft. Now the big challenge was keeping these planes flying in a deployed environment.

and failures. In 1948, a year after the designation of the Air Force as a separate service, the air logistics community was faced with one of its sternest tests. The Soviet blockade of Berlin spawned the famous Operation Vittles, and a tremendous workload was placed square on the shoulders of a less-than-ready Air Force. Central to the problems faced by the Air Force was the lack of an adequate air transport platform. In 1948, the sole aircraft readily available (in any appreciable number) was the aging C-47, but this airplane wasn't well suited to the task at hand. While the C-54s were bigger, faster, and better suited for the task, they were scattered around the globe. Therefore, the Air Force began to take steps to get them involved. Initially, there were some serious obstacles facing AMC regarding the C-54. The amount of C-54 spare parts available in Europe was negligible. As a result, AMC orchestrated the movement of more than 35,000 pounds of spare parts, enough to "keep 40 C-54s flying for 30 days."[3]

While this shipment averted a major problem early on, the nature of Operation Vittles compounded the difficulties faced by AMC. Hauling coal and flour did not exactly leave the inside of the aircraft in pristine condition, and the dust actually ate into the electrical components in the cargo hold. Additionally, the continuous flying required by the mission placed an incredible burden on the supply of spare parts. Consumption rates were higher than any expected by the command, and no matter the number of parts sent, there was always a good chance that there would be a number of parts the command just could not supply. However, the supply system at the Rhein Main Depot overcame these obstacles, and by the end of the operation, more than 200 C-54s had participated in this life-saving mission.[4]

AMC and the Korean Conflict

After only 4 years of peace, the United States found itself involved in another conflict. The outbreak of the Korean War in 1950 severely tested the Air Force logistics structure. While better prepared than it was for the two world wars, the Air Force was still not considered a *top tier* air force, as its lone jet platform was the outdated F-80. Therefore, AMC was faced with the task of forming an industrial base that could handle all necessary production increases. Following the precedent set by the Aircraft Production Board in 1916, AMC decided to give a great deal of the work to contractors. The nature of the mobilization of the industrial sector was not total as it was before World War II but more of a *creeping* mobilization—industry would be involved while attempting to limit disruption to the national economy.[5] However, any new production meant there would be a sizable delay in receiving new equipment, a delay that was unacceptable. For the first time in US aviation history, the Air Force was able to employ a large number of stored aircraft. While the majority of these platforms were outdated, they could be modified to serve a very useful role in the theater of operations. AMC was tasked with the overhaul and modification of these airframes.[6] Still, the work was too much for the command, and contractors were used to augment the efforts. The end result was that, by November 1950, AMC had overhauled, modified, and restored more than 400 aircraft. Now the big challenge was keeping these planes flying in a deployed environment.

As with the wars in Europe, a major obstacle was the length of the logistics pipeline. While the initial difficulties painted a less-than-rosy picture, AMC implemented a number of steps

that had a positive effect on supply early in the war. A massive centralization of the support depot system facilitated resupply, with three dedicated control depots serving specified areas of the world.[7] It didn't hurt that AMC was blessed with a bit of good fortune. At the time of the conflict, the command had an established supply depot in Japan. This depot was in the perfect place to become a vital cog in the logistics wheel. Supplies were stored in and distributed to Korea from this depot. This facility allowed AMC to keep a continuous flow of materiel in and out of the theater.[8]

But not all was right with the world, logistically speaking. While AMC experienced some good luck with its organizational structure, it was cursed by luck of a different kind. First, the North Koreans decided to attack at the end of a fiscal year. As is the case today, the Air Force did not have the money needed to meet the "increased cost of operations."[9] Second, as in Operation Vittles, the spare parts supply needed to sustain a much higher operations tempo than is normally experienced in peacetime was simply not available. The scramble for spares support cast the supply system into a chaotic state that was difficult to escape. Fueling this fire was the rampant abuse of the priority system used to order and receive requisitions. In the first 3 weeks of the conflict, there was a backlog of top-priority items that would take more than 2 months to airlift. It is probable that a number of the requests did not need to go top priority. Nevertheless, the incredible number of these requests clogged the ports, as well as the air channels of transportation. Ironically, most parts sat at the ports longer than it would have taken them to be delivered via surface transportation. And not all the problems were at the ports waiting to leave the United States. Once the parts reached Korea, there was no guarantee they would be sorted and issued. In 1952, an inspection of a port in Pusan revealed that nearly one quarter of the items stored at the port hadn't been sorted and, subsequently, could not be issued.

One notable exception to all of the frustrations experienced by Air Force supply personnel was the actions taken to resolve the F-86 external fuel tank shortage. In the first 2 years of the conflict, F-86 pilots were clamoring for external fuel tanks. The tanks were needed to increase the range of the aircraft, since most of the aerial engagements happened near the Yalu River in the northwest corner of North Korea. Air Force supply came through, and supplied the external tanks in a timely fashion.

One budget-estimating job that had consumed 250 man-hours and 110 machine-hours was reduced to only 16 man-hours and 31 minutes of machine time with the UNIVAC.

Post-Korea, Pre-Vietnam

The years between the Korean War and the Vietnam War significantly changed the Air Force logistics environment. The Cold War was well underway, and US foreign policy toward the Soviet Union dictated the nature of the logistics community. Many innovative changes were born that shaped Air Force logistics. One of these was the use of commercial charter aircraft to transport property and personnel. This program, known as LOGAIR, served as the backbone of the Air Force air logistics system for nearly a decade.

While LOGAIR satsified the Air Force requirement for a domestic element of the air logistics system, AMC faced many other challenges. Of these, none was more critical than the need for a system to improve information flow and reduce the time spent on information processing tasks. Since the end of World War II, the mission of the logistics community had actually increased in scope,

while personnel levels decreased. In 1955, the Air Force inventory was huge: 41 million items, $11B in aircraft and equipment purchases, and nearly $40B in outstanding contract.[13] The punchcard system used since 1940 was no longer adequate. Something had to be done to decrease the processing times and errors associated with this unwieldy system.

In July 1954, AMC's first Remington Rand UNIVAC computer was activated. This addition to the command paid immediate dividends in both time and accuracy. For example:

> One budget-estimating job that had consumed 250 man-hours and 110 machine-hours was reduced to only 16 man-hours and 31 minutes of machine time with the UNIVAC.[14]

Even though the computers were expensive and still prone to mistakes by human programmers, their infusion into AMC operations went ahead. By 1957, managers were receiving reports that gave them incredible amounts of information aimed at facilitating their decision-making process. In 1958, General Curtis E. LeMay, Chief of Staff of the Air Force, tasked AMC with completely automating the data-handling tools in the materiel-handling system. Finally, in 1962, AMC was virtually automated and was, at the time, the "world's largest user of electronic data-processing equipment for business purposes."[15]

Other Actions

While AMC had developed a domestic means for logistics airlift, it still needed to get property around the world quickly. Unlike LOGAIR, this global logistics channel would be a bit more complex. Depending on the command, the structure of the airlift would differ significantly. For example, the United States Air Forces in Europe (USAFE) required a system of set channel missions that could service a huge area. The command sponsored the Air Logistics Service (ALS) in 1953, which immediately paid major dividends. In the first year of its existence, ALS transported nearly 24,000 tons of cargo across Europe. Remarkably, the aircraft used in ALS flew at 90 percent capacity, compared to 57 percent for commercial airlines.[16]

Like USAFE, the Alaskan Air Command (AAC) had specific needs for its global airlift. In this region of the world, speed was of the essence. Bases in Alaska needed the ability to receive and ship inventory quickly in order to reduce their stockpiles. Since many of the bases were located within an easy hour's flight of the Soviet Union, inventory storage was considered a vulnerable target. With this quick airlift, AAC was able to keep warehouses "on the road, and in the air."[17] Instead of USAFE and AAC operating their own airlines, AMC decided it could better supervise the operations of each. From 1955 to 1960, AMC expanded its area of control to cover both commands and associated air transportation services. Where these two commands had once exercised a great deal of control over their respective theaters, AMC became the big kid on the logistics block. While there were concerns, especially from the commanders who lost control of the airlift, the move went relatively smoothly.

The Cost of Logistics

The storage of aircraft in the Arizona desert reached its apex in the mid-1950s with the retirement of venerable platforms such as the B-36, F-86, and B-29. Each of these aircraft played a monumental role in the formation of the Air Force as a separate service. Even though these planes were

no longer useful to the Air Force, AMC decided that it was entirely feasible to refurbish and overhaul them for foreign military sales. Already, the mission and responsibilities of the command were growing. At the same time, the costs associated with arming the United States during the Cold War were increasing. AMC was forced to find ways to lower the costs of logistics. In 1952, the command decided to examine the spare parts issue. Amazingly, the investigators found that half of the budget allotted for the purchase of aircraft spares actually purchased only 3 percent of the items. Eighty-five percent of the other items "cost less than $10 per item," meaning that a new style of inventory management was needed to give closer attention to those items that constitute a majority of the money spent on spares.[18] This new style was captured in a 1954 program called *Hi-Valu*, which sought to determine the correct procedures to monitor the procurement and repair process associated with high-dollar items. If done smartly, the program could prevent the Air Force from spending more than was needed for these expensive parts. Excess and expensive spare parts were something the Air Force just could not afford, and this program was successful.

Prior to fiscal year 1955, Hi-Valu included only 2.9 percent of the spares in the inventory, but these parts accounted for nearly 62 percent of the total cost of spares for the weapon systems involved. By the end of the same fiscal year, the number of parts included in the Hi-Valu program increased to nearly 7,000 items and now included parts for spare engines. By 1957, this program led to a *significant* decline in the number of materiel requests by the Air Force to Congress.[19]

A second initiative that AMC designed to conduct business smarter was the IRAN (inspect and repair as necessary) program. Before 1952, the depots would completely "disassemble an item, inspect it, and recondition it."[20] If they found anything marginal, the depots would replace it and return the aircraft to active service. Sometimes, this meant a lot of work to replace something that may not have affected the operational capability of the aircraft (and could wait to be replaced). These practices often kept an aircraft out of service longer than necessary and led to greater costs. Under the IRAN program, only those repairs needed to keep the aircraft safe

LOGAIR

During 1952 and 1953, AMC conducted a series of studies showing it could operate a contract cargo, airlift system between its depots and the aerial ports of embarkation for overseas airlift for about half the cost per ton of existing commercial delivery. An annual savings of nearly $500K was possible.

The regularly scheduled contract airlift service received its charter in March 1954 through an Air Force regulation, which stated air transport should be used whenever its estimated cost, including packaging and handling, was less than any other means. AMC interpreted this to mean that airlift should be used for high-cost, critical, or emergency requisitioned item unless surface transportation could be justified.

Actual commercial cargo service commenced in the spring of 1954 with the *Mercury Service*, which provided five round-trip shuttles each week, carrying a 13,000-pound payload on C-46 aircraft.[10] The name was changed to LOGAIR in August 1954, since a major passenger airline already used the Mercury designation on some of its fleet.[11]

Two commercial carriers—American Import and Export Company of Miami and Capitol Airways of Nashville—began flights in April and June 1954 respectively. The command also developed a feeder network of air and surface routes to channel high-priority cargo through the depots. The system was confined to transporting cargo within the CONUS and primarily handled items that were urgently needed or would represent significant savings.

After a year of operation, LOGAIR succeeded in expediting support to AMC customers in numerous instances, at a cost per ton mile that was substantially below the cost of regular commercial airfreight.

The number of customer stations serviced increased from 11 in 1954 to 52 by 1958.[12]

LOGAIR's use of the C-46 and C-54 limited the types and amount of cargo that could be carried, so its performance continued to run behind its potential. However, the Air Force did, in fact possess a true system of air logistics, shaped to conform to the capabilities and requirements of present and future weapons systems and strategies with fast response and flexibility.

and operational were made between scheduled reconditionings. This program wasn't implemented very smoothly, and modifications were made as late as 1958 to again scale down the number of nonessential repairs made on the weapon system.

AMC also implemented Operation Bench Check. which was designed to encourage using organizations to fix items at the lowest possible level, sending parts to the depot if repair could not be accomplished at lower levels. Like the Hi-Valu system, this policy produced immediate dividends. In 1954, assorted air materiel areas screened 12 million items, discovering that only about one-third of the items needed depot level repair. By repairing the other items at lower levels, AMC recognized savings of more than $27M.[21]

Now that AMC had implemented these policies across the Air Force, the time between overhauls on the aircraft increased, placing an emphasis on accurately forecasting the life of the spare parts needed to keep the planes flying. AMC used a variety of actuarial techniques to accomplish this task. (For more information on the computation of Air Force requirements, see T. J. O'Malley's article on page 72 of this monograph).

The Creation of the Air Force Logistics Command

In the late 1950s, the relationship between AMC and the Air Research and Development Command (ARDC) soured. For years, ever since the Air Force began using the systems approach for the management of weapons systems, there had been a disagreement between the two organizations as to the responsibilities of each. Some thought the commands should be merged, while others continued to foster the opinion that the two should remain separate and a major redefinition of each command's responsibilities should occur. Specifically, senior ARDC officials believed they should be in charge of procurement, stating that AMC "exhibited 'a lack of sympathetic understanding for ARDC's situation.'"[22]

As a result of continued negotiations and the transfer of responsibility for the space program to the Air Force, the two commands were reorganized. On 1 April 1961, ARDC and AMC were renamed the Air Force Systems Command (AFSC) and Air Force Logistics Command (AFLC), respectively. Under this new arrangement, AFSC became the office of primary responsibility for a weapon system during the research and development and initial procurement stages of the system. AFLC was tasked with spares support and procurement of materiel to support systems already in the inventory. The remaining air materiel areas (depots) were realigned under AFSC, but AFLC maintained all necessary materiel and procurement functions needed to accomplish its logistics mission.

The Defense Supply Agency

Not long after the creation of the two new major logistics organizations, the Defense Supply Agency (DSA) was formed to help the Department of Defense purchase materiel in a more economical manner, based on logic that a single organization consolidating the buying process could do things cheaper. This new body had a military officer as its director and a "Defense Supply Council made up of key department officials" that helped the Secretary of Defense monitor the actions of the agency.[23] The Defense Electronic Supply Center (DESC), under DSA, was responsible for the procurement of electronics equipment, an inventory class that comprised

about 25 percent of all inventory items. This development was not one that AFLC was excited about. Not more than a decade before, the Air Force had sought to be the single item manager for this type of property, since the other Services were entrusted to manage other classes of supply. With the creation of the DSA and DESC, the Air Force was no longer needed as the focal point for these items. However, AFLC compromised and turned almost half a million parts over to DSA management.

> The DSA introduced a new format of logistics management, but it was not fully operational at once, and its pattern of future growth had not yet crystallized. During the period of transition, AFLC would have to transfer materiel assets, manpower, and responsibilities, while making sure that the two logistics systems were compatible—all the while providing the quality of support which the Air Force weapon system demanded. Obviously, the relationship between AFLC and DSA would have to work itself out over a long period of time. The demarcation of functions between the two organizations inevitably left some gaps and areas of uncertainty during DSA's infancy, and there was a real possibility that its scope would enlarge under the continuing pressure for commonality. In short, AFLC might have no choice but to adjust continually to the precocious newcomer who seemed destined to grow up to become a muscular and voracious half brother.[24]

AFLC might have no choice but to adjust continually to the precocious newcomer who seemed destined to grow up to become a muscular and voracious half brother.

AFLC and the Vietnam War

Project Bitterwine

With the 1964 Gulf of Tonkin attacks by the North Vietnamese, the Air Force was propelled into a combatant position. As a result, AFLC was faced with the daunting task of supporting a sizable air force deployed thousands of miles away. As was the case in previous overseas engagements, distance proved to be an obstacle. Working in concert with the Pacific Air Forces (PACAF), AFLC designed a way to provide support for the air forces in the Pacific theater. Project Bitterwine was the name given to the operation that AFLC used to furnish materiel support for the established main operating bases in the Far East, as well as for expanded capabilities of existing bases in the area. The materiel needed ranged from only a few spares to enough supplies to turn a bare jungle strip into a fully operational main operating base. Through the help of Project Bitterwine, bases at Takhli, Kung Kuan, and Cam Ranh Bay were established, and the capabilities of four bases in the theater were expanded to handle the inevitable increased operations tempo.

AFLC's role in making Project Bitterwine a success was enormous. After the project received the go-ahead and a final date was set for the aggregation of materiel for the new bases, AFLC went to work. The responsibilities of the command included the preparation of the materiel support lists:

> . . . all of the aircraft assigned to the main bases; supply all needed materiel; assign field support officers . . . and develop and issue all required support policies.[25]

In addition to these responsibilities, AFLC was also tasked to prepare the initial spares support lists for all aircraft that would be based in Southeast Asia and provide the necessary administrative (tech orders and so forth) and precision measurement laboratory support to all bases in the theater.[26]

As part of AFLC's tasking to support an aggressive base expansion plan in the theater, General Kenneth Hobson, the new commander of AFLC, instituted Programming Plan 65-6. This plan "identified a total of 27 bases, which . . . were involved in PACAF's base extension program."[27] The plan outlined AFLC's commitment to provide an initial supply capability to each deploying unit at either a main operating or support base. Additionally, AFLC took the initiative to facilitate the supply operations at these new and expanded bases by sending in rapid area supply support (RASS) teams. These teams helped the bases establish stock records and warehouses and train newly arriving supply personnel.

RASS Teams

The need for the RASS teams was a result of the magnitude of the initial *push* of materiel to the bases in the theater. Often these quantities were so large that they totally overwhelmed the base's supply system. Simply put, these systems had little capability to deal with the sudden, incredible increase in materiel arriving as a result of Project Bitterwine. The first RASS team—a ten-person group consisting of two logistics specialists and eight materiel facility specialists—was deployed in May 1965.[28] Over the course of the Vietnam War, AFLC raised the number of people authorized for each team. In September 1965, the RASS team was 30 people strong, and the teams reached their ultimate size of 60 in November 1965.[29] At that time, each air materiel area was tasked to provide two teams, one civilian and one military.

Often faced with substandard housing, inadequate transportation, and poor dining facilities, the RASS teams performed remarkably well. The following are examples of the accomplishments of a typical RASS team (this one served at Tan Son Nhut Air Base). The first team was in place from July to November 1965, and a civilian team was dispatched in December of the following year to conduct an inventory.[30]

- Constructed enough containers to accommodate 54,000 items.
- Placed 26,000 line items in storage.
- Processed a backlog of 80,000 documents.
- Inspected and identified 110,724 items.
- Condemned 448 items.
- Inventoried 45,523 items.
- Packed 222,473 items for shipment and 34,253 for storage.
- Discovered 49,000 excess items.
- Processed 19,000 items for redistribution to other bases.

The RASS teams at other bases, mirrored these accomplishments in many respects.[31] These teams eased the burden placed on the supply systems of the overseas bases by the push supply system used to furnish requirements of Project Bitterwine. Without these teams, it is pretty safe to say that the air war would have suffered greatly. (For more information on supply support during the Vietnam War, see Major Randall Ray's article on page 25 of this monograph.)

AFLC in the Disco Age: *The Logistics of Deterrence*

Just like the days following the Korean War, the mood of the country after the Vietnam War reflected an antimilitary theme. Many people, discouraged with the way things turned out in Southeast Asia, voiced the

popular opinion that military spending needed to be reduced. The political climate of the time was not conducive to increased military appropriations, and the economic state of affairs was not the most attractive. As a result, the Department of Defense sought to reduce its expenditures across the Services, and the Air Force was not immune to the changes. In the late 1940s and again in the mid-1950s, logistics was seen as the primary place where the government could save money. Well, the 1970s were not any different.

AFLC was tasked with finding areas to cut resources and save the government money. The first, and sometimes most obvious answer, was to reduce manpower in the command. In 1970, AFLC employed nearly 134,000 people. By the end of the decade, manning was around 97,000, a 25 percent reduction.[32] It did not make sense for AFLC to agree to these changes without a corresponding change in the functional responsibilities of the command. Since the mid-1950s, the Air Force had been tasked with the development and sustainment of the country's missile program. In the 1970s, the missile program was less manpower intensive than the aircraft side of the house, so positions could be dropped.[33] Some programs were cut entirely. AFLC closed its regional procurement office in Europe and the Far East. In 1970, the responsibilities formerly attached to these organizations were transferred to the Contract Maintenance Center.[34] Other activities were reorganized in ways that were logical and cost effective at the time.

In 1970, AFLC employed nearly 134,000 people. By the end of the decade, the manning levels would remain around 97,000, a 25 percent reduction.

Issues in the 1970s

Contracting Out

A common misconception is that the notion of contracting out certain functions throughout the military is a new one. As early as 1940, the Department of Defense had practiced some form of contracting out. For the most part, contracting out in the 1940s and 1950s was partial in nature, meaning that parts of the functions were given to contractors. In the 1970s, AFLC decided there was an opportunity to farm out entire areas to contractors, freeing critical Air Force resources and personnel. Some functions that were considered prime candidates for outsourcing were base audio-visual services, vehicle operations and maintenance, and laundry services.[35]

While there was a tremendous upside to this new management tool, there were also some major problems. One problem resided in the command's intention to contract out the precision-measurement equipment laboratories at the air logistics centers. The entire process was a long and flawed one, as the contract bidding stages were delayed during the creation of a comprehensive statement of work that would ensure the same level of support previously provided by organic troops. In all, the process that started in 1975 didn't reach the final award stage until 1979, a lot longer than most thought it would take.[36] The end of the actual awarding of the contract did not mean that AFLC was out of the woods. Not surprisingly, there were discrepancies in the type and quality of service provided by the contractors. This difference meant that AFLC (as well as the Air Force) was forced to continuously perform watchdog functions—not something they had thought would be necessary.

Welcome the DLA

A rather unpopular initiative in the 1970s was Washington's proposal to create a single national supply system to handle all the military's supply needs.

The Air Force and others in the Department of Defense were adamantly opposed. The major concern of all parties involved was the adverse effect this move could have on readiness and responsiveness.[37] On 1 January 1977, the Defense Supply Agency was redesignated the Defense Logistics Agency and was about as close to a centralized operation that the Air Force had ever seen.

While centralization was feared across the board, the external pressure to accumulate similar functions under a single manager was pretty strong. As a response to these pressures, in 1964, members of the military community formed the Joint Logistics Commanders.[38] The group consisted of the AFLC commander and his counterparts from the other Services. The group's charter was to find ways to improve mutual support and "reduce duplication of effort and resources."[39]

Combining AFLC and AFSC into AFMC

Reform swept through the Department of Defense in the late 1980s, and the logistics/acquisition community felt a great deal of it. The powers in Washington wanted to redesign the defense acquisition structure and reduce the "superfluous layers of management."[40] Ever since the 1940s and 1950s, the acquisition side of the house (ARDC and AFSC) and the logistics side (AMC and AFLC) had argued over who was to do what. As a result, there was often duplication of effort or neglect of the responsibility in question. So, in 1989, Secretary of the Air Force Donald Rice agreed that the merger of the two commands (AFLC and AFSC) was an idea "whose time has come."[41] The goal of this initiative was to:

> . . . eliminate management layers and functions that do not add value; consolidate functions where possible; and improve the efficiency of DoD's acquisition management, logistics distribution . . . .[42]

To examine the feasibility of a merger, the Air Force commissioned the McDonald-Loh study. Under the supervision of Lieutenant General Charles C. McDonald (Air Force Deputy Chief of Staff, Logistics and Engineering) and Lieutenant General John M. Loh (Aeronautical Systems Division), the study scrutinized those tasks that could be merged, left alone, or eliminated.[43] This was done by grouping existing tasks into three categories: fully common, essentially common, or unique. Based on this stratification, the study concluded that a merger could be easy with recognizable savings (fully common tasks), easy without any savings (unique tasks), or difficult with little savings (essentially common tasks).[44]

The study also developed two concepts of operation for the new command. Under one plan, it would be the sole contracting authority for the Air Force—something that went against the intent of the acquisition reform of the time. Under the other plan (which limited the acquisition role of this new group), the command would conform to the reform initiatives.[45] Authorities charged with this study were quick to remind people that this was not a blueprint for a merger but merely a feasibility analysis. The bottom line was that a merger was, in fact, feasible, but great care was needed to make sure it was done right.

Even though a merger was, more or less, proven to be feasible, there were those who opposed a unification of the two commands. The commanders of the respective organizations were

convinced that the current organization was the right one to ensure quality logistics and acquisition support.[46] Both commanders felt that a merger was an attempt to fix something that wasn't really broken, and both thought certain measures they had taken were sufficient to reach the goals set by the Department of Defense. Both commands pointed to a myriad of streamlining initiatives designed to improve business practices while reducing resource costs. Unfortunately for the two commands, a merger was in the cards.

On 7 August 1989, the Chief of Staff of the Air Force, General Larry D. Welch, met with the commanders of AFLC and AFSC and told them the commands would be merged.[47] While the decision wasn't quite official and General Welch listened to alternative proposals from each of the commands, preservation of the two organizations was short-lived. In November 1990, Secretary Rice decided that a merger would happen and tasked both affected commands to devise an integration plan.[48] About a month and a half later, the commanders briefed the Secretary, citing desires to:

> . . . integrate the work force and resources of the two commands; to improved existing business practices by providing a completely integrated weapon system management process throughout the weapon system's life cycle; and to provide a single face to operational commanders . . . .[49]

In addition to these goals, the commanders proposed an implementation schedule to Secretary Rice, and Air Force planners decided this new command would be located at Wright-Patterson AFB. To facilitate the activation of the new Air Force Materiel Command, on 1 July 1992, the Air Staff agreed to the activation of a *provisional* command on15 April 1991.[50] This *shadow command* was organized in exactly the same manner that the fully functioning one would be but with fewer people.[51]

The offices in the provisional command were tasked with paving the way for the permanent organizations they represented.[52] For those functions involving financial management, manpower, and personnel, this task was extremely important. No other aspect of the provisional command would have as direct an impact on the potential success of the permanent command. Another key player in the formation of the new command was the Integration Control Center. This office, attached to the command section, was responsible for tracking the tasks identified in the new AFMC Programming Plan and Program Action Directive.[53]

Integrated Weapons System Management

Merging AFSC and AFLC headquarters was, obviously, a key step in forming the new command. However, that merger was not the only important action in the formation process. Central to the workings of the new command was the concept of the integrated weapons system management (IWSM). This concept, presented to the planners in 1991, gave power to:

> . . . a single manager with authority over the widest range of weapon system programming decisions and resources to satisfy customer requirements.[54]

Benefits of this single-manager approach included having one person deal with every stage of the weapon system's life, from cradle to grave, thereby presenting a "single face to the user."[55] This would allow the new command to have a seamless

organization and provide for the complete integration of logistics so managers would not have to deal with initial versus replenishment supplies.[56] For 15 months, from April 1991 to June 1992, senior leaders and planners worked tirelessly to find a way to make this IWSM concept a reality.

In 1992, the provisional command was deactivated, and the Air Force Materiel Command was born. This organization continues to provide worldwide support for all weapon systems and is the backbone of the Air Force logistics system. From Air Materiel Command in the 1950s to Air Force Logistics Command in the 1960s, the journey to create this organization was anything but smooth. However, with hard work and foresight, the Air Force has solidified itself as the finest flying force in the world, with the finest logistics support in the world.

Editor's Note: The material presented here was taken, with permission, from Logistics: an Illustrated History of AFLC and Its Antecedents, 1921-1981, by Bernard J. Termana, Layne B. Peiffer, and H. P. Carlin, Office of History, Headquarters AFMC, Wright-Patterson AFB, Ohio, and Building a New Foundation: Plans and Preparations for Establishing the Air Force Materiel Command, by H. P. Carlin, Office of the Command Historian, AFMC, Wright-Patterson AFB, Ohio. Changes in wording were made to fit the constraints of this article, and should not be construed as original work of the editor.

Notes

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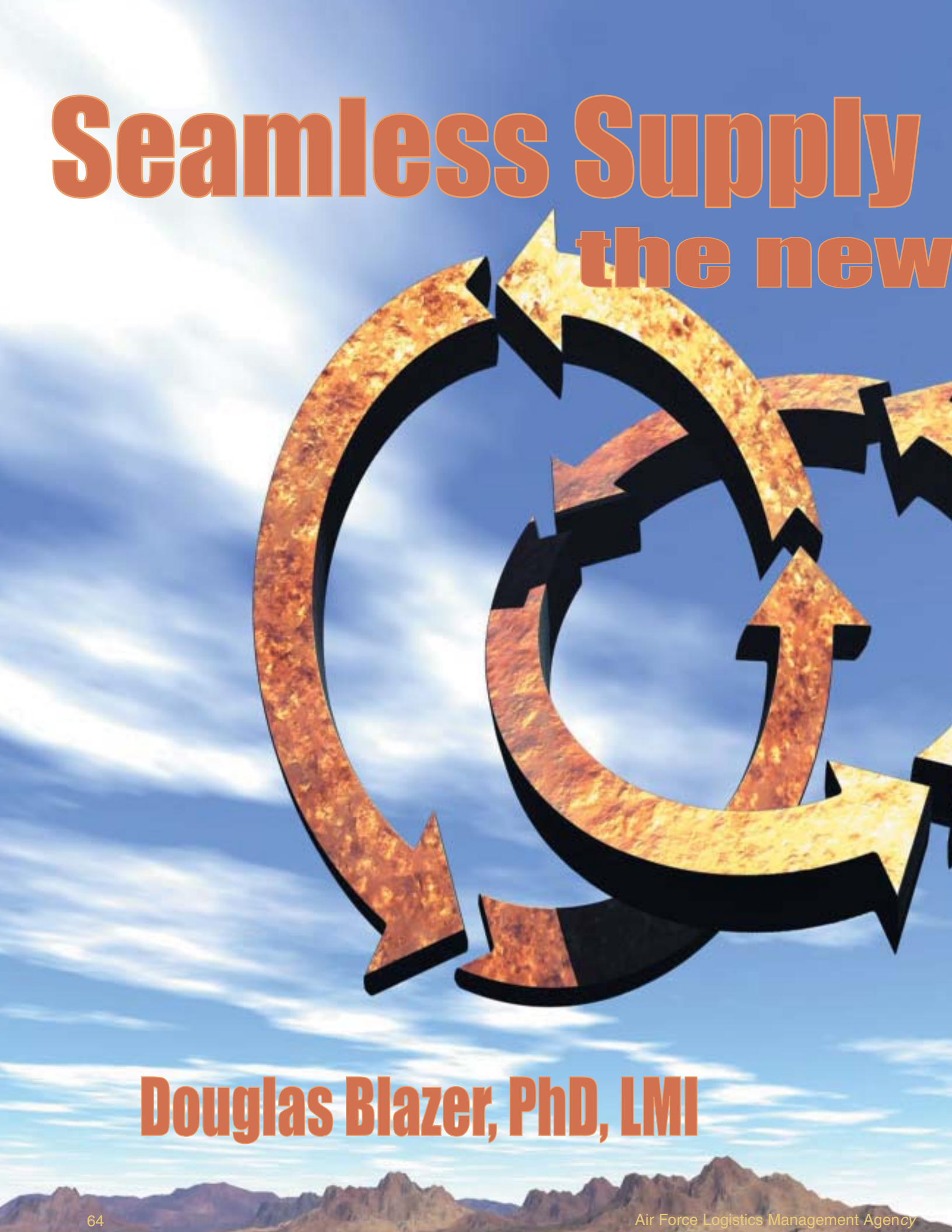
Seamless Supply the new



Douglas Blazer, PhD, LMI

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What will the new millennium bring to the Air Force supply community? Many exciting initiatives are underway that should result in significant improvements in flight-line supply support. Key supply systems are undergoing—or will shortly undergo—modernization. These modernization efforts are coupled with a new focus on removing the seams between key supply components. The wholesale stock control system (SCS) is in the midst of incremental modernization, with improved capabilities already available. The Standard Base Supply System (SBSS) is beginning modernization through a change in the technical approach to the Integrated Logistics System-Supply (ILS-S) program. The Air Force Equipment Management System (AFEMS) has already produced a web-based capability and is continuing to incrementally modernize. New technologies associated with these modernizations will eventually create a single *virtual* supply system with *seamless* data sharing between these systems. How will these initiatives address some of the most compelling complaints regarding the current Air Force supply system?

Have you ever wondered why, if we can send a man to the moon, we can't get a requisition to the depot? This will soon be accomplished by two means. First, as part of the SCS modernization, the Air Force Materiel Command (AFMC) developed an SCS web inquiry accessible through http://scsweb.day.disa.mil. Since the spring of 1999, any Department of Defense user can access this web inquiry and receive asset availability (retail and depot), requisition status, and reparable item movement control information. Soon, authorized users will have the capability to order through this same web page, replacing telephone calls to item managers for critical requirements.

The Materiel Systems Group (MSG), Standard Systems Group (SSG), and the SCS developer—Computer Sciences Corporation (CSC)—are putting an asynchronous connection between SBSS and modern SCS. This asynchronous connection is made through the new Global Combat Support System—Air Force (GCSS-AF)—recommended technology. In this case, the technology is IBM MQ-Series Message Oriented Middleware (MOM), which, by spring 2001, will provide immediate order processing, status updating, and Reportable Asset Management Process (RAMP) reporting from SBSS to SCS.

Why does AFMC direct base supply to ship items it does not have? There are several reasons, and most will be corrected shortly. First, SBSS-to-SCS transactions are often lost as they wind through intermediary systems like DAAS and M024B. These lost transactions cause a false asset picture in SCS, which leads to SCS redirecting nonexistent or nonexcess materiel from base accounts. The use of MQ-Series to pass data directly from SBSS to SCS will eliminate this problem.

Fifteen to twenty percent of the RAMP data (the data the base sends to AFMC) never gets to the AFMC database.

Second, the old legacy D035 used a cumbersome and complex transaction process to account for asset and usage data passed from SBSS to SCS. This process is already eliminated in the first version (SCS 1.5) of the modern SCS, implemented in February 2000. Base asset, level, and usage data simply update the modern SCS database.

Why can base supply use the Mission Capable Asset Sorting System (MASS) to see what assets another base has and get that asset to satisfy mission capables (MICAP) but AFMC cannot? As of SCS 1.5 rollout in February 2000, AFMC can show assets at all bases as reflected in one modern SCS database. In addition, modern SCS also shows all wholesale and depot retail assets, while MASS reflects only retail assets. With the activation of modern SCS in February 2000, the picture of retail assets improved significantly and should improve further with the MQ-Series interface between SBSS and SCS. This will result in one valid, reliable source for all Air Force item asset data.

Why do bases spend so much time and effort collecting data to send to AFMC so they can compute the Air Force spares requirements, yet there never seem to be enough spares to fill base stock levels? The lack of spares to fill levels has nothing to do with data processing or information technology. The Air Force cannot fund 100 percent of all stock level requirements. Therefore, systems like readiness-based leveling (RBL) and the Execution and Prioritization of Repairs Support System (EXPRESS) attempt to allocate levels and assets to best fulfill critical Air Force requirements. The improvements listed above in SBSS, SCS, and data transfer will improve the allocation decisions of RBL and EXPRESS as they rely on improved SBSS and SCS data for those decisions.

Maybe the new millennium will lead to improved supply support. To ensure it does, the Air Force is combining numerous *seamless supply* initiatives with the supply modernization programs. One of these initiatives is a seamless supply integrated product team (IPT), headed by the Standards Systems Group (SSG) with participation from MSG, the major commands, and various development and support contractors. The Air Force has formed this seamless supply team to leverage opportunities resulting from modernization of four core supply systems (wholesale and retail) reflected in a 1997 seamless supply task order study. This task order, led by a government and contractor team—consisting of Lockheed Martin Federal Systems, CSC, BDM/TRW, and Dynamics Research Corporation—focused on SBSS, SCS, the Weapon System Management Information System

(WSMIS) and the Requirements Management System (RMS). The goal was to define the functional requirements needed to improve or eliminate the seams in the Air Force supply system, a seam being defined as an impediment to a clean interface between the various inventory levels (wholesale and retail).

Today, the Air Force supply system is really an interconnection of SBSS, SCS, WSMIS, RMS, other systems such as EXPRESS, the Requirements Execution Availability Logistics Module, Defense Logistics Agency's Distribution Support System, and other Services' supply systems, to name a few. A seam is a connection (interface) between two or more components in the supply system, and that connection hinders the smooth flow of data. For example, studies have shown that 15 to 20 percent of the RAMP data (the data the base sends to AFMC) never gets to the AFMC database. A similar percentage of requisitions never reach the inventory control point (ICP). This problem will be completely eliminated by use of the MQ-Series between SBSS and SCS. This type of technology is a *practical* way to eliminate seams.

Today, many of these connections are imperfect as a result of decades of developing individual subparts of the Air Force supply system. The Air Force developed each component of the supply system at different times, so the interface was usually constrained and could not be changed. The new component had to provide the data to the component that was not undergoing a change the same way it always had. With seamless supply and modern technologies, the Air Force has a rare opportunity to modernize supply components simultaneously while ensuring practical incorporation of new technologies like MQ-Series to pass Extensible Mark-up Language (XML) Business Object Documents (BOD) that virtually eliminate seams between these systems.

So are today's seams really that bad? And what are the changes the seamless office will make?

Are the Seams that Bad?

If you could start from scratch, would you design a system where the retail system used different business rules than the wholesale system? Previously, bases computed pipeline times (repair cycle and order and ship times), and the depot also computed these times with the same data, but with different rules. The results were always that different requirements didn't match. Now, modern SCS accepts the base-computed pipeline times and passes them to other wholesale systems such as D041.

Would you design a system with interfacing transactions that were limited to 80 positions—the number of positions that were allowed on punchcards? This old technology forced Air Force bases to use multiple transaction images (with redundant data) to report status changes to the depots. The use of MQ-Series to pass XML BODs will eliminate this.

Would you replicate the retail databases at the depot? Modern SCS provides a single integrated picture of retail and wholesale assets for Air Force-managed items. This is not a replication but a consolidation. Incorporation of GCSS-AF technologies such as MQ-Series will allow asynchronous updating of these databases, creating one virtual, shared data environment. Today, the AFEMS collects hundreds of thousands of transaction images from both wholesale and retail systems that update a central database. AFEMS is also participating in the seamless supply initiatives, and future improvements in equipment management are planned.

Would you rely on a data transmission process that was a carryover from delivering a punchcard deck to the

communications center twice a day? What if the data transmission process forced these transactions to go through multiple checkpoints (systems) and, in some cases, reformatted the transaction along the way before getting (if ever) to their final destination? Before SCS modernization, RAMP transactions that the bases sent to the Air Force Materiel Command went through four, five, and even more different *systems* before they reached the stock control database. SCS modernization and the MQ-Series connection between SBSS and SCS will eliminate all these steps. Modern SCS has already eliminated the passing of transactions internal to D035. Transactions directly update the modern SCS database.

We live in the world of the Internet. Why not incorporate modern business-to-business (B2B) and business-to-consumer (B2C) technologies? Yes, using MQ-Series to pass XML BODs is a B2B implementation. Web inquiry and web requisitioning are B2C incorporations. Both will soon eliminate numerous transaction gateways, causing transactions to take days to reach their destination.

Seamless Supply IPT

So what is the Air Force supply community planning to change? Eight integrated process teams were created to develop the functional requirements for a seamless supply system. The IPTs are listed in Table 1.

It would take too much space to discuss each IPT here, so we'll discuss those that have documented the requirements and have had those requirements approved by the Air Force Supply Executive Board. For more information about all the IPTs, contact SSG/ILS.

IPT 1, Air Force-Managed Items

Perhaps the biggest opportunity to improve the wholesale-retail interface is with the Air Force supply system that manages spare parts (recoverable items). Improving the spares system has the biggest potential payoff. The current spares inventory consists of 2 million line items of which 200,000 are actively managed, with an annual buy-and-repair budget of $24B. An improved interface could result in more accurate requirements. A 10 percent increase in accuracy would mean a savings of $350M annually. Plus, these items are Air Force managed, so it is really only Air Force systems that have to be changed, and those systems are undergoing modernization.

There are two phases to the IPT 1 initiatives. Phase I has been partially implemented and consists mainly of changing the system to use one source of data and business rules for both retail and wholesale and to provide the data. These two changes sound like common sense, but the previous system had the bases send individual transaction data to the wholesale system daily. The bases used the data to compute pipeline times for their base levels. The wholesale system used the transaction data to compute base pipeline times also but used different business rules. The wholesale system only needed the pipeline data quarterly to compute

IPT	TITLE	TEAM LEAD
1	AF-Managed Items	AFMC Supply Management Division (AFMC/LGI)
2	Non-AF-Managed Items	Standard Systems Group
3	Regionalization	Air Combat Command Supply Division
4	PICA/SICA	AFMC/LGI
5	Equipment	HQ USAF Supply/Fuels Policy and Procedures
6	Stock Fund	Logistics Management Institute (LMI)
7	Requirements	LMI
8	Depot Retail (D035K)	AFMC/LGI

Table 1. Seamless Supply Integrated Process Teams

worldwide requirements. So the IPT 1, Phase I seamless initiatives provide the SBSS-computed pipeline data directly to the system that needs it (the requirements computation) quarterly.

IPT 1, Phase II initiatives take the Phase I initiatives a step further. Phase II will provide the daily base-level data (assets and levels data) online to the depot database. The plan is to have the base connect directly to the depot database (periodically or online) via the web or directly and pass data back and forth; that is, while connected, the two databases will be reconciled. Eventually, the plan is to update each database with the original customer transaction. For example, a base issue will update the base and wholesale database simultaneously. In the interim, at least once a day, we'll know the two databases are exactly alike.

The Phase II initiatives include:

- **Online RAMP.** The base will provide data assets and levels directly to the stock control system via MQ-Series MOM.
- **Online Redistribution Orders.** Bases have had MASS for some time. This initiative allows the stock control system to connect online to a base, verify data assets and levels, and instantaneously direct a shipment from that base.
- **Online Requisition Reconciliation.** The base will connect with stock control daily to ensure the data match. All base requisitions will be loaded in the stock control database, and all status and in-transit data will be reconciled. In transit today is so inaccurate that most systems do not use the data.
- **Global Data.** Today, there is performance data displayed at the base, and some of that data is passed to the Air Force Materiel Command to consolidate into worldwide performance statistics. Under seamless supply, a virtual shared database of retail and wholesale data will be formed, so worldwide MICAP data and issue and stockage effectiveness by national stock number will be available without requiring duplicate databases.
- **Awaiting Parts (AWP) Reporting.** This initiative will ensure the wholesale systems managing the repair process have complete visibility of all assets in base repair. This includes linking component parts to their AWP end item as well as the capability for AFMC to direct redistribution and returns of excess AWP end items. Air Force repair will be centrally managed, based on worldwide needs, rather than each base repairing any failures that generate when there is no need for the end item.

Phase II initiatives should reduce or eliminate dirty data that plagues the current system. Reduced dirty data means shortened replenishment times, higher redistribution order success rates, more accurate requirements and budgets, and improved mission support.

IPT 2, Non-Air Force Managed Items

The main thrust of this IPT has been to develop a *seamless* ordering concept. This IPT has documented the requirements for a single ordering system where a customer enters the request into the computer and the system sources the asset from either on base, another base, the wholesale inventory control point, or a commercial source. The customers will know immediately the status of a request and where (and how soon) to get the asset. Today, customer orders not satisfied from local base resources go through a (delayed) requisition process or lateral support process and involve different business rules depending on the source of supply. The future system will combine the ordering and requisitioning process, and the entire process will be virtually the same for the

customer regardless of the source of supply. The unique business rules for *sourcing* and paying for the asset (such as the International Merchants Purchase Authorization Card) will be imbedded in the software and transparent to the customer.

IPT 3, Regional Supply Centers

The wave of the future is regional supply centers. The Air Combat Command, Air Mobility Command, Pacific Air Forces, and United States Air Forces in Europe have all started regionalizing selected supply functions. The future supply system must not only accommodate regional centers but also take advantage of the opportunities of centralized management. The IPT 3 documented requirements for the future supply system to provide management products by regions, sources of supply, and weapons systems rather than by individual base (Stock Record Account Number, SRAN) account. For example, with regional centers, *retail stock controllers* will be interested in MICAPs, AWPs, and requisitions across weapon systems and specific ICPs, rather than by SRANs. No longer should the Air Force manage stock funds or build General Support Division operating programs by SRAN; regional stock fund reports will provide management with much less effort.

IPT 5, Equipment Management

The current Air Force Equipment Management System is a prime example of an early effort toward a seamless environment. AFEMS subsumed 11 ancillary equipment systems used to manage equipment allowances and provide total asset visibility and requirements information at the wholesale and retail levels of supply. The SBSS existed with its multiple retail databases (each SRAN had a database), as did the various ancillary systems. What was needed was a global database. The Air Force built an automated system that consolidated the ancillary systems and accepted data from the current retail and wholesale systems to create a global database. To feed the global database, the Air Force developed transactions processed at the base or depot to update AFEMS. The problems inherent with keeping the SBSS and AFEMS in sync were based on timing and more stringent transaction edit criteria in AFEMS versus the SBSS and communications. So it takes considerable effort to maintain the two databases, and the Air Force, at times, has had limited effectiveness keeping the two databases the same.

IPT 5 asked how to finish incorporating the remaining equipment-unique processes to achieve a seamless equipment environment. A concentrated effort was begun to identify *equipment-unique* processes for eventual migration from the SBSS to *componentize* the functionality within AFEMS, along with that of the remaining requirements systems (D039 - Classified Equipment Requirements Computation and D200C - RDB Equipment Requirements). The migration of D039 equipment requirement computation logic has begun, and planning is in the final stages for incorporating the Serial Number Control System for cryptographic assets and D-184 (serialized control small arms) as components in AFEMS. Once completed, the AFEMS will achieve *seamless* equipment processes.

Other Seamless Supply Initiatives

In addition to the SSG-led seamless supply IPT, three other major initiatives are occurring in conjunction with supply system modernization.

IL Interface Working Group

This interface working group consists of MSG program managers, SSG, and AFMC Logistics Process

Integration Division functional mangers and their development contractors. It is focusing on near-term incorporation of GCSS-AF technologies to eliminate seams between SCS, WSMIS, RMS, EXPRESS, and AFEMS, with a goal of creating a virtual shared data environment between wholesale supply systems.

SBSS and SCS Interface Working Group

This interface working group consists of SSG and MSG program managers, development contractors, and functional managers. It is focusing on near-term incorporation of GCSS-AF technologies to eliminate seams between SCS and SBSS, with a goal of creating a virtual shared data environment between retail and wholesale supply systems.

Decision Support Web Enabler

The WSMIS/Decision Support Environment is undergoing a seamless initiative to consolidate support into a central database that is totally web enabled. Today's WSMIS consists of independent modules connected only through traditional flat-file interfaces, resulting in significant data redundancies and the potential for dirty data conditions.

Readiness Assessment and *Supportability Analysis and Visibility* are the two initial capabilities functioning in this central database/web-enabled system environment that is DII/COE Level 5 compliant and moving toward GCSS/AF compliancy. The readiness spares packages (RSP) computation and assessment system includes unit assessment reporting, master unit validation, and unit reporting by RSP and peacetime operating stocks.

The supportability, analysis and visibility (SAV) functional area includes:

- Weapon system readiness driver support
- Asset constraint analysis support
- Back order analysis support (within and across all weapon systems)
- Asset distribution (imbalances)
- Analysis support
- Global analysis support for retail/wholesale asset requirements

Readiness database support is operational, and the SAV functional area is undergoing operations testing and evaluation.

Another major area of support provided by WSMIS/Decision Support modules is the AFMC Depot Repair Enhancement Program/Agile Logistics initiatives. EXPRESS provides a single, integrated priority list of all repair requirements at an air logistics center, determines the ability of existing resources to support repair actions, and provides the data and mechanism to move items into repair. EXPRESS is on the schedule to migrate into the central database/web-enabled system environment.

Summary

As you can see, there is a lot new in the Air Force supply system. The new, modernized system will take advantage of existing technology to eliminate the seams between the current wholesale and retail systems. Seamless supply is moving the supply community into the 21st century.

Dr Blazer is a senior research fellow at the Logistics Management Institute.

for MET

HOD behind the Magic

T. J. O'Malley

The Air Force manages almost $24B in aircraft reparable spare parts inventory. In fiscal year 1999, the Air Force requested about $1.3B for procurement and $1.9B for repair of these components. These are not cheap parts—nuts, bolts, and wire—but major components like brake assemblies, avionic units, and engine fuel controls.

a history of spares computations

They are expensive enough to warrant repair in their own right when they fail. The Air Force maintains an extensive inventory of these items because repair (or other resupply) is not instantaneous and serviceable units on hand can prevent aircraft down time while a failed unit is being repaired.

A classic logistics question, particularly pertinent in this context, is *how much is enough?* The Air Force has a complex web of information systems to answer that question, balancing expense and support level. Chief among these are:

- The Requirements Execution Availability Logistics Module (REALM), which determines the requirement for Mobility Readiness Spares Package (MRSP)-the mix of spares that supports a squadron's deployment or in-place wartime mission, providing an acceptable number of mission capable (MC) aircraft
- The D041 system and the Aircraft Availability Model (AAM), which determine peacetime stock requirements—the mix of spares worldwide that support peacetime training and readiness, programmed depot maintenance, and engine overhaul schedules, while maintaining specified levels of aircraft availability by weapon system
- The readiness-based leveling (RBL) system in the D035 Stock Control and Distribution System, which refines the D041 results, incorporating more detailed information to develop requisitioning levels by location
- The Execution and Prioritization Repair Support System, which guides and prioritizes inductions into depot repair and the filling of base requisitions on wholesale supply

Other associated systems, like the Standard Base Supply System (SBSS) and other elements of the stock control system, hold base-leveling information, process requisitions, and track the movement

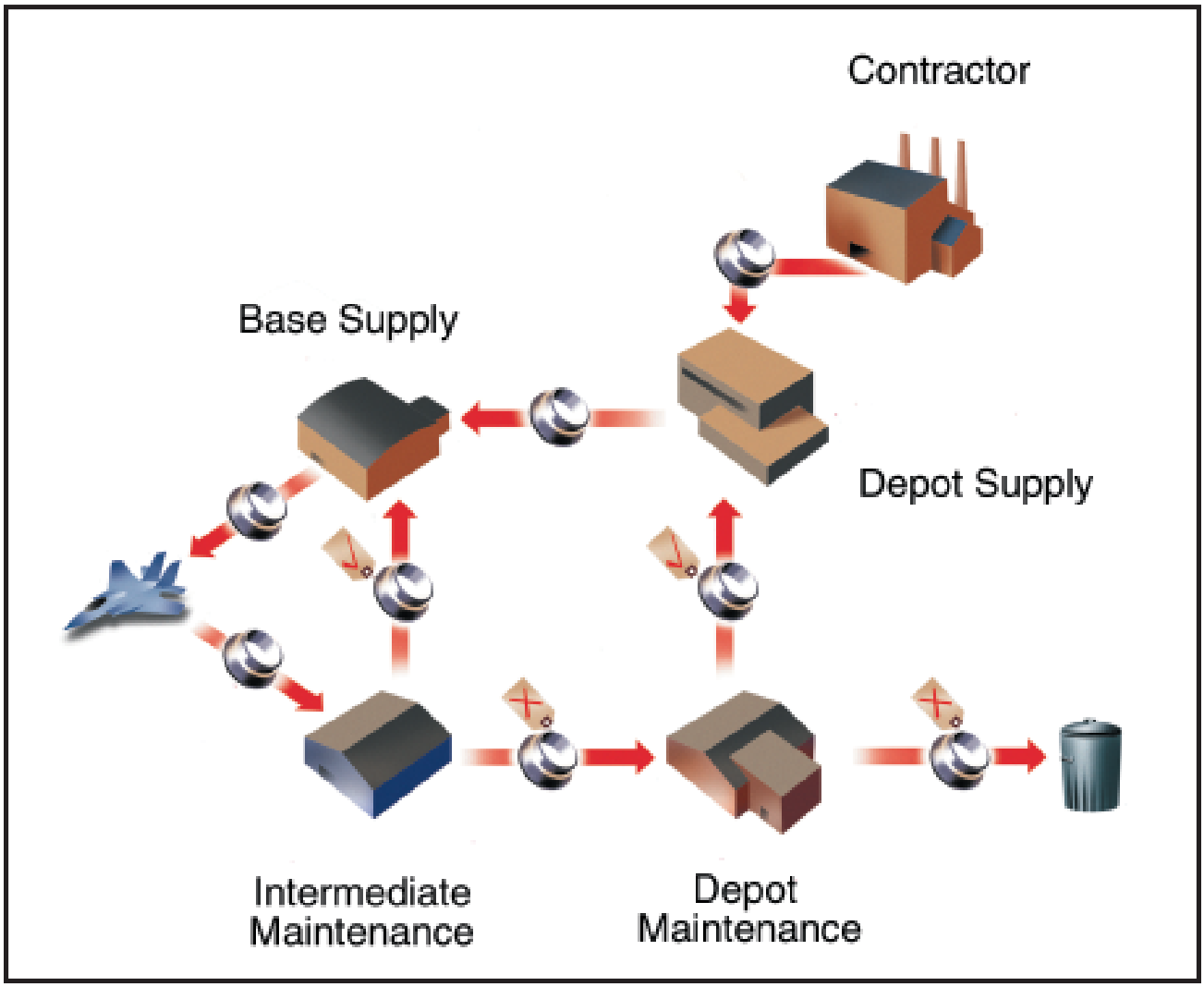


Figure 1. Rotating Logistics Flow

of spares through the logistics system.

It was very different in the early 1950s. The Air Force was still in its infancy, and computers were not widely used. However, the flow of assets through the logistics system is essentially the same, at least in abstract, as shown in Figure 1.

The Air Force operates a multi-echelon supply system, with stocks at the wholesale or central echelon (usually an air logistics center or depot) and the base or retail level. Each base has a level for each item and maintains its inventory position—the number of serviceables on hand, plus the number of assets due in from other sources (usually from base repair or transportation from wholesale supply), minus the number due out (back orders)—at that level. When a demand occurs, the inventory position drops by one, triggering a resupply action to bring it up to the target level again. This action may be an induction into base repair or, if the failure is beyond the capability of base repair, a return of the unserviceable part to the depot, along with a requisition for a serviceable unit. Wholesale supply at the depot operates in much the same way. When it receives a requisition, it issues a serviceable unit, if one is available, or establishes a due out (back order). This drops the depot inventory position by one, and the depot reacts by inducting an unserviceable into repair to bring it up to its target.

Real life, of course, is not quite so simple. We have not considered all the possible sources of supply (such as lateral resupply) or cannibalizing from parts already in repair. Depot maintenance sometimes batches repairs to obtain economies of scale rather than inducting immediately upon receiving a requisition, although the repair-on-demand concept has recently been revived as a key tenet of Agile Logistics. Of course, no one familiar with today's supply system would recognize the manual processes used to gather and exchange information in the 1950s.

Broadly speaking, the materiel requirements problem—how much is enough?—consists of establishing the wholesale and retail levels (often called reorder points, for obvious reasons). In the early 1950s, with the reliance on manual methods and the difficulty of data collection and computation, methods of setting levels were necessarily simple and straightforward. Item levels were set independently, item by item. Base and depot levels were set independently. No doubt the SBG method (sergeant's best guess) saw wide use, as did the earliest recorded requirements determination technique, Noah's algorithm—take two of everything. But the combination of escalating cost due to the Cold War, the spread of expensive high technology, and budget pressures focused attention on the requirements process. The Spares Study Group, created by the Air Force in 1952, found that half of the spares budget went to purchase 3 percent of the items, while 95 percent of the 725,000 items in the inventory cost less than $10 each. The Hi-Valu program, instituted to provide selective management of cost drivers, is long gone. However, it was the impetus for splitting the management of consumable parts (discarded upon failure) from the management of the more expensive reparable spares. At the same time, advances in operations research and inventory theory provided systematic and efficient ways to approach the requirements problem.

Crucial to any requirements computation is an estimate of the average number of units of a component going through the repair/resupply pipeline. If, at any time, there are more units in the pipeline than there are spares, then some aircraft must be waiting for a unit of that component; that is, there are back orders. The number in the pipeline depends on how

often the item fails and how long it takes to move through the pipeline. Suppose, for example, that national stock number A (NSN A) fails twice a day, each failure going into a 3-day base repair cycle. Then there would be six units of NSN A in the base repair pipeline. If half of the failures (one per day) are NRTS (not reparable this station) and are returned to the depot for repair and the time to ship a serviceable spare from the depot is 10 days, then there would be ten units in the order and ship pipeline, in transit to the base, and three units in the base repair pipeline. So the total requirement for that base would be 13, enough to fill the pipeline. Similarly, the depot has a requirement to fill the depot pipeline, determined by aggregate demand from all bases and the depot repair time. The depot situation is complicated by the fact that it must also support periodic airframe rework, engine overhauls, and repair of parts needed to repair other parts and must allow for a pipeline of spares recently procured and still in production or shipment from the manufacturer.

For deployment packages or flyaway kits, a modified method was used, since deployments typically had less maintenance capability than home station, and resupply from the depot could not be relied on. Instead, the Air Force established a 30-day support period and sized the kit to the expected number of demands in 30 days for items with no repair and to the base repair pipeline, plus an estimated 30 days of NRTS demands for other items. Since deployed flying hours were usually different from peacetime experience, demand forecasts were adjusted proportionately.

Item managers and base supply managers realized, of course, that the pipeline requirement was not sufficient since it did not allow for variability in the pipeline. Our NSN, with an average number in the pipeline of six, for instance, has a probability distribution associated with that pipeline. Some percentage of the time, there will be zero in the pipeline, some percentage one, two, and so on, as shown in Figure 2.

The Poisson distribution is frequently used to express variability of demand and, hence, the number of units in the pipeline. Thus, for a pipeline with a mean of λ, the (Poisson) probability that there are n units in the pipeline is:

$$p(n) = e^{-\lambda} \frac{\lambda^n}{n!}$$

Extensive research on determining the form of this distribution and estimating the mean has led the Air Force to use the negative binomial for today's requirements computations, as it better describes the high-demand variability observed. This variability is due not only to the variation around a known mean but also to uncertainty about the mean

The number in the pipeline depends on how often the item fails and how long it takes to move through the pipeline.

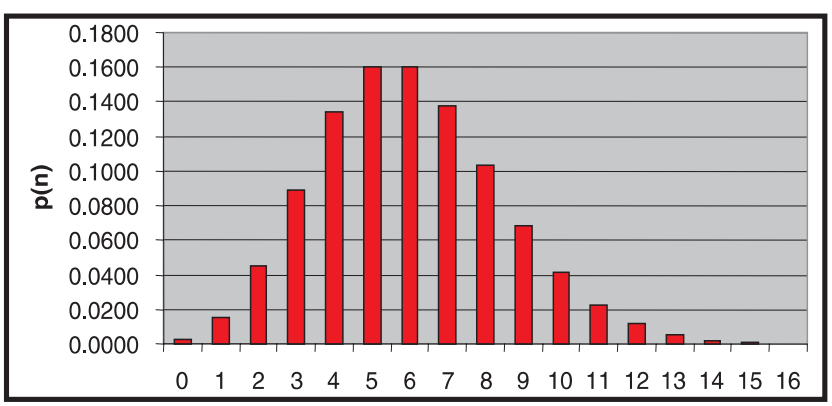


Figure 2. Poisson Distribution with Mean = 6.0

itself. Since procurement and budgeting lead times stretch into years, procurement decisions must rely on long-term uncertain forecasts.

Recognition of this variability led to the adoption of a safety level segment of the requirement, originally expressed as a fixed number of standard deviations of the pipeline. This form of safety level computation is still embodied in the SBSS calculation of base safety level.

Figure 2 illustrates the basic, How much is enough? It shows that a level equal to the mean pipeline of 6 will not always be sufficient and justifies a safety level. But it also shows that a level of 7 will also be insufficient, as well as a level of 8, and so on. There is still a non-zero probability of back orders. Where should you stop?

A valuable result of the probabilistic description of the pipeline is that it allows the estimation of measures of merit provided by a given stock level. With a spares level of s and a pipeline of 6, we can estimate supply availability or fill rate (the percentage of demands that can be filled immediately) as:

$$FR = \sum_{n=0}^{s-1} p(n)$$

This is just the sum of the probabilities that the number in the pipeline is less than the number of spares, which is equivalent in the Poisson context to the probability of at least one serviceable spare on hand when a demand occurs. Fill rate is also known as issue effectiveness. It is a commonly used measure of merit in supply operations, largely due to its ease of computation, but it has some serious drawbacks. It is insensitive to the length of a nonfill, for example. A back order lasting 1 day counts 0 for 1 in issue effectiveness statistics, as does a back order lasting 6 months!

We can also estimate the number of expected back orders (EBO), the average number of outstanding demands, as:

$$EBO = \sum_{n=s+1}^{\infty} (n - s) p(n)$$

This is so, since $n - s$ is the actual number of back orders when n units are in the pipeline, which occurs $p(n)$ percentage of the time. Taking the weighted average gives the expected value.

Measures such as these were commonly used (and are still in use today) to size inventories by setting a fill rate target for each item. RAND used this categorization to develop the Base Stockage Model in 1965, which introduced optimizing techniques and tradeoffs between items. The model exploited differences in cost and pipeline across the population of items stocked at a base, stocking spares with larger reductions in expected back orders per dollar of cost in preference to those that had smaller reductions per dollar. Thus, it developed a mix of levels, which minimized the total EBO at the base, for the resulting cost. The Base Stockage Model was never adopted by the Air Force, though elements of the optimization technique were later incorporated into the war reserve spares kit computation in the D029 system, a predecessor to the Weapon System Management Information System/REALM.

Complicating the issue further is the variability of demand on the depot and the interplay of base and depot stock levels. All else being equal, a higher spares level at the depot results in better response time to the bases, as there is less chance of a depot back order and delay. Depot spares make it more likely that a serviceable asset can be shipped immediately when requisitioned so that a base receives it precisely in time to process the requisition and ship it. At the other

extreme, if the depot has no spares, it must repair the returned unserviceable asset before it can ship to the base. Thus, the base has a depot delay equal to the depot repair time and sees a long response time from the depot. It is useful to think of the total base pipeline as composed of three parts: the base repair pipeline, order and ship pipeline of assets matched with requisitions in transit to the base, and depot delay pipeline of requisitions being delayed at the depot until a serviceable asset is available.

In the late 1960s, RAND developed the Multi-Echelon Technique for Reparable Item Control (METRIC). For an individual component, METRIC found the best balance of spares at the depot to reduce base turnaround time and total base pipeline and spares at bases available for immediate use to avoid or end back orders. Thus, a component with low demand used at many bases might have only a small number of spares stocked centrally. A component with high demand used at many bases might have most of its spares stocked at bases. METRIC makes these tradeoffs to provide the lowest number of total expected back orders at base level.

METRIC also included an optimizing procedure, which allowed the development of least cost spares mixes (worldwide both base and depot) minimizing total base-level EBOs for a specified population of items (for example, all those on a weapon system). The Air Force intended to incorporate METRIC into its Advanced Logistics System (ALS). Its development began in 1967, and it was intended to be a real-time, all-encompassing system for managing Air Force wholesale logistics. Ultimately, ALS proved too ambitious for the technology of the day and was abandoned. METRIC survived, however, as the Variable Safety Level (VSL) model in the D041 system requirements computation.

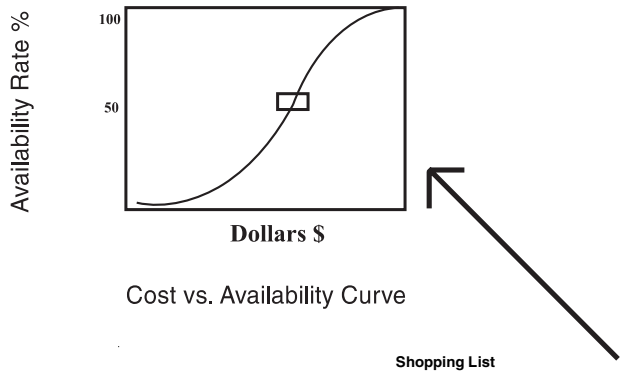
METRIC/VSL was a great step forward; the efficiency of the linkage between wholesale and retail supply has still not been attained today by the other Services.

METRIC/VSL was a great step forward; the efficiency of the linkage between wholesale and retail supply has still not been attained today by the other Services. However, METRIC still fell short in answering how much is enough. The Air Force used METRIC to size the requirement to support a 92 percent (base) weapon system fill rate in peacetime. When push came to shove though, no one could justify the use of the 92 percent figure. Fill rate gives no information about the length of back orders when they do occur, an important consideration. Fill rate, by weapon system, is not an unbiased and well-behaved measure. In fact, the Logistics Management Institute (LMI) pointed out that supporting two different weapon systems at the same fill rate would result in the more complex aircraft having a lower MC rate. At that time, Smith, Fisher, and Heller at LMI noted that one could extend the EBO results of METRIC to obtain measures of aircraft readiness.

Suppose NSN *i* has enough spares to produce EBO (*i*). Then, if a particular weapon system has N aircraft, the probability that a random aircraft is missing one of the NSNs is $EBO(i)/N$. The probability of not missing one is $1 - EBO(i)/N$. The probability that an aircraft is not missing any component (or the percentage of the fleet that is not missing a part) is given by

$$AA = \prod \left(1 - \frac{EBO\ i}{N} \right)$$

where the product is taken over all the reparable components on the weapon system. LMI called this quantity aircraft availability and extended this expression to multiple applications per weapon system, common components, and other complications. They also developed an efficient pure marginal analysis optimization



Shopping List

Item A, B, C...	Unit Cost $	Added End Items per $10K	Total Cost $	Availability Rate
6th A	1,600	0.388	101,600	66.67
11th B	2,300	0.352	103,900	66.69
2nd C	10,000	0.312	114,300	66.74
12th B	2,300	0.283	116,600	66.76
1st D	13,800	0.154	130,400	66.78
7th A	1,600	0.144	132,000	66.79

Figure 3. Cost/Availability Curve

technique. This technique ranked all the potential spares buys for a weapon system in terms of its marginal return (measured in terms of improved aircraft availability per dollar) to form a shopping list with buys having the biggest bang per buck at the top, as seen in Figure 3.

Tracking the cost and the resulting availability rate allowed the Aircraft Availability Model (AAM) to build a curve-relating expenditure for spares procurement to the projected aircraft availability rate for each weapon. These curves allowed logistics planners to examine the probable consequences of budget and allocation decisions in operational terms meaningful to nonlogisticians and to defend those decisions. This was particularly useful to Headquarters Air Force in the late 1970s, defending a reconstitution of the spares inventory after the hollow post-Vietnam era and the extensive consumption in support of Israel during the 1973 Yom Kippur war. Headquarters Air Force was, in fact, the chief user of the AAM in the assessment and defense of spares budget submissions. It was not until several years later that the AAM was embraced by the Air Force Logistics Command.

About the same time, an internal Air Force effort led to the next step, the development of MOD(ified)-METRIC. Initial provisioning of the F-15 began in 1970, and the F-15 relied heavily on modular design, particularly for the F-100 engine. Major assemblies (line reparable units or LRUs) were designed to be removed from the aircraft upon failure and replaced with another at the flight line. The LRUs were then repaired by removing and replacing subassemblies (shop replaceable units or SRUs). An LRU back order directly grounded an aircraft, while a back order of an SRU only delayed the repair of an LRU, which might or might not keep an aircraft on the ground, depending on whether a serviceable LRU spare was on hand. Thus, it was improper to trade off LRU and SRU EBOs in an optimization, as METRIC did, as they were not comparable in their effect on aircraft readiness. MOD-METRIC repaired this flaw in METRIC by exploiting the analogy between depot spares and spare SRUs—both reduced the total base pipeline. Although MOD-METRIC is no longer widely in use, the three-way tradeoff—finding the proper balance between spare LRUs at the depot, spare LRUs at bases, and spare SRUs—was

incorporated into the AAM. The AAM was adopted officially by the Air Force and is now incorporated into the D041 system in the computation of the peacetime operating stock requirement, as shown in Figure 4.

As complex as the D041/AAM structure is, it does make some simplifying assumptions. In particular, it fails to completely capture the differences between bases and the unique requirements this drives. Bases still computed their levels independently in the SBSS, a legacy of the time prior to the linked multi-echelon system. Thus, the D041 worldwide requirement did not necessarily match the rolled-up base requirements. The Air Force's first attempt at fixing this problem was the D028 Central Leveling System. This system uses the techniques of METRIC and highly detailed, base-specific information to allocate the worldwide requirement to bases. The D028 was successful at removing the disconnect between wholesale and retail levels but was not responsive enough to changes in deployment or flying activity. It was so overtaxed during Operation Desert Storm that the Air Force actually turned it off. Its successor, the RBL module of the D035 system, is more robust and responsive. While RBL is still in the implementation and shakedown phase, it removes one of the major seams in the supply system.

Development of the wartime/mobility spares requirement computation continued over this time. The 1970s' D029 system used a hybrid optimization system to determine a squadron's war reserve kit. It minimized total EBOs at the end of the 30-day support period relative to cost, while considering the probability of having no more than a specified number of aircraft down on Day 30 (the Direct Support Objective or DSO). Unlike the peacetime stock situation, where Air Force policy was to size the requirement as though cannibalization did not occur, cannibalization was explicitly considered in the wartime computation.

In the 1980s, RAND developed Dyna-METRIC to better assess the ability of a spares kit to support a contingency. Unlike D029, which focused on the final day of the support period, DYNA-METRIC modeled the time dynamics of the pipeline. A surge in flying caused more failures and more items to enter the pipeline; establishment of repair/resupply allowed items to leave the pipeline and become serviceable. LMI built on the RAND experience, using marginal analysis optimization and dynamic pipeline theory to build the Aircraft Sustainability Model (ASM) to calculate requirements for spares kits. They found, in some fighter scenarios, the most taxing period for spares support was just after the initial surge, not at the end of the period. Further, the sortie plan sometimes required more aircraft during the surge than in the following sustainment period. This

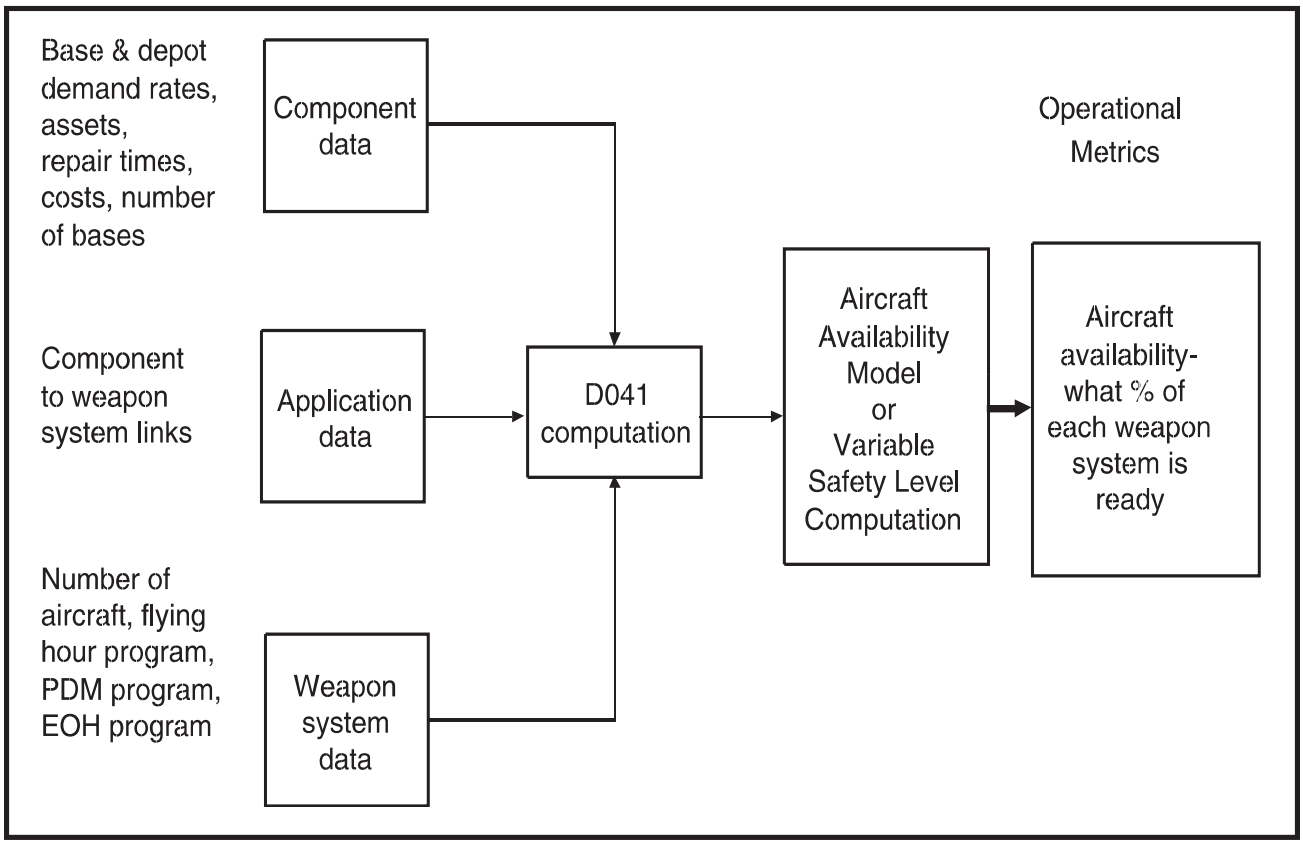


Figure 4. D041/AAM Reparable Spares Requirements Computation

led the Air Force to adopt the dual DSO policy, requiring kits to explicitly support both surge and sustainment periods. (At the same time, the meaning of the term DSO reversed from the number of aircraft allowed down to the more logical number required up.) The ASM was incorporated into REALM in the 1990s to calculate mobility readiness spares kits.

Also during this period, LMI developed improved methods of forecasting demand rates during contingencies. This deceleration method recognized explicitly that sortie length was an important variable. Other things being equal, two 1-hour sorties result in more demands than one 2-hour sortie. Wartime demand forecasts are now adjusted within the REALM computation to allow for differences in sortie length.

The requirements problem is a hard one and always will be. Given the basic contrariness of nature and component failures, the computation will never be exactly right. But some methods are better than others, and the evolution of the Air Force system shows increasing effectiveness over the years. The introduction of METRIC and related methods such as RBL gave Air Force supply a worldwide perspective, rather than a local one, and ensured the proper distribution of levels. The focus on meaningful measures like aircraft availability and expected back orders moved supply away from flawed measures like issue effectiveness/fill rate and oriented Air Force supply toward operational effectiveness. The optimization techniques introduced in the AAM and ASM enabled Air Force supply to determine the required support—explicitly based on operational requirements—at the least cost.

Much remains to be done. This article focuses on how the requirement system models the flow of parts and its effect on weapon systems. It is primarily a history of ideas. We have glossed over the many changes and improvements in Air Force logistics organization and processes over the years. But the Air Force must continue its efforts to improve the processes. Reductions in resupply time through improved information systems and business processes can dramatically reduce the cost of the requirement as well as the error of the requirement. (If the Air Force could drive response/resupply time to zero, the spares requirement would also go to zero.) The Air Force needs to remove the seams between retail and wholesale supply to ensure data and business rules are compatible throughout the system. While we have discussed primarily the materiel requirement—which parts, how many, where to stock—this needs to be translated into the right funding to get the materiel into the system. With the recent transition to working capital funds, this remains a difficult problem. The move to an expeditionary aerospace force will bring challenges in determining the proper level of support. The Air Force has already discovered that readiness kits designed to support major theater wars do not do well with the partial squadron deployments that are increasingly common.

We can expect technical improvements in computational methods as well. Recognizing that ASM/REALM do not portray strategic airlift operations as well as they do tactical deployments, LMI has recently developed new methods to size wartime spares requirements for the Air Mobility Command airlift fleet. Other challenges include how best to use the increasing amount of data that technology is making available, how to spare for the increasing number of highly reliable avionics, and how to make better use of advances in simulation technology. The story is far from over.

T. J. O'Malley is the program director for the Mathematical Modeling Group of the Logistics Management Institute.

AAF Supply exhibit at "Army Day"

1945

World War II ends.

"Inventory time"

1947

US Air Force established as a separate service.

AAF Supply Manual

1950

Korean Conflict begins. USAF Supply troops overcome F-86 external fuel tank shortage.

1954

IBM 858 cardatype machine tested at Lockbourne AFB.

1940s

1950s

USAF Supply

The First 20 Years...

1964

Sperry Rand
UNIVAC
1050-II installed
at Andrews AFB.

1961

Air Force
Logistics Command
created.

1965

Vietnam Conflict rages.
AFLC RASS teams attempt
to establish supply accounts
in Southeast Asia. POL
troops provide nonstop
flight-line support.

1960s

. . . till now

Supply files at Keesler AFB

1972-73

Bunko Ramo assumes maintenance contract of the UNIVAC 1050. Support suffers.

1979

JP-8 is developed; lower flashpoint makes it safer to work with.

1984

Sperry 1100 replaces 1050-II; Phase IV introduces COBOL to the Supply community.

1985

Cold War intensifies; AF/IL designates 1985 as "Year of Supply"; Blue 2 created.

1970s

1980s

1991

Operation Desert Storm begins. Contingency Supply Squadron supports deployed unit. Afterwards, Operations Southern and Northern Watch remain ongoing missions.

1998

Plans begin for development of ILS-S, tech refresh of SBSS.

2000

All MAJCOM RSS now fully operational.

1988

Sperry 2200 replaces 1100/60; brings personal computing to base supply.

1998

Operation Noble Anvil commences over Kosovo. Intense aerial operations demand top-notch supply and fuels support.

1998

Regional Supply Squadrons come online; base squadrons assume 3-flight structure.

1990s

The EAF & Supply

Randall King, PhD, LMI

Do you ever feel stuck in a rut? That the world around you is changing so fast you can't keep up? So it is with the Air Force supply community's ability to keep pace with rapidly changing concepts of operations. The Air Force is undergoing an organizational revolution. The end of the Cold War—combined with the experiences in the Gulf War and subsequent contingency operations, both in Southwest Asia and the Balkans—has motivated the Air Force to fundamentally change its deployment concepts. With our forces garrisoned, for the most part, in the continental United States and with threats scattered around the globe, we have replaced the Cold War-era concept of operations with forces reorganized into ten relatively small aerospace expeditionary forces (AEF). These ten identified AEFs, along with two aerospace expeditionary wings *on call* to support contingencies for 90-day periods, constitute the Expeditionary Aerospace Force (EAF).

The new operational concepts require updated support concepts. However, some of our support concepts are stuck in the Cold War rut. To support the operational changes, the Air Force has embarked on several initiatives. Programs originally known as *lean logistics,* now more fully developed as Agile Combat Support (ACS), have been designed to provide the kind of support AEF operations require. ACS exploits technological advances the private sector uses to reduce logistics response times and minimize inventory requirements, enabling quick reactions to the many uncertainties associated with contingency operations and customer wait times.

While ACS tenets outlined in AFI 10-400*, Aerospace Expeditionary Force Planning*, embrace concepts like *reachback*, reduced logistics *footprint*, and rapid and assured resupply, a closer inspection shows that some supply policies have been slow to react to the dynamics of force employments. Specifically, when we examine the methodology for computing the readiness spares packages (RSP), the deployable sets of reparable spares that accompany the fighting unit, very little has changed from old operations concepts. In fact, the only noticeable change is that the wartime tasking—as published in the *USAF War and Mobilization Plan*, Volume 5 (WMP-5)—was altered to reflect a two major regional contingency (MRC) scenario. One unfortunate consequence of this change was that aircraft availability goals used as target performance measures for RSPs *were lowered*, leading to kits that rely extensively on cannibalization actions and, in particular, do not provide adequate support to partial squadron units. Since partial squadron deployments are common in the AEFs, today's RSPs do not adequately support the EAF concept.

This article describes how we got to the current state of RSP computations, and inadequacies in the computations. It explains what steps the Air Force—under the leadership of the Director of Supply, Deputy Chief of Staff for Logistics (USAF/ILS)—is taking in the short term to remedy the problem. These include the authorization of contingency high-priority mission support kits (CHPMSK) to augment the current RSPs and a proposal to increase the aircraft availability goals

used in sizing the RSPs. Finally, it outlines some longer term approaches the Air Force is exploring.

A Brief Review of RSPs

The earliest kit computations were based on a simple computation of the number of expected breaks over the support period, where the support period referred to the length of time a kit was designed to be self-sufficient (usually 30 days). Under this methodology, an item with a projected daily demand rate of .1 would require .1 x 30 = 3 spares over a 30-day support period. (In reality, the daily demands are not constant, as demands are projected on the basis of sorties and flying hours, which may vary over the 30-day scenario.) This computation neither provided protection for demand variability nor produced output measures (for example, expected back orders, issue and stockage effectiveness, or aircraft availability) for assessing the *goodness* of the kit.

Since that time, we have introduced more operational measures of merit into kit computations and incorporated *marginal analysis* methods into the algorithms. Marginal analysis refers to a mathematical technique for optimizing system performance, subject to a resource constraint. The old D029 system was the first to use some form of marginal analysis for kit computations. While originally focused on projected back orders, it now uses aircraft availability goals explicitly as the measure of merit. In the mid-1980s, the Logistics Management Institute (LMI) developed the Aircraft Sustainability Model (ASM), based on mathematical foundations developed by the RAND Corporation and employed in RAND's Dyna-Multi-Echelon Technique for Reparable Item Control (METRIC) model. The ASM expanded Dyna-METRIC performance by providing the capability to trade off the investment in line replaceable units (LRU) versus shop replaceable units (SRU) and describe the optimal cost/availability relationship.

The ASM computes the least cost (measured in procurement costs) mix of spares to achieve the designated aircraft availability goals, officially known as Direct Support Objective (DSO). The DSOs represent the target number of fully mission capable-supply aircraft—sometimes presented as a percent of the unit and sometimes as the equivalent number of aircraft not mission capable-supply (NMCS). The DSO for strategic airlift is currently 91 percent; for bombers and most other nontactical aircraft, the goal is 83 percent. For fighters,

$$\textbf{DSO} = \frac{Sortie\ Rate \times PAA}{Max\ Turn\ Rate} + \textbf{(spare aircraft)}$$

the DSOs are computed from the WMP-5 planning factors.
Where the number of spare aircraft is based on a table look-up (1 spare for 12 or 18 PAA, 2 for 24 PAA, and so forth).

Air Force requires the DSO for fighters to remain at more than 63 percent. Therefore, the precise value of the DSO is the larger of the above calculation and 63 percent. This formula permits DSOs to vary over the 30-day scenario to reflect the changing sortie profile. When the ASM was implemented in the Weapon System Management Information System (WSMIS), the policy was changed to reflect *dual* DSOs corresponding to the surge and sustainment periods of the WMP-5 tasking for fighters.

When the DSO formula was first implemented, the WMP-5 still contained Cold War scenarios. For example, the DSOs for a 24-PAA squadron of F-15E aircraft were 81 percent for the surge period and 75 percent for the sustainment period. For the F-16C, the DSOs were 93

percent and 63 percent, respectively. In this case, the spares needed to achieve the high-surge DSO actually caused the availability on Day 30 (the last day that the kit is expected to support by itself) to exceed the 63 percent minimum value. The DSOs originally computed with this formula were *reasonable* in practice and provided acceptable support to Air Force operations.

In addition to the changes brought about by the implementation of dual DSOs for fighters, cannibalization was incorporated into the computation. Specifically, the allowed NMCS aircraft implied by the DSO were considered available for cannibalization, and the kit computation took this into account. For certain items that are flagged as *hard to cann* (based on policy published in Air Force Manual 67-1, *USAF Supply Manual*, Volume 1, Part 1, Chapter 14), the flag only serves to establish a minimum kit quantity equal to the pipeline (expected demand) value. All parts, regardless of the flag value, are treated as *cannibalizible* for purposes of marginal analysis.

Current Kit Policy

Changes to the WMP-5 following Operation Desert Storm included fighter support reflecting two MRCs. Fighters generally fly fewer sorties, but for longer durations. As a consequence, the above formula resulted in lower DSOs because the numerator was reduced more than the maximum sortie rate used in the denominator. The typical DSOs for fighter units today are mostly at the 63 percent minimum allowed for sustainment periods and range from the high 60s to low 80s for surges. As a result, 20 to 30 percent of the aircraft are presumed to be available for cannibalization within the first days of the conflict.

Kit computations are determined by:

- Specified support period (usually 30 days).
- Scenarios (sorties and durations) as published in WMP-5.
- Direct Support Objectives published in WMP-5.
- Maintenance concepts, selected items designated as remove, repair, replace (RRR) when repair capability is deployed with the unit. Most items are designated RR (remove and replace—no repair capability).

The ASM then uses the item-specific factors (demand rates, repair times, and so forth) to build the least cost (measured in procurement dollars) mix of spares to achieve the given DSOs throughout the support period.

Problems with Current Kits

The ASM, as incorporated into WSMIS, represents *state-of-the-art* inventory theory for computing kits in accordance with the specified policy parameters. However, some of these policies should be reviewed in light of the changing threat scenarios that have led to the establish EAF. For instance:

1. Validity of the WMP-5 scenario. Does the WMP-5 truly reflect the most likely kind of engagement?
2. Support period. Is it realistic to build kits to be largely self-sufficient for 30 days? ACS concepts call for rapid and time-definite resupply. Shouldn't these concepts be included in the kit computation?
3. Maintenance concepts. ACS calls for rapid deployment, which, in turn, argues for a light footprint. This calls into question the wisdom of deploying maintenance to accompany the fighting unit. Converting from RRR to RR can be expensive, however, as it increases the pipeline. Therefore, there is a need for expensive LRUs that were previously repaired under the RRR concept. Part of this cost could be offset by regional maintenance concepts, such as those suggested by RAND (*Supporting Expeditionary Aerospace Forces: An*

Integrated Strategic Agile Combat Support Planning Framework, Tripp, Galway, Killingsworth, Peltz, Ramey, and Drew, The RAND Corp, 1999).

4. Cannibalization assumptions. The combination of a cannibalization policy and relatively low DSOs leads to unrealistic demands on maintenance to perform the number of cannibalization actions implied by the kit computation.
5. Kits built to support full squadrons often cannot meet the tasking associated with a partial squadron deployment. This happens because of the reliance on cannibalizations that may not be possible if some aircraft are left at home station.

Let's illustrate some of these problems with some analysis of a particular (but representative) kit—built to support a 24-PAA F-15E unit.

Table 1 shows the makeup of a 24-PAA F-15E kit. *Range* refers to the number of national stock numbers (NSN) with an authorized quantity, while *depth* is the sum total of the quantities. *NOP* items represent *nonoptimized* items—parts whose failure characteristics are not related to flying hours. Wheels and tires, electronic countermeasures, and gun parts generally fall into this category. NOP parts are computed using procedures outside the ASM and maintained in the RSP database.

Note that of 205 candidate NSNs, only 78 computed positive quantities for a total depth of 373 units of stock. Most of the NSNs are not stocked. This is a direct result of the 68 percent surge and 63 percent sustained DSO goals. A part that has three or fewer demands over the 30-day support period can usually be *sourced* from one of the allowed *cann birds*.

Similarly, we only took 2 of the 21 candidate RRR LRUs.

Figure 1 shows an evaluation of this kit over the 30-day scenario. We are assessing a full kit in this depiction. In other words, this graph shows the aircraft availability over the 30-day period that will result if everything goes *according to plan*. These availabilities are projected based on the planned rules of engagement—no resupply for 30 days, flying precisely the WMP-5 scenario and so forth. We achieve 63 percent availability on day 30, for example, precisely because that is the goal. We have a significant number of aircraft down by day 15 and could do better than this depiction by relying on resupply. However, as shown, the kit is self-sufficient, so there is no resupply other than the repair capability for the selected RRR items.

Figure 2 shows the expected back orders, or LRU mission capables (MICAP), that are projected to occur given a full kit. On day 30, for example, we expect to have more than 430 MICAPs consolidated into six or seven aircraft, so that we have 63 percent (the DSO goal) of the jets in flyable condition. Remember that 63 percent aircraft availability and a liberal application of cannibalization are built into the RSP methodology. If the kits are resourced to 100 percent (they often are not), current Air Force policy imposes a

Today's kits are inadequate for supporting the partial squadron deployments as required under EAF taskings.

Category	Candidate NSNs	Range	Depth	Cost ($M)
RR LRUs	205	78	373	16.0
RRR LRUs	21	2	2	0.3
SRUs	141	48	118	1.8
NOP	98	61	127	6.2
Total	465	189	620	24.3

Table 1. 24-PAA F-15E RSP: Typical Makeup
DSOs = 68 percent surge, 63 percent sustain

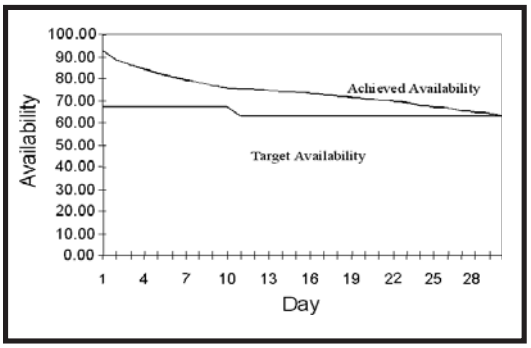


Figure 1. Assessment of Standard Kit

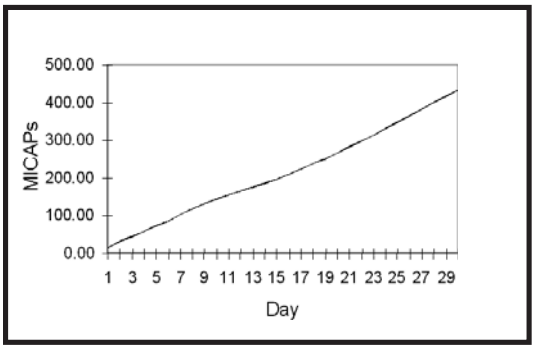


Figure 2. MICAPs on 24-PAA Squadron

significant cannibalization workload on maintenance.

Figures 3 and 4 show the aircraft availability and MICAPs, respectively, if the entire kit designed to support 24 aircraft is deployed with only 12 aircraft. In this scenario, the flying hours and sorties are 50 percent of the values used in the original kit computation. Aircraft availability for the 12 PAA is seriously impaired (below 75 percent) even if the RRR capability is deployed. How can this be? Remember, this assessment is predicated on flying half the sorties the kit was originally designed to support. This counterintuitive result arises because we don't deploy with the number of *cann birds* that were originally assumed. If maintenance is not deployed, the results are truly abysmal. MICAPs on day 30 total 156 even in the presence of RRR maintenance (there are 177 MICAPs without).

In summary, today's kits are inadequate for supporting the partial squadron deployments required under AEF taskings. Actual Air Force experiences with these deployments confirm an excessive reliance on cannibalizations.

Short-Term Remedies

How is the Air Force coping with actual contingencies? Individual major commands (MAJCOM) have been authorized CHPMSKs to support specific contingency scenarios. Specifically, CHPMSKs can be built to meet specific operating tempo and DSO goals. The CHPMSK is meant to be an additive (over and above) requirement to the deploying unit's existing RSP. However, since the CHPMSK requirement is not incorporated into the Air Force's total spares requirement, individual CHPMSK authorizations are *sourced* from existing peacetime replenishment stock. The readiness-based leveling (D035E) system is actually used to honor the CHPMSK *off the top* and to reallocate any remaining shortfalls in a way that minimizes bases total expected back orders.

While some would argue that the very existence of CHPMSK is conclusive evidence of the inadequacy of the RSPs, in reality, there will always be circumstances where the actual contingency is different from the plan. We need to support the warfighter even if the war is not fought in accordance with WMP-5. But we must do a better job of standardizing the process. For example, there are no standard tools in place for the MAJCOMs to use in building CHPMSKs. The Dyna-METRIC Microcomputer Assessment System (DMAS) has some capability for

computing kits. DMAS, in fact, contains a version of the ASM, the model that is used to compute today's RSPs. However, the DMAS interfaces do not permit a full range of computational capability. For instance, it is not possible to compute kits that incorporate resupply. Moreover, the individual parameter settings (sortie profile, DSOs, maintenance concepts) are left to the discretion of the MAJCOM, without knowledge of the support implications for nonengaged units. These shortcomings are well known and are being worked by the Air Force Supply Wartime Policy Working Group, which has the responsibility for formulating and advocating changes to the policy for computing RSPs.

The Air Force has also approved increases in the DSO floors for fighter units. Analysis conducted by LMI shows that these increases, and kits to support them, will enable better partial squadron support and mitigate cannibalization requirements. The F-15E kit referenced earlier will increase in cost from $24.3M to $47M. This would result in a range of 297 NSNs (from 189) and a depth of 921 units (from 620). But this kit would, in support of a 12-PAA deployment, achieve a 74 percent availability on day 30 (compared to the current value of 57 percent). However, the necessary funding ($109M for new procurements and repairs of existing assets) has been incorporated into out-year (fiscal year 2002 through 2004) funding. Therefore, it will be some time before the fielded kits reflect the higher DSO goals.

Longer Term Approaches

Under the sponsorship of USAF/ILS, LMI has developed some alternative strategies and enhanced computational methods for implementing those strategies. The basic idea is to get away from the self-sufficiency aspects of today's kits (which may have been appropriate for Cold War scenarios but are no longer valid) and build the kit requirements at forward operating locations (FOL) with a forward support location (FSL) as the resupply source. Essentially, this piggybacks on published research cited above by the RAND Corporation, which argues for a regional repair concept. The FSL that provides the maintenance function could, under our proposal, also serve as the resupply hub to the FOLs. The spares needed at the FSL—consisting of both SRUs and repair parts necessary to repair LRUs, together with the spare LRUs needed to resupply the engaged units, could be computed as a separate kit. We have designated this the

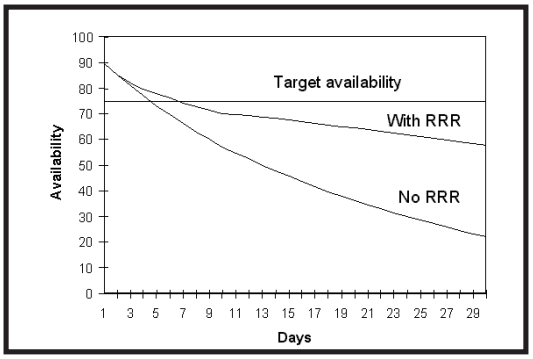


Figure 3. Standard 24-PAA Kit Assessed Against 12-PAA AEF Scenario

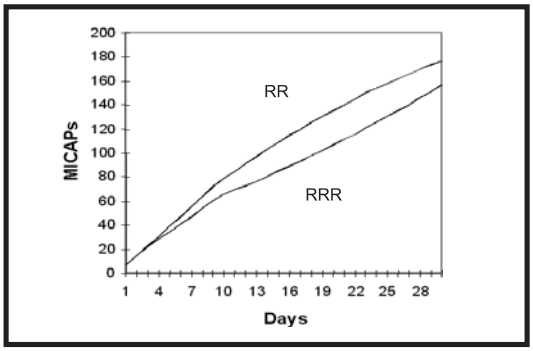


Figure 4. Standard 24-PAA Kit Assessed Against 12-PAA AEF Scenario

Consolidated Support Package (CSP)—a kit meant to support multiple units engaged in the same theater.

However, there are other, as yet, unresolved issues related to the proposed CSP. Who would *own* it and be responsible for maintaining its capability? Unit assessments would become more complicated by the need to assess not just the unit's RSP but the CSP assets as well. Because the CSP supports multiple units, this implies the necessity to do theater rather than unit assessments. Whether or not the CSP concept is feasible or even necessary, it is important to recognize the consequences of simply reducing the support period. If the forward stocks are reduced to encompass some feasible resupply time (7 days or less, for instance), there is the need for *serviceable* spares at the source of resupply. Essentially, reducing the support period just moves the requirement for spare parts from the forward locations to the resupply point. While there may be some efficiencies, there is no free lunch.

Summary

The Expeditionary Aerospace Force is *moving out* (literally) like never before, supporting a variety of contingency missions throughout the world, under rapidly evolving deployment concepts. The policies, procedures, and analysis tools needed to support the forces operating under these conditions must also move out. The Air Force does not need to replace a rigid set of logistics support assumptions (30-day self-sufficiency, prespecified operating tempos, and the like) with another set of equally rigid policies. What is needed, is a flexible set of policies, procedures, and computational tools for building spares support that mirrors the flexible and uncertain rules of engagement for the EAF. Specifically, the Air Force needs tools that will both build and assess kits against multiple scenarios that may be different from the officially sanctioned war plans.

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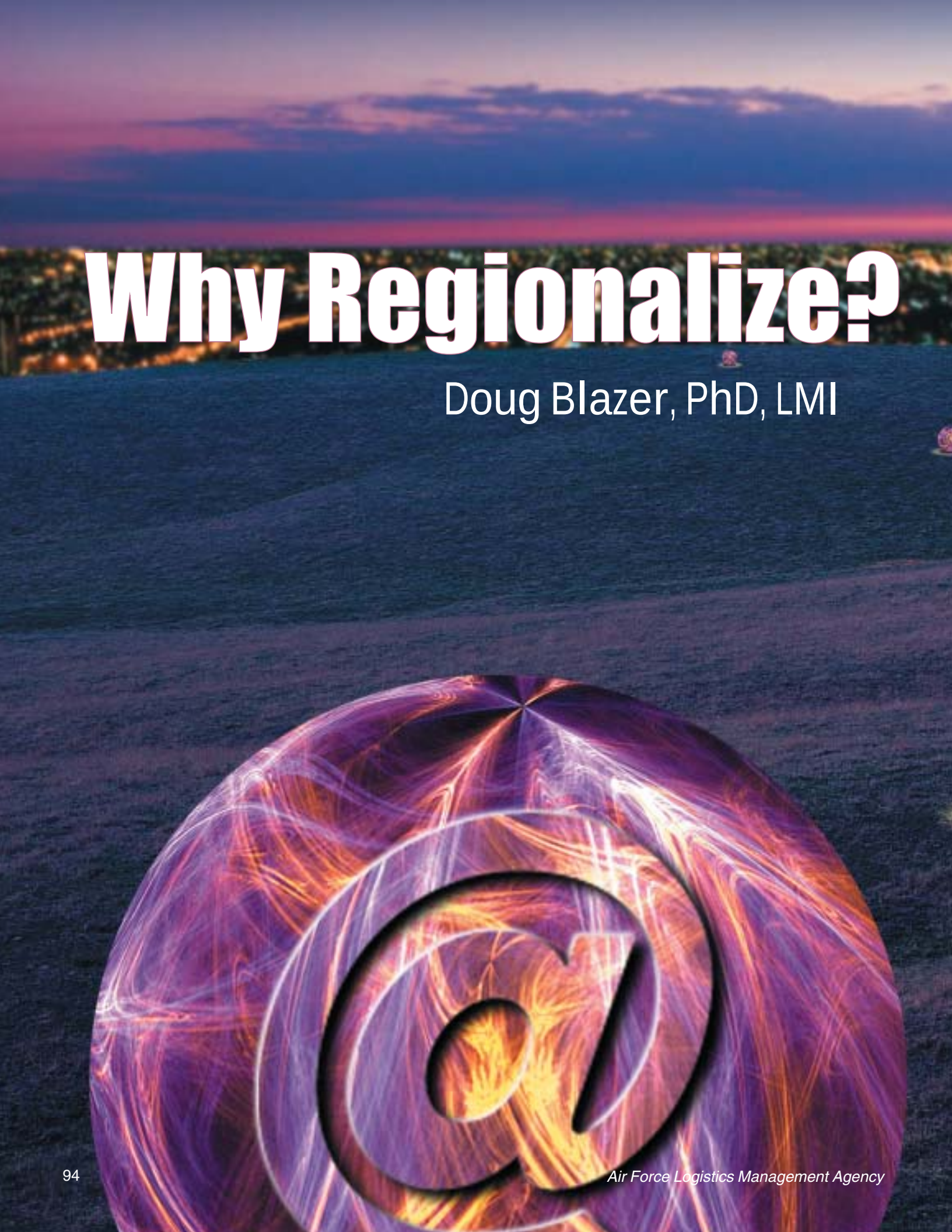
Why Regionalize?

Doug Blazer, PhD, LMI



the concept behind and development of the Regional Supply Squadron

Have you ever heard the phrase "operate in peace as you're going to operate in war"? That saying used to mean developing wartime procedures that are the same as those used in everyday operations. Air Force supply leaders have historically been perplexed by supply support during a war or conflict. The Air Force supply system relies on automation—specifically the Standard Base Supply System (SBSS)—to operate effectively for any length of time.

In the old days, supply had a variety of computers (U1050-II) that could be packed up and shipped to a contingency. But that was a cumbersome process. It took weeks (even months) for the computers to become operational in a deployed environment. Then the Air Force built a contingency supply system (CSS)—a scaled-down version of the SBSS that worked on a smaller, more mobile computer. But the more mobile system was too scaled down. For example, it did not requisition to the source of supply. So for many years the Air Force relied on post-post (mostly manual) operations at the contingency site and sent the transactions back to the home base SBSS via mail, phone line, or satellite.

None of these systems was very effective. The Air Force *made do* but needed a better way. Then came Operation Desert Storm, and necessity became the mother of invention. The Air Combat Command (ACC) developed the USAF Contingency Supply System Activity (AFCSSA)—a centralized supply activity that provided supply support to the troops in the desert. For those troops, it was like having an SBSS on site, but the central computer was at Langley AFB. AFCSSA not only provided automated supply support but also performed the *back-shop* supply functions. That reduced the number of individuals needed to deploy and established a supply operation immediately. *The AFCSSA allowed the Air Force to operate a supply system from long distances and reduce the number of people that had to be on site.*

So operating in war as in peace took on a new meaning. Why couldn't the peacetime bases operate like the Desert Storm bases? ACC asked that question, and established the first regional supply squadron (RSS). The United States Air Forces in Europe, the Pacific Air Forces, and Air Mobility Command have also decided to create regional squadrons for their bases. And there is talk of Space Command creating an RSS.

The RSS Concept

So what is an RSS? The RSS is a supply squadron that centralizes the back-shop supply functions for its supported units. The back shop functions include computer support, stock control MICAP management, equipment management, procedures and analysis, and wartime assessments. The supported units are the peacetime and contingency bases (with pre-established accounts even where there is no base) within the major command. The supported units' supply functions include the physical movement of property (warehouse, delivery, receiving, and fuels), local purchase, customer liaison, and base level research.

The Air Force is in the process of adopting a standardized RSS concept of operations for the four current regional squadrons. It is important that each of the squadrons operate similarly so supply personnel can move from one RSS to another and from one base to another and not have to *relearn* the Air Force supply sytem. Figure 1 shows the currently proposed organizational structure for an RSS.

The RSS provides both peacetime and wartime support. The RSS will provide logistics data to the Air Force Forces (AFFOR) commander. Figure 2 shows a schematic of the lines of communication for the RSS and how the RSS can provide logistics

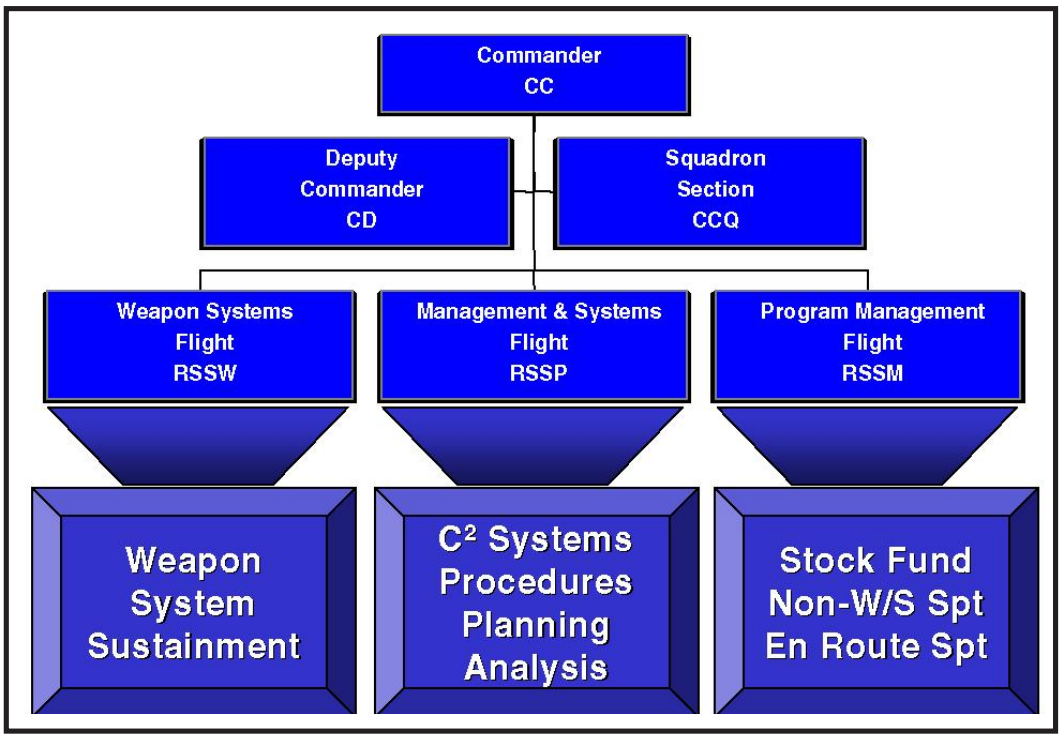


Figure 1. RSS Organizational Structure

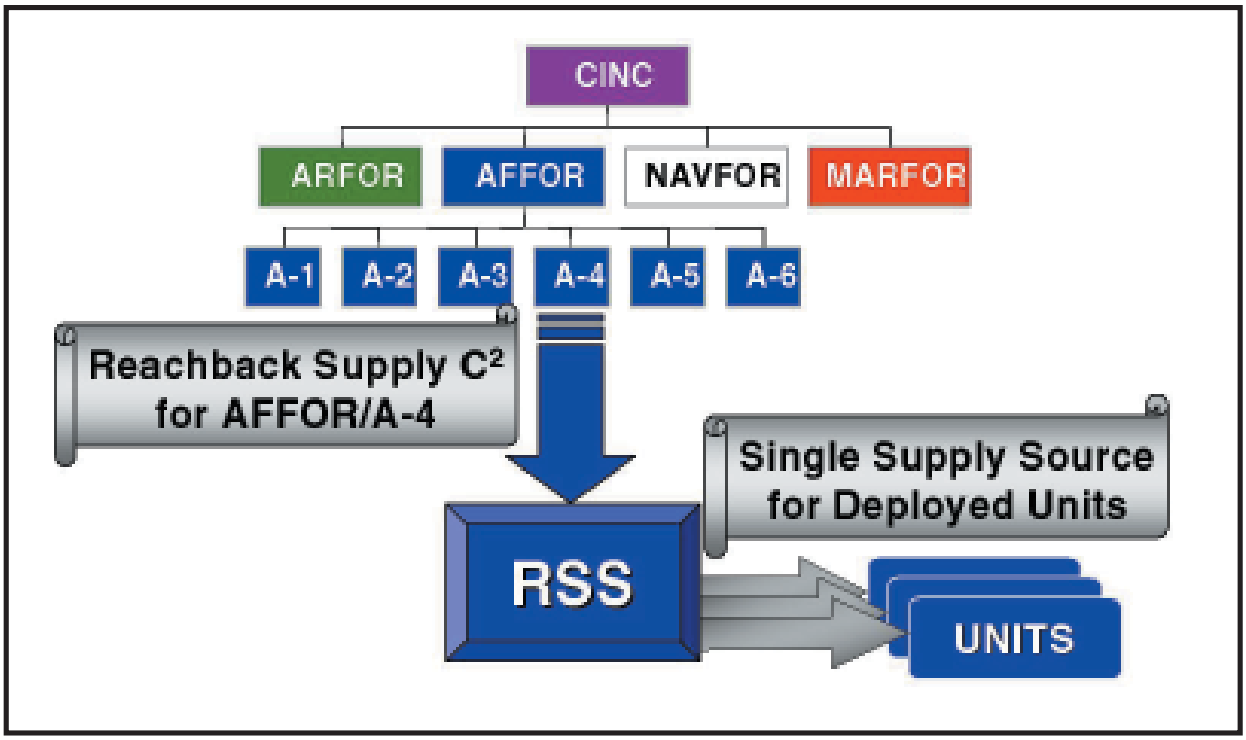


Figure 2. RSS Lines of Communication

command and control for the theater commander in chief (CINC).

The current RSS relationship to the theater CINCs is provided above.

RSS Benefits

The Air Force has realized significant benefits already and there will be more to come as it realizes the full potential of centralized retail supply management. The RSS has eliminated 570 manpower positions—that's a reduction of $25M a year in manpower cost. It means a smaller wartime footprint—less people in harm's way at the contingency site. The RSS has improved wartime support by reducing the time it takes to order and receive critical spare parts. The RSS also provides command and control of assets in theater.

The RSS is just beginning to scratch the surface of benefits from centralized management of supply. The RSS has weapon system managers for the whole command or theater rather than by base, so the RSS can direct the lateral movement of spares to increase the fleet mission capable (MC) rates. And the RSS manages the stock fund by major command rather than by base. So maldistributed stock fund monies can be easily transferred to where the need is more critical.

The four current regional squadrons are very concerned about customer support and perception. The regional squadrons strive to ensure the customers continue to receive the same human interface they have grown accustomed to at the base level. They collect a myriad of performance measures to ensure no decline to support caused by centralized management. So far, all of the metrics have been steady or improving as a result of implementing the RSS. It appears supply can do more with less—at least with the RSS.

Summary

The RSS is an already proven concept. It was the key to supply support for Operation Desert Storm and the contingency operations during Kosovo. The RSS provides automated supply support nearly instantaneously in the world. The RSS allows the Air Force to truly operate the same in war as in peace and provides logistics command and control for contingency and wartime activities. The RSS is how the Air Force will fly, fight, and win in the new millennium.

Regionalization? Who's responsible for this?!

Colonel Jim Daup

When asked to write about the formation of the Regional Supply Squadron (RSS), I was pleased. I was there when it all came together—you might even blame me for it. I saw the RSS as the culmination of years of experience with an eye to the future—just the next step in the ongoing Air Force process of making things better. After all, change is part of our way of life, and this idea was part of my generation's legacy. The way I remember its beginning is like this.

When I arrived at Langley AFB, Colonel John "Gun" Gunselman challenged me to help him make the Air Combat Command (ACC) and Air Force supply better. At the same time, we were lucky enough to have Chief Master Sergeant Mark McLaughlin on the supply staff. Mark has an unusual ability to take a number of seemingly disparate ideas and see common threads. After many discussions of what didn't seem right, what might be, what should be, and what we'd do if it was up to us, Mark said, "It *is* up to us." Over the next few weeks Mark and I set out to describe our brave new world to Gun.

I believed then, as now, ideas are usually born of a synthesis of previous experiences and ideas, even great ideas, don't always receive a warm welcome when first proposed. The RSS idea was no different. Feeding on our experiences—good and bad— we designed our supply organization of the future.

For me, there were three defining experiences that persuaded me our idea was an important improvement over the current system. First, as a young lieutenant, I closed a MICAP section (without permission) and moved the effort into the more traditional stock control setting. While the experiment only lasted slightly more than 3 months, I could see no decrease in MICAP support and there appeared to be an improvement in overall wing support. I freely admit that I was unable to convince my boss (a good guy) that my idea had merit, so I did it his way.

Second, years later, I found myself in Korea. I hadn't been at base level for several years and had forgotten how some things really worked. I discovered that stock control— in many ways— the heart of a supply operation was having trouble because the leadership and many of the folks assigned had no experience or training to equip them for the task. MICAP was real busy because stock control was in trouble. We overcame and I was very proud of the folks, but I could see that it was much harder than it needed to be.

Finally when I arrived at Langley, the Contingency Support Squadron (CSS) was providing stock control and supply management support for forces remaining in the Southwest Asia theater in the aftermath of the desert conflict. In the early days of Desert Storm, it became clear that all the supply forces we planned to deploy couldn't be transported or supported in theater. A new way to manage supply support for deployed forces was needed, and Colonel Van McRay was there with an answer. The Contingency Support Squadron was born. By 1995, the use of CSS to support peacekeeping forces in places like Saudi Arabia and Kuwait was well established. The existence of CSS meant a reduced number of forces in theater.

Building on these ideas and focusing on using the least number of folks possible to do an effective and efficient job, we concentrated on moving electrons rather than people. Our initial presentation to Gun got us a, "Well that's certainly outside the box!" and the approval to take a briefing to the Air Force Supply Executive Board (AFSEB)—the major command directors of supply.

The AFSEB briefing was given, and the reaction was just as Gun had predicted. People saw it as a threat to each one's own separate kingdom. "Why would you centralize tasks and reduce squadron size? You are taking control away from the squadron, and we will lose people and grade structure." Though I argued that it was the only way to get the jump on the inevitable downsizing and it made the best use of limited funds, it fell on deaf ears (mostly). In hindsight, our timing couldn't have been much better. Downsizing was directed

just a few months later, Gun had moved to DC and was now the chief of Air Force Supply policies and procedures (AF/ILSP), and I was the ACC Chief of Supply. Suddenly, the idea was a little more tolerable to the rest of the Air Force, and we had a chance to make it work. Some still wanted to tell the bases to take a 25 percent cut and have a nice day without changing the way we do business. But clearly, that was not the right choice.

Armed now with a real problem that all could see (the mandated career-field reduction) and supported by AF/ILSP, we built our plans. The functions dealing with information were marked for movement to a central activity and for marriage with the existing CSS activity. The next AFSEB briefing gave ACC permission to proceed if we could get command support. We briefed the ACC Director of Logistics, and he approved taking the proposal to the commander of ACC (COMACC). COMACC saw the value of the idea, and the risks, and approved a test at Langley. The test proved very successful. It highlighted some complications and ways to address them and allowed the folks doing the job to write procedures with the real processes in hand. Given the successful test and our decision to proceed, COMACC approved the concept, gave us the go ahead, and introduced our initial briefing to the command's wing commanders.

Clearly, the personnel and organizational issues presented the biggest challenges. Deciding what to do was the easy part. Changing manpower documents was not easy, and changing the flow of folks into and out of a squadron was not as simple as we first thought. Addressing the fears caused by change; explaining to people that supply was still a career field; and designing software to standardize MICAP, stock fund, and stock control processes and procedures across the command were thought out, executed, evaluated, and modified as the need presented itself. It wasn't perfect, but it was effective. We significantly reduced manpower, improved responsiveness, reduced the number of supply people required to deploy, gave the command better access to and control of information so they could deal with suppliers more effectively, and provided all levels of command much better visibility into command or theater supply requirements and problems.

While I give Chief McLaughlin and Gun credit for the idea and encouragement, I would be remiss if I gave them all the credit. The idea is really the child of many people over many years. Selling it, working its implementation, and nurturing its growth are hundreds of people (inside RSS and out) dedicated to making the Air Force supply system truly world class. It would not have worked without all these folks. They made it a real success.

Col Daup (USAF Retired) was a career supply officer. He is still involved in the Air Force supply process as the F-22 Senior Manager, Supply Services, Lockheed-Martin Aero, Marietta, Georgia. He can be reached at daupy@email.com.

notable *quotes*

Tomorrow's warriors will have to relearn the things that today's warriors have forgotten.

General Billy Minter, USAF

A-76 & Outsourcing

HQ AETC/LGS

During the Cold War, support services were funded at higher levels than is possible today. With the fall of the Berlin Wall and the end of an important era in history, the mood of Congress and the country shifted toward a programmed reduction of the defense budget. The initial cuts in defense spending were focused on operational forces and new weapon systems. Support services spending did not fall at the same rate, so the logistics *tail* was disproportionately large for the operational *tooth.*

However, efforts over the past several years have been made to reduce support services spending in order to modernize the reduced force structure. Intense pressure has been placed on Air Force leadership to cut infrastructure costs and apply the savings to modernizing aging weapon systems and technology. One program for achieving these ends is outsourcing and privatization (O&P), also known as competitive sourcing and strategic sourcing. Support services, including supply, have been targeted for cost reductions through O&P.

Background

O&P has been identified as a key way to cut infrastructure costs. The A-76 study—an Office of Personnel Management program—is a highly defined process that identifies functional areas for possible outsourcing and provides a thorough comparison of the cost and value of outsourcing the functions or keeping them in house with a civilian work force. The O&P initiative is designed to:

- Free up resources (manpower authorizations and payroll),
- Take advantage of technology, innovation, and *best business* practices from the commercial sector, and
- Allow the Air Force to concentrate on its core competencies.

O&P is the cornerstone of the Air Force approach to implementing the best practices from industry. The A-76 process provides a vehicle for determining the best service provider, who can use those best business practices to lower costs and achieve savings.

Air Education and Training Command (AETC) supply is no stranger to O&P or the A-76 process and continues to play a major role in these streamlining initiatives. Within AETC, commercially contracted base supply activities have been operating at Vance, Sheppard, and Laughlin AFBs. Vance was originally outsourced in 1962, as part of a test with Craig AFB to determine whether outsourcing base operating support (BOS) was more cost effective than operating those functions in house. That comparison resulted in commercial contracts at those bases, and Vance has retained its *umbrella* BOS contract ever since. Sheppard AFB conducted an A-76 study and converted to contract operations in 1985. Goodfellow and Columbus AFBs also conducted A-76 studies, and their in-house government bids won designation as *most efficient organizations* (MEO), which have been operating at those bases for a number of years. So, award of the contract to provide support service can be made to either a contractor or an in-house, civil service work force. The outcome of the award depends on

which bid shows the best value to the government. Whether the award goes to a contractor or stays in house, the base benefits from the streamlined processes and lowered costs that the winning bid organization provides.

Discussion

The Department of Defense directed the Services to look at six support areas for possible outsourcing: base support, materiel management, depot maintenance, finance and accounting, education and training, and data centers. AETC considered base support functions, including supply, attractive candidates for outsourcing since they presented fewer risks and higher potential for cost savings than other candidate areas.

AETC's approach to outsourcing support functions involved *bundling* all of the candidate BOS functions on a given base into a single A-76 study, rather than having numerous individual studies underway at one time. The program was dubbed *Project Pick-a-Base*, and five AETC installations were selected to participate: Maxwell AFB, Lackland AFB, Randolph AFB, Keesler AFB, and Columbus AFB. Since O&P efforts have historically yielded 30 to 33 percent savings, AETC's Project Pick-a-Base is projected to provide savings of more than $52M annually and 5,400 manpower authorizations when all five studies are implemented.

Lessons Learned

Outsourcing has not been a bed of roses. There are both rewards and risks. On the plus side, outsourcing (including award to in-house government employees) can result in lower costs, improved performance, better focus on mission requirements, greater mid- to long-term flexibility, continuity, experience, and innovation. When contractors win the award, partnering with them to establish mutual respect and trust, ensure a long-term successful relationship, and involve them from the start are keys to giving them incentives to put their best practices into place for the best possible mission support.

The downsides to outsourcing include the potential for contractor failure to perform, sometimes with catastrophic results. The contract must clearly and adequately specify requirements and expectations, and the source selection authority must select a qualified service provider. The possibility exists for loss of real-time control of performance where commanders are used to being able to *reach out and touch*. Mission changes can affect workload, or the contractor may not meet Air Force expectations. It can be difficult to clearly specify requirements and expectations in contract documents—authors of those documents must be experienced functional area experts and able to express themselves clearly and completely.

In all likelihood, departing civilian and military members will have left holes in the organization that will disrupt daily operations. Those vacancies can also affect the quality of the A-76 process itself, as fewer people are left to carry on the everyday workload at the same time the A-76 workload (which can be tremendous) is at its heaviest and most critical point. Base officials should select their most qualified functional area people to develop performance requirements for the bid solicitations, to create the best possible, *most efficient organization* as the base's bid and to evaluate bids during the source selection phase. A lack of solid, core functional area knowledge can result in long-lasting contract performance problems. Personnel who participate in A-76 studies should receive appropriate training and support from their wings and be available throughout the entire process. This will ensure the MEO and potential contractors get a true picture of what is needed, how best to organize, and how to ensure true costs for the requirements are established.

When the new service provider takes over, whether contractor or MEO, planning and preparation on the base's part are critical for success. A transition plan is necessary, whether a contractor or an MEO wins the bid award. The plan must allow for sufficient overlap while the new service provider puts people and place in the new organization. Retaining the best people is difficult but essential to success.

Conclusion

Supply, as part of BOS, needs to change our traditional ways of thinking about the best ways to get the job done. We need to incorporate industry best practices. We must ensure contracts, when they are used, are written adequately from the start and develop metrics that reflect contract compliance and customer satisfaction. We must develop healthy relationships with contractors who take on the important job of supplying our customers. And we must fully understand the A-76 study and outsourcing processes to get the best value for the Air Force.

Supply Chain Management

How Business Gets Done

Wing Commander
Paul Thorogood (RAF)
AFMC/LGI

Air Force readiness has declined since the end of the Cold War, mainly as a result of a reprioritization of funding allocations by Congress in reaction to a national call for a *peace dividend*. During the Cold War, the Air Force logistics system was built on a philosophy of creating and prepositioning contingency stockpiles in Europe, which was possible given the relatively significant funding available. Defense funding has diminished with the end of the Cold war, bringing an era of uncertainty. Worldwide crises are now expected to develop quickly and without warning. Air Force Materiel Command (AFMC) must support an expeditionary aerospace force capable of deploying anywhere in the world within 48 hours and ready to fight within 72 hours. This radical change in customer requirements, along with reduced funding, has caused AFMC to revolutionize its strategy in support of the warfighter. It no longer manages support in a relatively stable *push for contingency* environment.The support environment is uncertain and variable. At the same time, the command has had to develop a more businesslike perspective in the way it consumes resources allocated under the Air Force Working Capital Fund concept. Previously, similar Air Force initiatives focused on reducing the logistics support pipeline. Accordingly, the Air Force has reduced the budget by $948M over a 3-year period in anticipation of process improvements that would reduce depot cycle times for reparable items. However, these improvements did not materialize.[1] Consequently, as the savings had already been spent, there was a need to focus on process improvements in an effort to improve the Air Force's operational readiness posture.

Figures 1 and 2 show how overall Air Force readiness has declined in the last 10 years.

While other agencies are also responsible for supporting Air Force readiness, AFMC's role of providing spares support to the warfighter is a major contributor to operational effectiveness. AFMC's leading indicators showed a similar decline up to the beginning of fiscal year 1998, which has led to a reduction in confidence by the Air Force acquisition community. This loss of confidence has ultimately led to an increase in contracting out supply support for new weapon systems.

AFMC Supply Chain Management

Accordingly, in early 1998, the AFMC commander directed the Logistics Directorate to implement a 5-year plan to significantly improve supply support to the

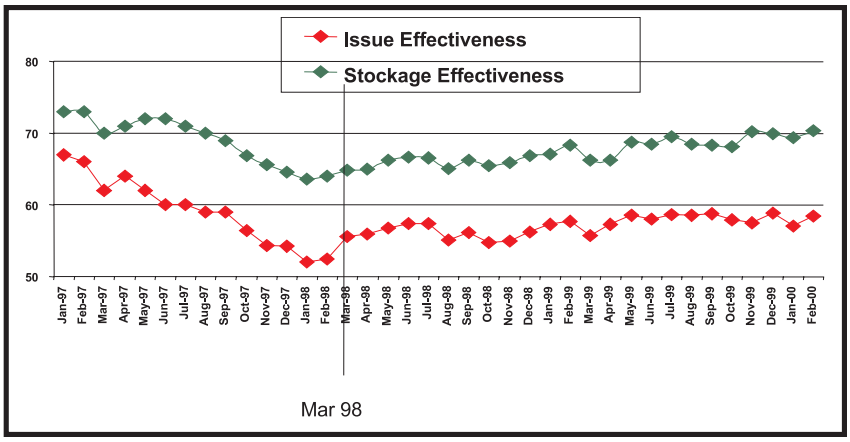


Figure 1. Issue and Stockage Effectiveness Indicators

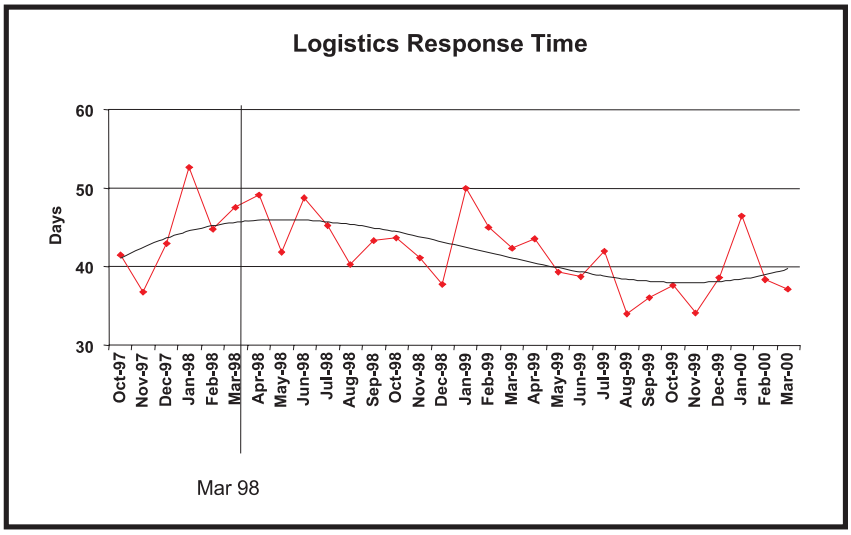


Figure 2. Logistics Response Time Indicators

. . . the Air Force logistics organization has developed along functional lines . . . by optimizing its own organizations, functional areas have tended to suboptimize the whole logistics chain.

warfighter and, as a minimum, achieve the following improvements in its leading mission-essential task (MET) indicators:

- Retail Stockage Effectiveness. Increase the percentage of time base supply is able to satisfy a requisition with stock off the shelf, *for items that have an authorized level*, to 80 percent by 2005. (March 1998 performance was 64.8 percent and showed a downward trend.)
- Retail Issue Effectiveness. Increase, the percentage of time base supply is able to satisfy a requisition with stock off the shelf, *regardless of stock level authorizations*, to 70 percent by 2005. (March 1998 performance was 55.5 percent and showed a downward trend.)
- Logistics Response Time. Decrease the *overall average* time it takes AFMC to satisfy base requisitions *that have been back ordered to the depots* to an overall average of 20 days. (March 1998 performance was 47.5 days and heading in the wrong direction.)
- Back Orders. Show a continuous reduction in retail back orders. (In December 1998, retail back orders stood at 615,000 and were heading in the wrong direction.)

When viewed as a whole, the Air Force logistics organization has developed along functional lines, such as acquisition, supply,

maintenance, transportation, information technology, contracting, and others. By optimizing their individual organizations, functional areas have tended to suboptimize the whole logistics chain; evidence of fragmentation becomes more acute the further one looks down the command chain. Being so subdivided, the whole logistics chain tends to lose sight of customer requirements—the warfighter, for the Air Force. Business schools worldwide now advocate the application of supply chain management (SCM) as a proven method of focusing on customer needs. Processes that lead to the satisfaction of these requirements are traced back through the logistics support chain—to the supplier of raw materiel if necessary. These processes are then modified across the traditional functional *stovepipes,* where necessary, to the benefit of the whole supply chain and to ensure best practice and direct flow of supplies through the chain. Key enablers to this are ready access to information by all; the velocity of reparable, manufactured, and purchased items through the chain; and the holistic application of financial resources. Commercial organizations have benefited enormously from applying these principles, and both the AFMC commander and the Logistics Directorate directed the 5-year AFMC improvement plan to follow SCM principles to solve its supply support problems and regain the confidence of both the warfighter and the Air Force acquisition community. The AFMC definition of SCM is *the integration of key business processes that support the flow of products, information, and money from point of origin to point of use and return when warranted.* The SCM program plans can be found at www.scm.wpafb.af.mil. These plans detail how AFMC will evolve from a functional to a more process- and customer-oriented support organization over the next 5 years.

A team with a wide breadth of logistics knowledge and experience, coupled with process integration experience, was needed. Thus, members of the AFMC Materiel Management Division were brought together to form the SCM team. Initially, from early 1998 to July 1999, this small team operated as an integrated process team, drawing from personnel assigned to established branches across the Materiel Management Division, and improvement initiatives were apportioned along informal lines. However, in July 1999, the Logistics Directorate recognized the need to formally establish an SCM and Analysis Branch under the Logistics Directorate. In September 1999, overall direction of the SCM team passed to the AFMC Deputy Director for Supply Management.

Root Cause Identification and Analysis

Key to the success of the AFMC SCM improvement process is the identification and apportionment of responsibility to some 30 supply chain managers. These individuals—colonels, or GS-15s/senior service executives at the air logistic centers (ALC) and product centers—are now personally responsible for ensuring the items allocated to them are provided to the warfighter when and where required. However, in most cases, the functions, disciplines, and personnel required to do this do not fall under the direct control of the SCM, since the items are subdivided along product lines. Nevertheless, these individuals are required to take a broad view across the overall supply chain and use Service-level agreements, personal qualities, and innovative thinking to overcome difficulties. This required a radical change in thinking at the ALCs. However, by apportioning overall responsibility to the AFMC SCMs for the provision of allocated national stock numbers (NSNs) to the warfighter, regardless of

command and control considerations and without deference to traditional functional divisions of responsibilities, AFMC has created a single point of contact for the customer on all matters concerning individual NSNs. SCMs are now responsible for setting prices for products under the Air Force Working Capital Fund; establishing robust, competitive contracts with commercial and government suppliers; and understanding constraints that inhibit the optimum rate of flow of products through the AFMC supply chain to the customer. In many cases, SCMs will be confounded by deep-seated constraints that inhibit optimum support and must resolve issues, if possible, or raise them through the chain of command to a level where they can be satisfied.

AFMC recognized its customers were not prepared to wait 5 years to see tangible improvements in support. Furthermore, changing the culture of such a large organization as AFMC would require early evidence of the ability to achieve and maintain momentum. Moreover, it was recognized that it would take some time before SCMs would be in a position to properly analyze root causes and take corrective action to resolve or alleviate constraints. Therefore, to *kick start* the AFMC SCM program and ensure momentum was achieved and maintained, AFMC established the SCM Constraints Analysis Program (CAP). A readiness-based methodology was developed to identify major cross-functional constraints that inhibit the AFMC supply chain. Once constraints are identified, an in-depth analysis is conducted to identify the root cause and effect. Solutions are developed in conjunction with the SCMs and key cross-functional agencies to ameliorate the effect on the supply chain and, thus, improve support. Six constraint areas were identified and validated by the AFMC commander in September 1999.

In December 1998, back orders for AFMC-managed parts stood at more than 615,000, were escalating at an alarming rate, and showed no indication of reversing.

- Consumable support to the AFMC repair lines
- Component reliability sustainment
- Supplier management
- Inventory management
- Workload planning for the depot repair lines
- Due-in from maintenance policy creating misplacement of reparable carcasses in the logistics pipeline

Communication

Detailed change management and communication management plans have been written and serve as AFMC's roadmap to communicating SCM implementation progress regularly to the stakeholders. These plans outline numerous forums and communication mediums used to communicate SCM implementation progress. Examples include:

- A video by General George T. Babbitt, shown throughout the command, talking about the imperative for change and the importance of the SCM program to AFMC. An SCM article in the *Leading Edge* by Brigadier General Stanley A. Sieg and General Babbitt.
- Three SCM conferences where the SCMs and other key stakeholders meet to review progress.
- An educational SCM seminar, held in December 1999, which introduced SCMs to the analysis tools and educated them on how to use them.
- An SCM information web site (www.SCM.wpafb.af.mil), which provides up-to-date information on the AFMC SCM program

In addition, the AFMC SCM branch has maintained a very close working relationship with the Air Force Logistics Transformation Team, formed in March 1999, to ensure that both programs are vectored in the same, overall direction.

SCM Customer Support Metrics

AFMC has developed, from scratch, or modified available data capture and analysis tools that allow the SCMs to understand the drivers affecting AFMC's leading supply support MET indicators: issue effectiveness, stockage effectiveness, logistics response time, and back orders.

Issue and Stockage Effectiveness. Prior to development of the issue and stockage effectiveness tool, it was only possible to show performance against this metric at the aggregate level. SCMs could not identify the drivers that were affecting their overall performance because the Standard Base Supply System did not extract the relevant data in its monthly M32 report. With the assistance of the Air Force Logistics Management Agency, this data is now extracted and placed in a user-friendly database that allows analysis of issue effectiveness (IE) and stock effectiveness (SE) at the lowest required level. Currently, SCMs have historical NSN-level information that goes back 2 years, allowing them to isolate bad actor NSNs so the root cause of poor performance can be researched. This tool is web-enabled and can be accessed via the Internet at http://scm.wpafb.af.mil.

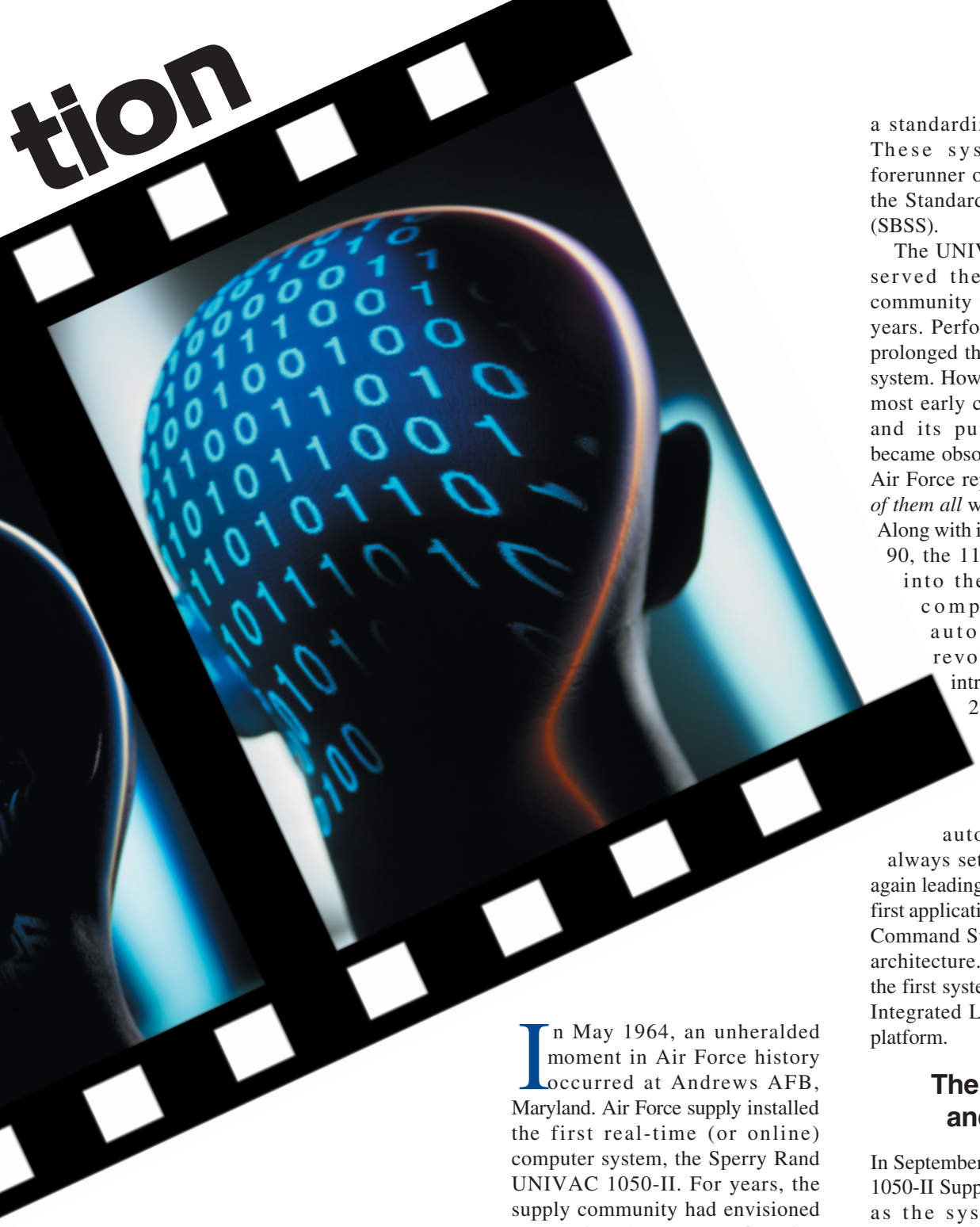
Logistics Response Time (LRT). The LRT metric is subdivided into four segments. Segment 2, which measures the average time taken by the depots to satisfy a back-ordered base requisition either off the depot shelf or by repairing an unserviceable carcass, accounts for the vast majority of the average LRT time. Consequently, by focusing on this segment and implementing process improvements that will reduce the cycle time of reparables, AFMC will be able to realize the $984M that has already been taken from the SMBA budget. Consequently, LRT is the key indicator for ensuring AFMC realizes the savings that have already been taken and more. Again, prior to the development of the LRT database, it was not possible to show LRT by NSN or SCM. The AFMC Studies and Analysis Office had already developed the LRT tool that drew data from the Logistics Metric Analysis Reporting System and could show NSN-level performance. Responsibility for this tool has passed to the AFMC SCM branch, which has modified the tool to allow stratification of reports by NSN, SCM, and ALC. The LRT query database can be accessed via the AFMC SCM web site at http://scm.wpafb.af.mil/.

Back Orders. A prime function of the SCMs is to minimize the number of back-ordered requisitions that pass from the base retail outlets to the source of supply depots. SCMs are to manage variability as much as possible by ensuring sufficient stocks remain in the logistics pipeline, or supply chain, to satisfy forecasted requirement levels at the base, thus improving IE and SE performance. However, once a requirement is back ordered to the source of supply, the SCMs must react quickly to satisfy the outstanding demand (measured by the LRT metric). In December 1998, back orders for AFMC-managed parts stood at more than 615,000, were escalating at an alarming rate, and showed no indication of reversing. Moreover, an analysis capability did not exist to allow SCMs and senior management to understand underlying trends and root causes of poor performance. As a result, the AFMC commander directed the SCM branch to use data-mining techniques on legacy requirements systems, where possible, to analyze the constraints that were driving poor performance. By March 2000, the back-order total stood at 295,000 and showed an increasingly positive downward trend. The SCM branch has developed a back-order analysis tool that provides NSN-level

(Continued on page 160)

CMSgt(S) Steve Sargent, SSG

The Computer Evolu



In May 1964, an unheralded moment in Air Force history occurred at Andrews AFB, Maryland. Air Force supply installed the first real-time (or online) computer system, the Sperry Rand UNIVAC 1050-II. For years, the supply community had envisioned automating the process of getting the right part, in the right quantities, to the right place at the right time. Major commands had even attempted to automate on their own, using systems such as the IBM 305 RAMAC, the General Electric 225, and the IBM 401. These early attempts at automation were costly, and training individuals to work them bordered on nightmarish. However, the efforts of the major commands highlighted the need for a standardized automation tool. These systems became the forerunner of what would become the Standard Base Supply System (SBSS).

The UNIVAC installed in 1964 served the Air Force supply community well for more than 20 years. Performance enhancements prolonged the life of this venerable system. However, as was the fate of most early computers, the 1050-II and its punchcard technology became obsolete. In April 1984, the Air Force replaced the *granddaddy of them all* with the Sperry 1100/60. Along with its big brother, the 1100/90, the 1100/60 kicked supply into the rapidly developing computer age. Supply automation was again revolutionized with the introduction of the Sperry 2200. This system brought the personal computer into daily supply operations. In terms of logistics automation, supply has always set the pace and is once again leading the way to become the first application placed on the Global Command Support System (GCSS) architecture. In addition, supply is the first system developed under the Integrated Logistics System (ILS) platform.

The Early Days and Vietnam

In September 1963, the Sperry Rand 1050-II Supply System was selected as the system of choice and installed at Bolling AFB, Washington DC, for design and development. A mere 8 months later, testing and validation began at Andrews AFB. In June 1965, the Air Force began a 2-year project, converting 133 bases to the SBSS. Richards-Gebaur AFB, Missouri, holds the title as the first operational base to receive the new SBSS 1050-II, but the true operational test was a baptism by fire during the Vietnam conflict.

Though the computer system was still in its infancy, Air Force leaders elected to deploy the 1050-II in support of Southeast Asia. From September 1966 to June 1967, the Air Force delivered, installed, and began supporting activities in a wartime environment using the 1050-II. A truly notable accomplishment of the SBSS during the conflict occurred in February 1968 when an F-4 warehouse was totally destroyed during the Vietcong Tet Offensive. Logistics history was made, with help from the UNIVAC 1050-II, when 78 percent of the items were reconstituted with shipments from the United States within 5 days. Experience gained from Southeast Asia confirmed the need for quick replacement of computers and computer facilities located in war zones.

Another byproduct of the conflict was the development of the first-ever deployable supply system, nicknamed the *penny-counter*. In essence, these systems comprised an entire 1050-II computer laboratory installed in semitrailers with mobility to replace destroyed accounts onsite or provide support to bare-base operations. The first penny-counter made by the Sperry Corporation was delivered to Clark Air Base, Philippines, in 1968, and because of its success, two additional systems were soon added. In retrospect, it is hard to envision the monstrous hardware required to run the SBSS. An entire work center existed for the sole purpose of interacting with the 1050-II through the use of IBM punchcards. It took a full crew of supply systems analysts to maintain it.

The Sperry UNIVAC 1050-II has a special place in the history books but will most likely be remembered for the distinct sound emitted from its Teletype remote terminals. The familiar *tick-tick-ticking* let users know the machine was up and polling, ready to receive the next transaction.

The Sperry 1100/60

The year 1984 will forever be remembered as the turning point for automated supply. The introduction of the Sperry 1100/60 mainframe computer system revolutionized the way the supply community conducted business. This was the first time a supply troop could sit at a remote terminal (UTS-40) and actually interact with the mainframe computer. Technicians had a variety of screens they could call up, insert data into, and then transmit that data and receive instant results. This conversion process, known simply as *Phase Four*, impacted more than just the supply community. The Sperry 1100/60 placed other customers on the same platform, simplifying the interface between supply, maintenance, finance, civil engineering, and contracting. Benefits of this new system, nicknamed the *green machine* because of its fluorescent green-on-black screen image, were many. Most important, Phase Four converted supply requirements into a computer language known as COBOL, which we continue to use today. Phase Four also removed the mainframe management duties from the supply systems analyst and placed them in the hands of the base communications center, creating a substantial manpower savings to supply. The 1100/60 allowed the customer to interrogate the system from a remote terminal without a tailored query language program or supply user report generator built by the supply systems analyst.

The 1100/60's big brother, known as the 1100/90, was faster and more powerful. The downfall of the 1100/60-90 was its remote terminal application. The (dumb) terminals were dedicated strictly to the 1100/60 and could not compete with the new kids on the block that put personal computing power on the desk of the common user.

The Sperry 2200

In late 1988, the Sperry 2200 was introduced to supply, bringing with it much-needed personal computer capabilities. This outlet spurred an explosive creation of software applications, adding extreme power to the supply technician. It became possible, with the application of the Mission Capable Automated Sourcing System, to scan the entire Air Force inventory from a desktop in search of a high-priority asset. The tedious job of replenishing a bench stock became a simple process of pointing a laser gun at a bar code, and 2 years of transaction histories could be accessed with the push of a button. Automated catalogs replaced the days of sitting in a dark room behind a microfiche viewer. The personal computer brought the flexibility to add applications with minimal interruption and continues to be the muscle behind the SBSS. What the 1100/60 did for consolidation of resources at the base level, the 2200 did on a much grander scheme. The 2200 brought on the creation of regional support centers, relieving the base communications centers of mainframe maintenance and centralizing several bases. These regional centers were later merged into defense mega centers for greater cost savings. The 2200 was the *bringer* of change, as was the 1050-II and the 1100/60. As we enter the new century, we look to yet another system to modernize supply.

Supply and ILS-S

As the turn of the century approached, the supply community was facing the decommissioning of the Sperry 2200. Modernization of the supply system was critical to the future success of the career field. In 1996, supply was chosen to participate in the Global Combat Support System-Air Force modernization effort. Supply would be the first large application to be replaced by an enhanced commercial-off-the-shelf (COTS)

product. The COTS product was chosen, and the supply community worked diligently to incorporate the commercial business rules into its procedures. After 2 years of hard work and analysis, the logistics community conceded that SBSS was too complex to easily adapt to commercial business. An acquisition strategy review was conducted with the approval of the Air Force Directorate of Installations and Logistics, the Secretary of Defense, and the Air Force Directorate of Acquisitions who directed a new technical approach.

The new approach was broken down into increments for a smooth and painless transition. The first increment technically refreshes the legacy system into an open, nonproprietary environment. Upon its completion, the legacy name *SBSS* will be changed to *ILS-S* (Integrated Logistics Systems-Supply). The second increment breaks down supply processes into functional components to place on the GCSS platform to share with other logistic disciplines. The vision is for all agencies to share information. The easiest way to do this is for us to reuse each other's modules (or components). This data-sharing environment is the wave of the future, and supply once again answers the call for leadership. We ended the 20th century as the innovative forerunner and remain the tip of the logistical sword.

CMSgt(S) Sargent is the superintendent of the Madernization Flight, Supply Division, Standard Systems Group.

Personal Recollections and Opinions from the Field

BUNKO RAMO: A "Sad Day"

Bunko Ramo was a sad time for the supply field. The first supply computer was built and maintained by the UNIVAC. They trained the blue-suit, active duty guys to operate and do some maintenance (mainly preventative) on the system. UNIVAC representatives assigned to each base did the heavy duty or involved maintenance. This system worked well from 1966 until the early 1970s. In about 1972-1973, when the contract with UNIVAC was up, the new contract went to Bunko Ramo. Legend says they were a bunch of ex-GIs, who were blue-suit trained UNIVAC maintainers, and some former representatives from UNIVAC.

Well, the problem was that UNIVAC wouldn't support Bunko Ramo with parts, and Bunko Ramo's expertise was not good enough to keep systems running on a consistent basis. The Air Force had supply computers going down for extended periods all over the world until the really experienced Bunko troops could fix them.

In those days, the computer data were on tapes. I traveled several times to other bases with tapes and boxes of documents to run backlogs of post-post transactions. I remember once going up to Fairchild only to find out that their system had just gone down. So we called around and found out Malmstrom was up and went there to finally run our post-post. At Travis, receiving had truckloads of stuff backed up laying all over the place, some outside in the elements. Inventory balances were a mess. I was working in the war reserve kits, and our balances were way off. Readiness was severely affected. Finally, the Air Force canceled Bunko Ramo's contract, and UNIVAC got us back to normal in a couple of months.

Senior Master Sergeant
Bruce Boyd
(USAF, Retired)

Personal Recollections and Opinions from the Field

USAF Supply Automation in the 1950s

Colonel William Stringer

MANUAL (CARDEX)

In June 1954, I transferred to my first assignment in base supply—at Lockbourne AFB, Ohio (now Rickenbacker ANGB). My previous experience as a unit supply officer emphasized accountability for what the unit had, with the report of survey as the pecuniary liability sword hanging over our heads for any losses. Base supply was an entirely different level of responsibility, which focused on mission support with the inventory adjustment vouchers/stock control vouchers available to avoid reports of survey. Lockbourne had a resident auditor who audited base supply annually, and an unfavorable report was often fatal to one's career. Resident auditors and their reports are long gone, and oversight is very superficial.

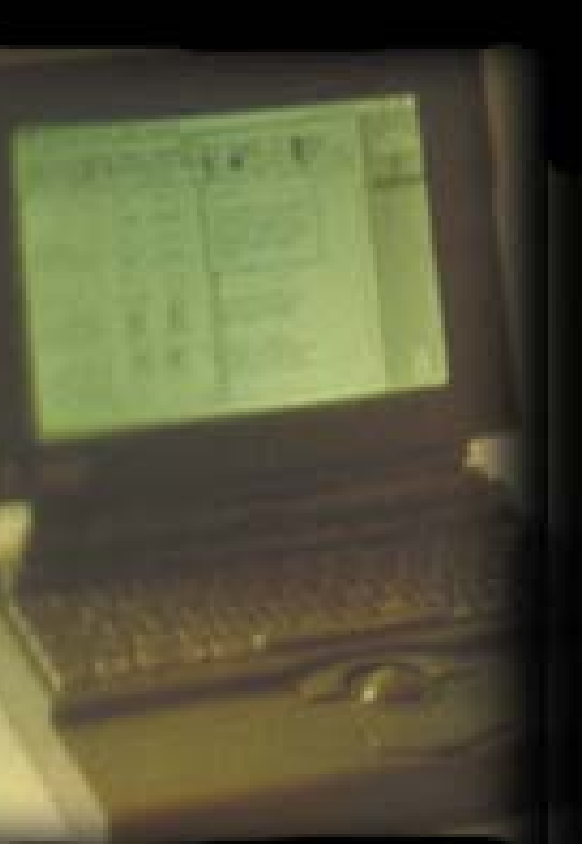
Our primary concern in base supply was back orders. Future requirements was my favorite subject, and most of my career has been devoted to some variation of that subject whether in terms of funds, physical plant, equipment, manpower, or spare parts.

My first challenge was to requisition all the initial spares required for two RB-47 wings. These were on supply tables, the ancestor of initial spares support list (ISSL) decks. It was clear that we did not have the resources to accommodate all the items involved. My boss gave me some shrewd advice: "Ignore the national stock numbers (NSN) with a quantity of less than four; for four or more, order the full quantity." Despite ignoring the lower quantity items, our support was very good. Even though the tables had been developed by the Oklahoma City Air Materiel Area (OC-AMA), their item managers canceled our requisitions as excessive, causing us to declare war on depot cancellations. The tables did not include WUC (work unit code), so we had no idea of the relationship of piece parts to LRUs. As I understand it, the current ISSLs still do not.

IBM 858 CARDATYPE

In 1954, Lockbourne AFB was a test base for automation in A&F, maintenance data collection, and supply. As the newest on board and with the least amount of base supply training and experience, I was the obvious choice as the supply Cardatype project officer.

The primary attraction of the Cardatype for the Strategic Air Command (SAC) was its capability to prepost supply documents and create issue/turn-in/shipping documents. After much effort, we managed to get the Cardatype system operational, and it was



adopted for use SAC-wide. At that point, SAC didn't care what anyone else used. Many of the other commands preferred to remain post-post and update balances via offset/marksense transactions using PCAM (punchcard accounting machine) support in stat services units. Post-posting means that issue requests go to the warehouse first and are posted later. Preposting means that issue requests go to stock records first. Post-posting often means faster response times but creates a risk of posting backlogs and increases inventory adjustments. The rest of the major commands (MAJCOM) chose to remain manual.

The manual Cardex system we converted from provided for the ultimate in flexibility and error potential. At Lockbourne, we had base supply service units in both field and armament and electronics maintenance shops. Service units were also located in civil engineer and vehicle maintenance functions. Delivery times were minimal, and person-to-person communication with the users was maximized.

However, the SAC goal was to get supply off the flight line, so we acquired a 100,000 square foot base supply building outside the flight-line fence about the same time we converted to the Cardatype system. That meant supply property accounting was significantly improved, communications with users significantly reduced, and delivery time became a major problem.

With support from the stat services' IBM 407 printers, sorters, collators, and so on, we managed to communicate with users via computer listings *mailed* through the base distribution systems. Many of the recipients treated them as *junk mail* and rarely read them.

At the time, supply was still accounting for most items via part number. Stock numbers were assigned only for common items such as handtools and administrative supplies/equipment. Aircraft maintenance personnel were assigned to base supply to research radio/telephone call-ins and provide inspector support in receiving. By the time the IBM RAMAC system arrived, the maintenance spaces were reallocated to more urgent requirements, and another communication channel dried up.

Initially, all requisitions were submitted via mail with a few high-priority ones called in to the depots. Later, we were part of the effort to develop punchcard requisitioning. Initially, we had only two priorities: immediate, covering aircraft out of commission for parts/aircraft not fully equipped (later became not operationally ready, supply [NORS] and now mission capable [MICAP]), and stock replenishment, covering everything else. The initial priority scheme was based on all deliveries in 30 days, and the priority immediately increased in priority as the time elapsed. It didn't take long for that system to break, and the Uniform Materiel Movement/Issue Priority System (UMMIPS) force activity designator/urgency of need alternative merged.

About this time, the Air Force completed the demolition of the old UPREAL (unit property record accounting list) in favor of the UAL (unit allowance list). The UPREAL allows table of organization and equipment (TO&E) units to move with all their equipment independently of base supply. Base supply provided initial shortage/replenishment support for UPREAL items and *plant account* items when the TO&E unit was in garrison rather than deployed. For example, the unit had field desks on its UPREAL for field use and steel desks on its plant account with base supply for garrison use. When the unit deployed, the plant account items were to be left behind.

While the system was very useful to Tactical Air Command (TAC) units and rotational SAC units, it was administratively expensive and tied up large stocks of field equipment. As SAC, Air Training Command (ATC), and Air Defense Command (ADC) units dominated the Air Force, the capability to deploy had decreasing appeal, and the good was thrown out with the bad. The Military Air Transport Service (MATS) had long ago gained acceptance of its basic difference as a worldwide airline deploying one aircraft at a time and struck out on developing a variant of the channel-based primary/forward supply point system. ADC developed its own forward supply point system for ground radar support known as the Electronic Asset Control Center.

There were two basic retail supply systems: base supply and wing supply. For multiwing SAC bases, there were multiple wing supply organizations but always one base supply. Wing supply accounted for all in-use equipment, managed bench stocks, and so on. Base supply included separate stock record account numbers for supplies, fuels, munitions, and clothing sales.

Probably the greatest single disaster encountered by supply was the mandatory conversion to the Federal Cataloging System. Whereas

Boeing B-47-peculiar items were identified by a nonsignificant four-digit class code (1AFE) followed by the Boeing part number, the conversion left supply with a major communications problem since the maintenance stovepipe refused to accept federal stock numbers (FSN) as part of maintenance data collection (MDC). The alleged reason was the limitations of the 80-column IBM cards. Efforts made by the Air Force Logistics Command (AFLC) to convert MDC to FSN/NSN were notably unsuccessful, so the costly MDC effort has had almost no effect on wholesale logistics, certainly not on wholesale supply.

Listings provided by the Standard Base Supply System (SBSS) only provide NSNs and have generally been ignored by maintenance. The supply and maintenance systems continue to operate with major differences between application and indenture data.

Numerous stock list changes continued to plague the supply system, particularly since the supply financial accounting systems required the base supply system to update stock list prices concurrent with the source of supply changes. At SAC's urging, AFLC finally developed the stock number user directory (SNUD) and tailored changes to those actually used by the individual bases. The SNUD is still the basis of automated lateral support (MICAP Automated Sourcing System [MASS]). Unfortunately, the Air Force Materiel Command (AFMC) inventory managers still refuse to use MASS to respond to SBSS requisitions.

Bottom line: Cardatype was installed at all SAC bases worldwide and operated successfully until replaced by RAMAC.

IBM 305 RAMAC

Encouraged by the Air Staff, the big stateside MAJCOMs (ADC, MATS, TAC, AFLC, and ATC) developed independent automated approaches to modernizing their retail level punchcard systems. SAC chose to upgrade to the IBM 305 RAMAC that maintained supply data on large *jukebox* disks. It also provided concurrent updating of financial data on base supply inventory, and automatic releveling/requisitioning, including consideration of interchangeables and substitute items.

ADC and TAC also adopted the IBM 305 RAMAC but developed independent software for their base supply accounts. The Air Staff made an effort to reconcile the different RAMAC systems but finally settled on a set of common principles that would apply to the next generation of supply automation (Air Force Regulation [AFR] 400-29).

After Korea, SAC was in the midst of activating B-47 and KC-97 wings and building bases for B-52s and KC-135s. SAC was happy with the RAMAC system even though it was slow and incomplete. It still required considerable stat services support for creating major listings, but the system was truly online, and most of the supply community could read and understand the RAMAC computer instructions. SAC put a lot of effort into discouraging base-level modifications to SAC-developed software.

The ADC RAMAC system had many superior features that SAC thought were not affordable. The Navy depot at Quonset Point was supported by a RAMAC with a much better system design than any Air Force RAMAC. However SAC was prepared to leap forward to the next generation with the IBM 1401, bigger and better than the RAMAC, with tape drive capability.

In the late 1950s, the RAMAC system was clearly better than anything available to the AFLC depots, so the Air Staff encouraged MAJCOMs to innovate even further. The bases were obviously outstripping anything that AFLC could do with its IBM 7080 tape-based systems. AFLC also wasted much time and resources on various disk drive systems with no real success. PDS and D033 were two notable failures. The Priority Distribution System was a Burroughs system intended to allow item managers to prepost priority requisitions and later transfer the shipment data into the 7080s. D033 was an IBM 360-35 system intended to provide prepost support to depot maintenance and SBSS-like support to tenants.

AFLC attempted to institute weapon system accounting at base level (rather than depot level) as part of Volume XVI (for deployed weapons) and Volume XX for worldwide support of B-52 and KC-135. Volume XX really operated at the Ogden Air Logistics Center with an IBM 705-RAMAC and was intended to support SAC airborne alert. All B-52 and KC-135 requirements were submitted to the Oklahoma City Volume XX rather than to the myriad of individual item managers. All other requirements for the same items were sent directly to the item managers.

For various reasons, AFLC abandoned Volume XX, much to the dismay of SAC and other using commands. The net result was that the users managed by weapon system and WUC, but AFLC insisted on managing by the Federal Supply Classification with incongruous groupings via the Materiel Management Aggregation Codes (MMAC) that were totally meaningless to everyone concerned. However, MMACs allowed each AMA (air materiel area) to maintain its management structure intact. They are no longer needed for this purpose. but AFMC refuses to allow their use to identify weapon systems in SBSS requisitions.

After the last B-52 and KC-135 base was activated, SAC called in

all the related balance cards from these bases and did a commonality study on the SAC IBM 650. The results were astounding. Despite the 8,000 line item initial spares package OC-AMA shipped to each base, fewer than 20 NSNs appeared in all 18 base files. For B-52 NSNs, 31 percent were used by only one base; for KC-135, 43 percent. OC-AMA suggested that the SAC bases were not current on NSN changes and reran the analysis using their master NSN files. The results were essentially unchanged. This finding struck at the heart of the Air Force policy on ISSLs and was, therefore, suppressed. Another opportunity to learn something was wasted.

Bottom line: the SAC RAMAC system successfully operated at all SAC bases worldwide, TAC bases, and Wright-Patterson AFB. The ADC RAMAC system operated at all ADC bases. The RAMACs and all other MAJCOM computer systems were eventually replaced by the SBSS.

UNIVAC 1050-II

The end result of the AFR 400-29 effort was the Air Force SBSS based on the UNIVAC 1050-II, the lowest bidder.

In 1964, I transferred to the Air Staff Supply System Design Office as the principal designer of the system.

UNIVAC *bought* the contract to provide an entry into base-level automation, a very profitable decision for them. The Burroughs 3500 was selected for all other base-level automation. The conversion of SBSS to COBOL under the Phase IV program allowed the UNIVAC 1100 to replace both the U-1050-II and the B-3500. UNIVAC has supported SBSS for more than 30 years, clearly a wise investment in hindsight.

UNIVAC representatives assured the Supply System Design Office that supply wouldn't be able to use it for more than 8 hours per day and likely would have to support nonsupply applications. These false claims led to a general disregard of processing time efficiency in the prototype software at the test location, Andrews AFB. By the time Andrews was declared operational, there were two 1050-IIs operating full time at Andrews in addition to the software development 1050 at Bolling AFB. Fortunately, significant improvements in throughput allowed the SBSS conversion program to begin a year later.

Regretably, internal supply politics led to a decision to give full automation of the equipment management function priority over full automation of the supply management function. Specifically, SBSS deferred dealing with the WUC, full interchangeability and substitution capability, internal NORS reporting, bench stock details, war readiness spares kit details, and so forth to swallow the enormous volume of equipment data related to administrative support (the old *plant account* stuff). The Air Staff later directed the deletion of base supply accountability for the majority of the administrative equipment.

The supply community still refuses to accept the WUC and full interchangeability and substitution capability as a priority requirement, much less do it.

Col Stringer (USAF, Retired) was a career supply officer. He currently resides near Dayton, Ohio.

Supply Personnel Information

A Message from Your Career Field Manager

CMSgt, Rick Grist, AF/ILS

I often get asked about the future of supply and what's going on to ensure there is a future in supply. There is no guarantee that you will spend the rest of your career in supply, but supply career field management is still alive and well. And, if you haven't guessed, supply is modernizing, just like the rest of the Air Force. Here are a few points to ponder.

From a macro perspective, Air Force-wide end-strength numbers are less than programmed, retention is lagging, and recruiters aren't meeting goals. This means we will not see any Temporary Early Release Authority, commonly known as early retirement, or Variable Separation Incentive/Selective Separation Bonus for the foreseeable future. Congress will not appropriate money to release folks early when overall end strength is less than programmed.

So, how about supply, and what are we doing to manage the career field from within the force? We are scheduled to lose approximately 3,600 blue suiters under Jump Start through fiscal year 2003. This will be accomplished through a combination of regionalization and competitive sourcing and privitization (CS&P). Some commands—Air Education and Training Command, Space Command, and Air Force Materiel Command—are relying heavily on CS&P, while others are offsetting a portion of their share of the losses through regionalization. You have probably either been affected by regionalization or heard of the regions being established at Air Combat Command, Air Mobility Command, Pacific Air Forces, and United States Air Forces in Europe. The manpower losses stretch over a few years, and the positions won't come off the books until these efforts are complete.

Other supply reengineering initiatives such as peacetime operating stock reduction, Supply Asset Tracking System, inventory changes, and so on will reduce workload and manpower. However, not much has been programmed into the manpower files. Although some commands claimed a projected 30 percent reduction in manpower requirements, this is what the authorized numbers looked like in the system (numbers are 2S0XX):

Month	Total
Feb 99	12363
Sep 99	12143
Sep 00	11752

Table 1. Manpower Authorizations

The numbers stay relatively stable. The bottom line is that until the workload actually goes away and the manpower authorizations come off the books the force management folks cannot make appropriate adjustments. On the issue of seven-level surpluses, we are working the issue hard through the Noncommissioned Officer Retraining Program (NCORP). This process employs a model that takes into consideration not only imbalances within the grades but also end-strength numbers based on gains and losses for the year. While we would like to reduce our surplus seven-levels so they're balanced, we must also consider five-level shortages. We worked the fiscal year 2000 NCORP numbers, and the model showed 895 surplus NCOs (E5-E7), and a shortage of 580 senior airmen (E4). Overall, we're a little bit more than 100 percent manned in AFSC 2S0X1. If we retrained all the surplus NCOs, we'd be a little more than 90 percent. I did, however, tweak the numbers up a bit for fiscal year

	SSgt	TSgt	MSgt
FY 99	430	131	10
FY00 (approximations)	350	150	100

Table 2. FY 1999 NCORP Numbers

2000. Table 2 shows fiscal year 1999 and a preliminary look at fiscal year 2000.

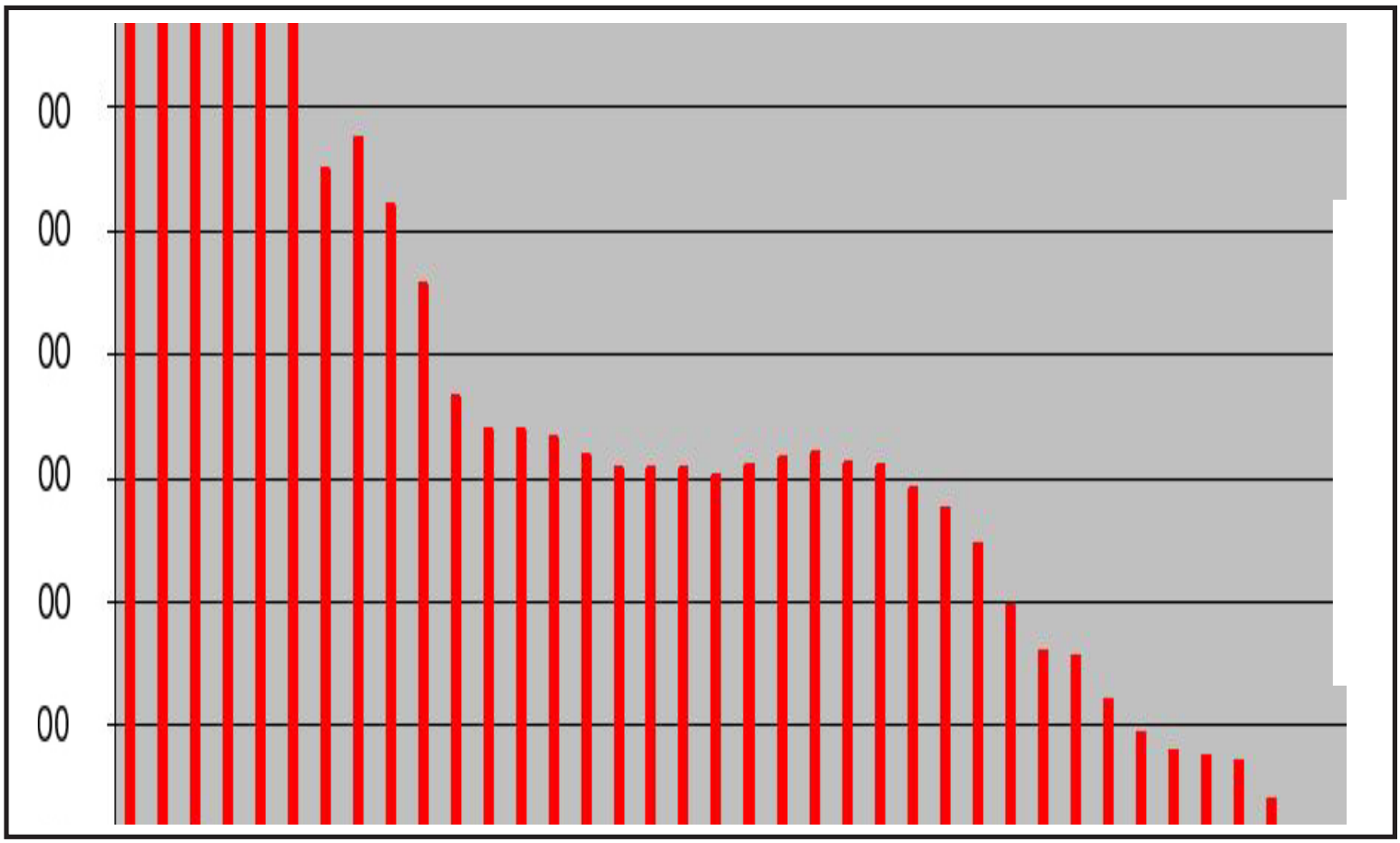
For the first time, we've retrained some X2s. We were restricted from doing this in the past because supply was a lateral career-field. As of now, the career field is total direct accession. There are 40 technical sergeants and 5 master sergeants.

Hopefully, this gives a clearer picture of what's happened in the world of supply career-field management. We must continue to exercise caution when determining manpower requirements and reductions. The current manpower standard is not valid for what we're doing in supply today and won't be applied as is. All career fields have been tasked to reengineer by fiscal year 2005, at which time the manpower standards will be updated (sooner if the reengineering is complete). We're doing a lot of things in the supply career field, such as regionalization and peacetime operating stock reduction, using *best guess* estimates for manpower requirements.We need to continue with these modernization efforts, using caution not to cut ourselves too deep. Once a manpower authorization is turned in, I don't think we'll ever see it again. All the talk about reengineering, manpower reduction, and workload decrease doesn't do a thing until we put it in writing. Until the manpower documents are updated to reflect what we are doing, nothing will change. Manpower drives force management. But please keep the first item above in mind. Career-field management is alive and well. We are not in the mindset of *willy-nilly* giving supply away. Accession, training, retraining, career progression, and other programs are carefully managed, so we will continue to have a supply career field where our people can learn and grow well into the 21st century, just like we've done for the past 53 years.

Your Career Field, Your History

The technical experts in supply often wear one, two, or three stripes. Airmen in the supply squadrons routinely execute all the day-to-day operations. In 1985, Lieutenant General Leo Marquez, Deputy Chief of Staff for Logistics and Engineering, coined the term *Blue Two* and established committees that provide supply junior enlisted troops with a means of communicating process improvements, quality-of-life issues, and other supply-related information to upper level management. Each supply organization is represented, and the results of the Blue Two conferences have been significant. From technical order changes to improvements in training instructions, the changes instituted Blue Two and approved by leadership are remarkable.

Supply Personnel Levels
1964-2002



Supply Enlisted Fuels Enlisted Officer

The table above paints a vivid picture of the downward trend in supply personnel levels. However, in order to truly get a picture of the history of our personnel levels, one must compare the supply levels to those of the entire Air Force. For example, in 1964, supply and fuels personnel totaled slightly more than 7 percent of the Air Force population. In 1976, after the end of the Vietnam War, supply comprised less than 6 percent of the Air Force body. And as of 1999, our community totals slightly more than 4.5 percent of the Air Force. So, our levels have dropped at a slightly greater rate than the levels of our Service as a whole.

"I put on my uniform this morning, didn't I?"

CMSgt John Drew

A chief master sergeant sits behind his desk, just down the hall from the operations group commander's office at Pope AFB, North Carolina. As the chief finishes his second cup of coffee and the last of the morning messages, the commander steps into the his office.

"Chief," the colonel says, "I hate to ask you this, but you are needed in Southwest Asia in 6 days for a 90-day rotation. Can you go?" With no emotion in his voice and without even looking up, the chief replies, "I put on my uniform this morning, didn't I?" The colonel is taken aback—the chief doesn't usually talk in riddles. Has this veteran of 28 years finally gone off the deep end?

The wise old protector of the enlisted corps smiles and begins to explain. "I made a promise to myself more than 20 years ago. I would only put this uniform on as long as I'm available for duty." While this may seem obvious to some Air Force members, it seems to completely escape others,

Available for duty means more than the desire to negotiate and select the premium assignments or choicest temporary duty assignments. A simple transition. Available for duty requires us to go anyplace in the world the President or officers appointed over us determine, at any given time. This doesn't mean we shouldn't have or receive our preferences, but it does mean we'll go when and where we're needed.

This approach may seem overly simplistic. However, upon further review, I think everyone will agree that, when it comes to defining service to our country, it is just that simple. In today's world of "What can you do for me," it's easy to lose sight of what service to our country is all about.

Service goes far beyond the individual—it affects the well-being of our nation. Sitting in southern Georgia, it's easy to forget the sacrifices we agree to endure in service to our country. Deployed to Southwest Asia, Italy, or Bosnia, the sacrifice becomes a reality.

The bottom line is, today, we are an all-volunteer force that has been reduced by 30 percent in the last 5 years while remaining a highly mobilized, continually tasked organization. Everyone is vital to its continued success.

The Air Force will go on tomorrow, with or without any single one of us; however, a unit's efficiency may be adversely affected by the loss of only a few.

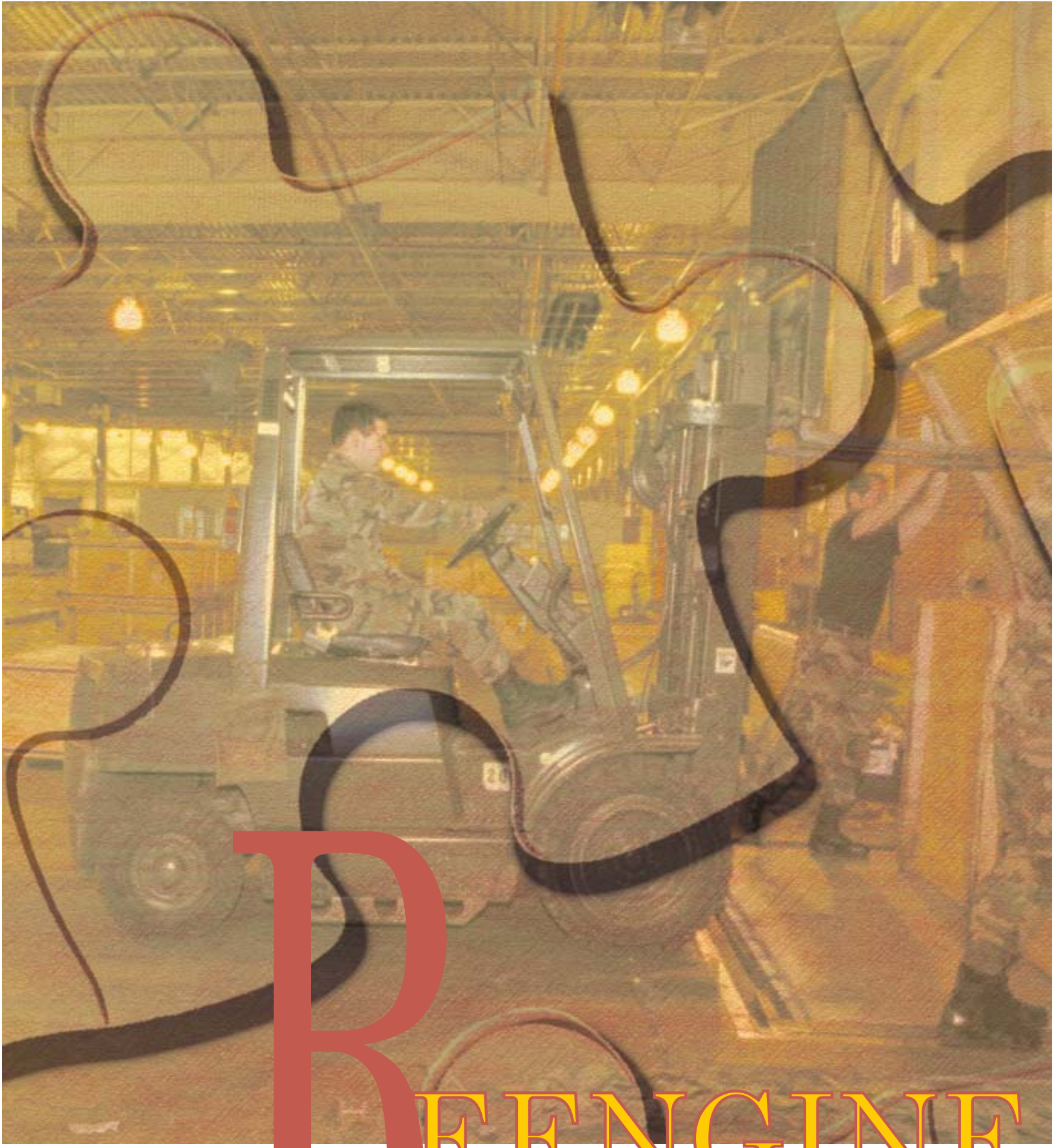
All of us have the responsibility to report our availability for duty. If people have a family problem or special circumstances that preclude them from being available, they need to report it immediately, especially prior to being asked to deploy. If one single person does not deploy when called upon, another person is forced to fill the slot. Anytime someone cannot or will not deploy, it ripples throughout the Air Force.

Everyone would like to have the family together for the holidays. I can't think of anyone who would intentionally miss a child's graduation. We're all aware that the pain of losing a loved one is compounded by the grief of not being with them in the final moments. Military members are asked to sacrifice continually. What we must remember is that we are serving our nation, and we are all volunteers. It's not easy—no one said it would be.

Our country depends on our being as good as our word. I believe each of us needs to take a look in the mirror and ask, "Am I available for duty?" If the answer is yes, then continue as the true professional you are. If the answer is no, you need to immediately notify your supervisor or your commander. Your next step is to determine if your nonavailability is temporary or permanent. You then face the toughest question: should you resign, separate, or retire? There are no pat answers.

I, too, put on my uniform today and am available for duty.

Chief Drew is assigned to the Maintenance and Munitions Division at the Air Force Logisitics Management Agency.



REENGINE

ERING

It may be time to do things smarter in Supply and Transportation

Lieutenant Colonel Mark Douglas
Lieutenant Colonel Linda Dahl

In August 1997, the Air Combat Command (ACC) directed the 20th Supply and Transportation Squadrons to evaluate the feasibility of reengineering processes associated with receiving, moving, and shipping cargo. Phase I of the test period ran from 15 September to 19 December 1997, and Phase II concluded 1 September 1998. An integrated process team (IPT) was formed with personnel from both squadrons. The team's first responsibility was to investigate current processes and brainstorm ideas. These initiatives and processes are likely to change further as results are analyzed and improvements are made. Suggestions made at Shaw may or may not be the best methods for all locations. Limitations, such as available space and technology, will be key factors as Shaw was the first Air Force base to implement the Supply Asset Tracking System (SATS) and has made significant strides in reducing its peacetime, nonaircraft supporting stock. Every effort was made to remain flexible while conducting the test.

The test objectives were threefold:

- Streamline and improve similar processes
- Effectively and efficiently utilize all resources
- Minimize adverse impact on customers while maintaining or improving mission support

The essence of *true* reengineering is to analyze one or more processes and make changes to improve them while remaining focused on improving the logistics system as a whole. In other words, do not reduce time, cost, manpower, defects, or risk in one process by simply transferring those costs to another. Every effort was made to ensure this project represented *true* reengineering.

The reengineering focused on three processes for base stock record account number (SRAN) 4803:

- Receiving
- Shipping
- Movement (intrabase distribution)

Affected work centers from the 20th Supply Squadron included:

- Pickup and delivery
- Storage and issue
- Receiving
- Flight service center (FSC)
- F-16 aircraft parts store

Affected work centers from the 20th Transportation Squadron included:

- Surface freight
- Packing and crating
- Vehicle operations

The reengineering tasking came to Shaw on short notice when the primary location became unavailable at the last minute. This meant that the first months were largely spent setting up the test and training. One of the strengths of the Shaw test came from

demonstrating process improvements at a wing with high operations tempo (OPTEMPO). For example, during the first 3 months of the test, the wing conducted a Phase I Operational Readiness Exercise (ORE), several ORE training modules, final preparations for a Phase I Operational Readiness Inspection, a Headquarters ACC Logistics Maintenance Daedalian team visit, a Headquarters ACC Logistics Supply (LGS) Daedalian team visit, several continental United States training deployments, contingency deployments to Operation Southern Watch, real-world air expeditionary force deployment to Bahrain, and fiscal year close-out. The point is if reengineering can be implemented at Shaw it can be implemented at other high-OPTEMPO locations.

Under the guidance of both unit commanders, three IPTs were with a mix of personnel from the effected work centers. Lieutenants from each squadron served as project coordinators, but in essence, the IPTs were given *blank sheets of paper* for each process. Involvement by the airmen, civilian employees, and noncommissioned officers assigned to the effected work centers led to unit and individual *buy-in* and was key to the success of this project. The IPTs reviewed all aspects of the processes to be reengineered: the mission requirements, customer service issues, costs, materiel-handling equipment, compliance requirements, documentation, computers, process tasks, safety issues, security, tools, and facility needs. They reviewed all tasks performed by both squadrons; looked for redundancy; and then designed the simplest, safest, least costly, most effective new process. In addition, similar processes at other bases and some commercial practices were compared.

SATS facilitated the reengineering effort. Shaw AFB is the test site for SATS, a system that works as a *front-end processor* with the Standard Base Supply System (SBSS). It serves as an input/output device, using handheld bar-code readers/printers with the capability to use radio frequencies to transmit data to and from the SBSS. In addition to SATS wireless and paperless features, it provides a continuous audit of property locations, times, and the identity of personnel who handle the property via encoded *smart cards*. Shaw's SATS provided many advantages and some limitations to the reengineering demonstration, but results and recommendations still apply to non-SATS bases. This will soon be resolved for ACC, since ACC/LGS purchased SATS for all bases with implementation during fiscal year 1999.

Old Receiving Process

As property arrived at the base, the transportation, inbound freight section would in-check it, determine any shipment errors, input data into the Cargo Movement Operating System (CMOS), then pass it to FB/FE4803 to the supply receiving element while other cargo was held for customer pickup. Supply would then in-check the property, determine any shipment errors, input data into SATS (which inputs to SBSS), and then move property to stock or deliver it to customers.

New Receiving Process

The IPT evaluation of receiving tasks completed by supply and transportation personnel showed that, of 22 total tasks, 17 were very similar. As a result of the IPT suggested changes, all cargo-receiving processes have been transferred to supply. Supply now processes all receipts, in-checks property, determines shipping errors, inputs data into both CMOS and SATS, and turns over the property to the transportation movement team for delivery to customers. The team also

implemented delivery of aircraft-associated assets directly to the flight-line warehouses for storage and issue. Several features distinguish this new process. First, base customers no longer pick up their property, with the exception of certain flight-line shops. This not only reduces mileage on vehicles and keeps personnel in their primary work centers but also maximizes the use of the transportation squadron's trained, experienced vehicle operators. Second, Shaw prototyped a consolidated form to replace transportation's Standard Form 361, Over, Shortage, and Damaged, and supply's Standard Form 364, Report of Discrepancy. This made a lot of sense based on all the common elements between the two forms. In addition, with the receiving element already responsible for the Supply's Tracer Action Reconciliation (TAR) program, the consolidation of forms enabled *one-stop* TAR processing. This was a vast improvement over a chronically hard-to-manage program due to its fragmentation between different units and work centers. Third, and possibly most important, the decentralized receiving process minimized pipeline time and eliminated excessive handling for critical aircraft spares.

To measure changes to the receiving process, the IPT tracked receipt processing times and reject rates. Processing time started with the initial property in-check and ended when it was placed on the shelf. Processing times decreased dramatically, while reject rates remained fairly constant.

For the last few years, supply has been moving aircraft spares out of general-purpose warehouses forward to flight-line storage locations, specifically the flight service center and the aircraft parts store. Since the advent of *lean logistics*, most serviceable and reparable spares are moved from depots and other sources via express carriers. The IPTs developed procedures and modified software to send express carrier receipts directly to the Aircraft Parts Store and the Flight Service Center. By identifying fiscal year Stock Record Account Numbers for each delivery location and modifying the supplementary address on the SBSS requisitions, aircraft spares, which constitute about 40 percent of supply's total receipts, are now delivered directly to flight-line warehouses. Aircraft spares are handled once instead of three times and are on the shelf immediately after delivery.

Old Shipping Process

In the past, property selected for shipment was pulled from the warehouse or from the FSC repair cycle line by supply, moved to transportation's outbound freight section, and then packaged and shipped. If any errors occurred with the property or documentation after the cargo was delivered to transportation, supply was called to pick up the property, correct the errors, and return the property to transportation. Priority shipments largely came from the APS or FSC, with routine shipments coming from the main warehouse. The surface freight operations were located across the street from the main supply warehouse and receiving functions.

New Shipping Process

The shipping IPT quickly identified that the major supply and transportation work centers involved in the shipping process should be collocated. As a result, the entire surface freight section relocated into the supply building adjacent to the receiving area. This space was formerly occupied by supply's local purchase receiving function and was available due to the wing's aggressive implementation of the International Merchants Purchase Authorization Card. Transportation renovated the

entire area to accommodate all industrial and administrative surface freight requirements.

After analyzing the shipping tasks, the IPT discovered that, out of 73 total tasks, only 8 were similar. The many special requirements for handling hazardous items made shipping a complex process. However, since most serviceable and reparable aircraft spares are nonhazardous, express-eligible shipments, another opportunity existed for decentralized operations. As a result, nonhazardous express eligible property is shipped directly from the FSC. This is the only decentralized shipping location, because no other shops generated a large quantity of shipments.

Results from the modification to the shipping process showed a reduction in the amount of time to ship property and a drastic reduction in the number of discrepancies. Simplifying the process and teaching each responsible work center about the *entire* process enabled the improvement.

Old Movement Process

Prior to the reengineering demonstration, supply delivered priority customer property almost immediately and routine property as it accumulated. Priorities were determined by customers based on their original issue transaction input to the SBSS. To accomplish the deliveries, supply's pickup and delivery element was authorized 23 vehicles and 25 people, although, due to prior improvements, supply was using only 15 vehicles and 15 people. The delivery system was very reactive and inefficient and not very interesting for the assigned airmen.

New Movement Process

The movement IPT saw immediate opportunities to improve the delivery process and reduce manpower and vehicles. One of transportation's core competencies is distribution. Vehicle operations deliver passengers all over the base every day but only deliver cargo on special occasions and during wing exercises and deployments. After careful review of customer requirements and mission needs, the IPT designed plans to move pickup and delivery from supply to transportation. In an incremental cycle of planning, testing, reviewing, and then planning again, the IPT blended the supply and transportation processes and trained personnel. The IPT ultimately developed time-definite delivery routes, maximizing use of personnel and vehicles, and still met mission requirements.

The results were amazing. The new transportation delivery function provided equal or better service using only eight vehicles and eight people. Training requirements for basic taskings did not pose a major problem because the IPT determined that, out of 32 total tasks, 30 were similar. In fact, the civilian job descriptions for transportation vehicle operations and supply pickup and delivery are the same. Also, fleet vehicle mileage drastically decreased since the delivery routes minimized the number of runs required.

Aside from the major resource savings, another success of the reengineering related to taking two fairly mundane jobs and building them into one better job. In these days of declining retention rates, ensuring sharp airmen have challenging, motivating jobs is very important.

Marketing

Since the reengineering demonstration began, Shaw has hosted numerous visitors interested in the project. The Secretary of the Air Force, Chief Master Sergeant of the Air Force, ACC Commander, and many other senior leaders have seen the reengineering

demonstration firsthand. In September 1998, Shaw hosted a 2-day conference to present the reengineering efforts. The supply and transportation open house provided the Air Force logistics community an opportunity to learn more about the project. It included a day of briefings and discussions by members of the IPTs and a morning of tours through the effected work centers. Many attendees seemed a little skeptical at first, but the enthusiasm of the IPT members and documented success of the project soon won them over. More than 80 people from 25 bases attended the event.

The supply and transportation commanders have briefed the results across the Air Force, including a live Internet presentation at the Department of Defense Logistics Reform Day II at the Pentagon. Briefings and discussions have been presented to students at the Air Force Institute of Technology, the Air Force Supply Strategic Planning Conference, the Air Force Logistics Board of Advisors, and many major command transportation and supply conferences.

Overall Lessons Learned

Anything can be accomplished if senior leaders work together closely and positively. Successful reengineering cannot be accomplished when people guard *turf*. Get the airmen involved in the change process—downward-directed reengineering is much more difficult. Once changes began, a momentum occurred that seemed to propel the IPTs throughout the reengineering process. Keeping the teams motivated and enthusiastic really fueled continuous improvements. Also, reengineering was accomplished incrementally for several reasons. One, at a busy operational base, it is difficult to change too much, too fast without increasing the risk of mission degradation. Two, some areas to be analyzed and changed are fairly complex and are interrelated with other processes. Controlling the changes so they can be clearly understood and accurately measured may take time. Three, success breeds success. The momentum needed for successful reengineering is developed gradually as the teams start and complete phases of the larger project.

The latest briefings, talking papers, and other information are available on the Shaw web site at www.shaw.af.mil/20fw/20log/20sups.html.

At the time of the writing, Lt Col Douglas was commander of the 20th Supply Squadron, and Lt Col Dahl was the commander of the 20th Transportation Squadron. Currently, Lt Col Douglas is assigned the to the Logistics Directorate, Headquarters Air Force Materiel Command. Lt Col Dahl is assigned to the Transportation Division of the Installations and Logistics Directorate, Headquarters US Air Force.

Air Force Journal of Logistics

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WORLD EVENTS WEEKLY

1985

Air Force Places "Huge" Emphasis on Supply

Also in this issue:
Scarlet Reign: 49ers Win Again
Who is the New Soviet Leader?

Colonel Doug Blazer (USAF, Retired)
with
Colonel John Gunselman (USAF, Retired)
Colonel Ed Offer (USAF, Retired)
Colonel Joe Corcoran (USAF, Retired)
Colonel Rocky Barnard (USAF, Retired)
Colonel Pete Greenlaw (USAF, Retired)
Chief Master Sergeant Tim Doolin (USAF, Retired)

Waxing nostalgic seems to be the craze these days. The older you get, the more nostalgia there is. So I asked a bunch of *old supply toads* what they thought were some of the memorable moments of supply history. There are three things that stand out about Air Force supply in their replies. First and foremost, supply is a community—like a family. Supply folks are special; they form friendships that last a lifetime. There's always an underground network with which to keep in touch and seek help in solving problems. That's true within the *active* Air Force as well as among us *old retired folks*. Second, supply has always been a challenging, rewarding, and fun job. Everybody on the base knows the supply folks, and there is always something new. The third constant is change—like I said, there is always something new. And the pace of change seems to be accelerating.

Look at Figure 1. How many of those terms and acronyms do you recognize? If you recognized more than 75, well, you can't count. If you knew more than 35, congratulations, you're old, but you've led an exciting life. If you recognized fewer than 15 and you're in the supply career field, congratulations, you have a great future ahead of you.

Now where was I? Ah, yes, the pace of change for Air Force supply. To prove my point, I trace some major changes affecting supply, starting with the *Year of Supply, 1985* and ending at the Integrated Logistics System-Supply.

The Year of Supply—1985

An Air Force News Service headline read, "General bets $100M on Year of Supply." Lieutenant General Leo Marquez, Deputy Chief of Staff for Logistics and Engineering, declared 1985 the Year of Supply. The Year of Supply was, above all, a realization by all Air Force members of the importance of supply to the Air Force mission. We *supply* airpower! Supply folks have always known that, but now the entire Air Force

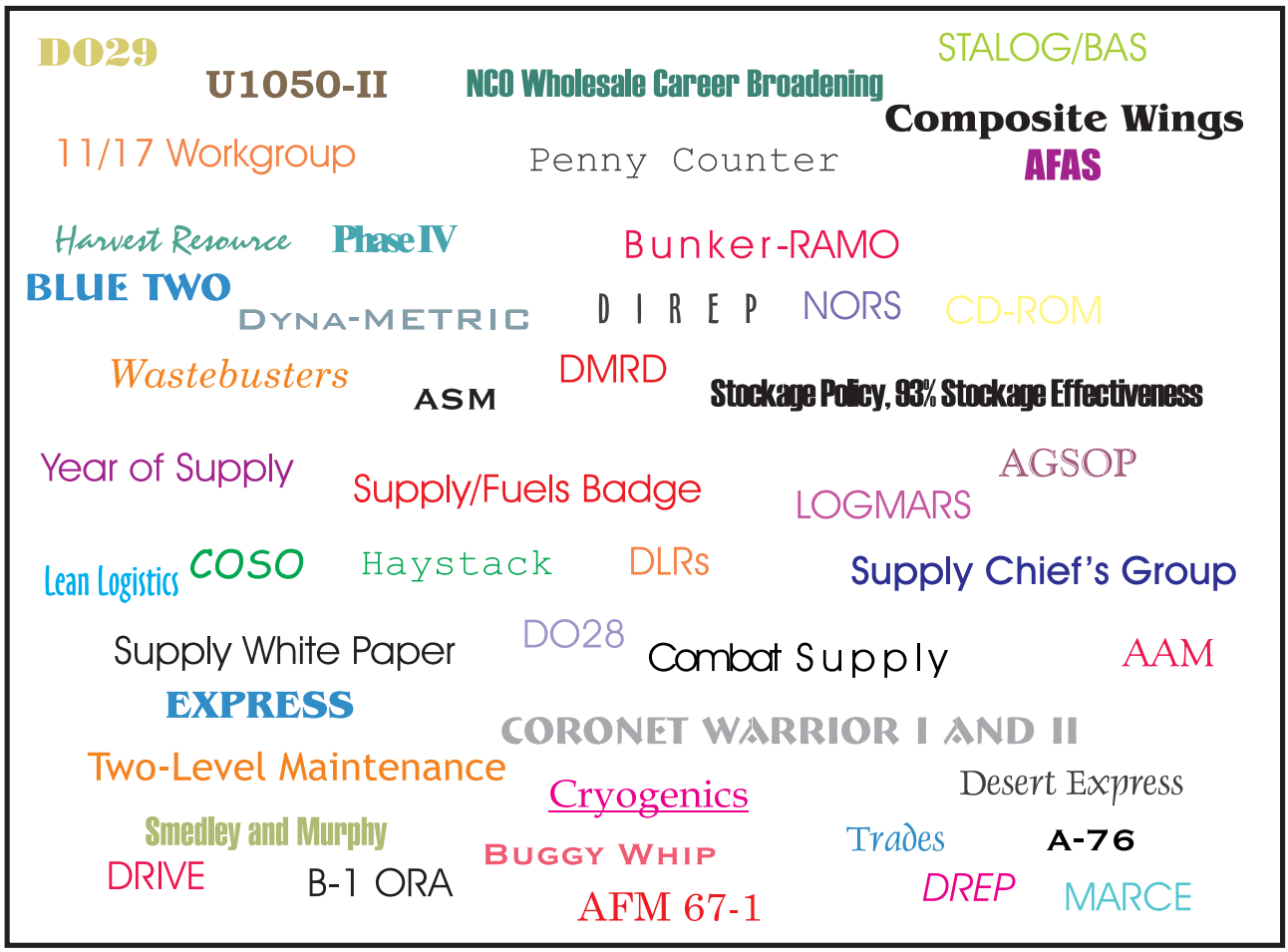


Figure 1. Supply Terms and Acronyms

knows it—from Secretary Orr, the keynote speaker at the Supply Executive Board in 1985, to the airman on the flight line, the *Blue Two*. In fact, supply coined the phrase *Blue Two* as one of the key initiatives of the Year of Supply.

Blue Two was a program that let the backbone of supply—the airman—identify ways to improve the supply system. The Air Force invested $100M in supply improvements its support. Many of the improvements were suggested and implemented by the Blue Two.

The initiatives derived from the Blue Two and senior supply leaders, developed from a *Supply White Paper*, were grouped into a program called Harvest Resource. Some of the results of Harvest Resource included rewriting base supply manuals and customer guides into *plain English* (it may be time to do that again), automating selected activities like mission capable (MICAP) management (eliminating grease boards), fuels management and stock fund operating programs, and logistics applications of automated marking and reading symbols (LOGMARS). There were several personnel and training initiatives, such as the development of the noncommissioned officer wholesale career broadening program and a complete rewrite of supply technical training courses. There were 43 Harvest Resource initiatives in all, and they made supply easier and more understandable to the customer and improved supply support to the mission.

The late 1980s and early 1990s brought major changes to supply—major force drawdowns, base closures, a complete revamping of the requirements computation—and major changes to supply management.

Other significant events included completion of Phase IV—the *modernization* and *rehoming* of the Air Force Standard Base Supply System (SBSS) on a shiny, new, more powerful computer—the Sperry 1100/60. This marked the retirement of the old standby UNIVAC U1050-II computer. In fact, supply had a retirement party for its computer system (probably the only Air Force community ever to do so). In 1986, the Air Force supply community gathered at the Civic Center in Montgomery, Alabama, to honor the UNIVAC 1050-II on its retirement from service with the Air Force. The *guest of honor* was present in the hall, looking over the entire crowd from atop a decorated flatbed trailer. More than 500 supply folks—many from out of town, who worked with "that *#%@ supply computer" during its 20 plus years of service—were on hand for the occasion.

The Air Force implemented several new *scientific* stockage policies, which increased inventory levels and supply support. In fact, the consumable item, stockage effectiveness rates reached 93 percent, still an all-time high. Speaking of science, the Air Force also started using Dyna-METRIC to assess supply achievable, wartime sortie rates with existing base stock levels for Status of Readiness and Training System reporting. This allowed supply stockage to directly relate to mission accomplishment (sorties) instead of some supply statistic-like fill rate.

Tactical air force supply reorganized. COSO (Combat Oriented Supply Operation), implemented in 1985, improved support to aircraft maintenance by making supply an integral part of the maintenance organization.

As I said before, the biggest change during the Year of Supply was the realization of the importance of supply to the Air Force mission. To symbolize supply's special place, the Air Force approved the supply/fuels badge. The badge symbolizes the supply/fuels community's professionalism.

Air Force Supply in a State of Change, 1986-1991 (Pre-Desert Storm)

You'd think the supply community would step back and take a collective breath after the eventful Year of Supply. But the 5 years after the

Year of Supply generated even more change.

First, the Air Force changed the way it computes spares requirements and implemented the Aircraft Availability Model (AAM) to replace the Variable Safety Level for peacetime base and depot production maintenance requirements. The AAM maximizes aircraft availability rather than computing requirements to minimize the number of back orders. Basically, for the same annual budget, the Air Force achieved a 5 to 15 percent increase in mission capable aircraft. The Air Force also implemented the Aircraft Sustainability Model (ASM), which replaced the D029 system and allowed the Air Force to meet multiple direct support objectives (DSO) at the lowest cost possible. Basically, aircraft availability replaced fill rate as a stockage goal. The ASM and the stockage policy changes allowed by it (multiple DSO, full cannibalization, and no stockage floors) resulted in higher mission capable rates at a lower cost.

The Air Force conducted a series of tests to validate the ASM and Dyna-METRIC models used to compute and assess wartime spares requirements. These tests included several Coronet Warrior exercises, which simulated actual wartime taskings where a squadron flew 30 days of sorties at a wartime tempo with only the ASM-computed readiness spares package as supply support. The exercises validated the models but pointed out a need to more strictly control the failure rates used to estimate wartime failures.

The late 1980s were a time when many reported fraud, waste, and abuse. Headlines read of $500 coffeepots and $75 hammers. Reports also cited the Air Force for rebuying items disposed of at exorbitant prices. So supply came to the rescue. The Air Force changed retention policies to hold on to items longer and initiated a program called *Wastebusters* (named after the popular movie at the time, *Ghostbusters*). Basically, customers were encouraged to return unneeded items to supply rather than disposing of them. So, "Who you going to call (to turn in unneeded parts)—Supply."

The biggest change to supply during this time occured with the end of the Cold War. The Berlin Wall came down, and supply folks got busy. Supply folks bore the brunt of the *peace dividend.* Spares budgets decreased (faster than the actual mission requirements decreased sometimes). Bases closed, weapon systems and squadrons deactivated, and missions changed. It is a fact of life that the supply workload increases as missions decrease. For example, supply people are the last to leave a deactivated base. The peace dividend also brought massive personnel decreases. So as folks walked out the door, supply got busier.

As part of the peace dividend, the Department of Defense (DoD) sought ways to reduce the defense budget. The result was a series of Defense Management Review Directives (DMRD), many of which affected supply. In fact, there were many major changes to supply. Examples include:

- Consumable item transfer (CIT)—the transfer of item management responsibilities for nearly 700,000 Air Force-managed items to the Defense Logistics Agency (DLA).
- Working capitol fund—directed that all support costs be accounted and paid for through a revolving fund. This directive eventually led to stock funding depot level reparables.
- DLA storage—DLA was to manage the storage and movement of property for all the Services. Basically, DLA took over warehousing responsibilities for all Service-managed items.

Many may remember the CIT-DLA take-over of the air logistics

center (ALC) distribution activity and stock-funding initiatives implemented in the mid-1990s. But the DMRDs that generated those changes were actually issued in the early 1990s.

The late 1980s and early 1990s brought major changes to supply—major force drawdowns, base closures, a complete revamping of the requirements computation—and major changes to supply management. Any one of these changes would have been a major adjustment, but implementing them all would take a miracle. Yet, supply held together and produced the miracle—support effective to win a war half way around the globe, a war that taxed supply and logistics like no other.

From Desert Storm to 2000

The period since the early 1990s has seen unprecedented change. The Air Force was still implementing many of the late 1980s-directed changes when Operation Desert Storm began. The war brought some major changes to supply, besides taxing the entire supply support system. The Air Force started Desert Express airlift, dedicated to critical spare parts. The contingency supply system was developed at Langley to provide the automation support required by the war. Finally, the Air Force began using the same system in war as in peace, with computer operations from the continental United States.

During the war, the Air Force implemented many of the changes directed earlier. The Consumable Item Transfer was underway, as was action necessary to stock fund depot level repairs. Besides the changes needed to reprogram the supply systems, stock funding, a major change, brought a new management mindset, to which the Air Force has not completely adjusted.

The end of the war brought pressure to reduce DoD budget and manpower levels even more. Competitive Sourcing and Privatization (CS&P) became a key strategy to reduce Air Force support personnel. Supply numbers had to be reduced, and competitve sourcing of supply accounts and functions was an effective way to do that. Accounts without deployment taskings were targeted. In addition, other selected functions were explored for competitive sourcing. The base service store and individual equipment unit were prime examples where blue-suit manpower could be freed up for wartime tasks.

The impetus to reduce manpower and the success of the Langley Supply Center during the Gulf War led the Air Force to regionalize its supply accounts. Some major commands (Air Combat Command, United States Air Forces in Europe, Air Materiel Command, and Pacific Air Forces) have begun regionalizing *back-shop* supply functions. So the major commands' regional supply squadrons will manage stock control, MICAP, stock funding, and records maintenance functions centrally.

Another major change in supply was the International Merchants Purchase Authorization Card (IMPAC). Customers order nonweapon system, local purchase parts directly from suppliers without going through supply. In fact, DoD directed the Services to use IMPAC for at least 90 percent of all eligible items. This reduced the number of items supply stocks and manages and allows it to concentrate on weapon systems.

Besides CS&P and regionalization, the Air Force has taken steps to combine like functions. Selected supply and transportation functions—receiving, shipping, and pickup and delivery—have combined, and there are studies to extend those initiatives into a distribution squadron.

So far we've discussed changes to supply, but our customers and

their management and missions have also changed. First, there was the composite wing—combining various types of aircraft into one fighting unit. These led to supporting more *types* of lower density aircraft. Either of these two—differing types of aircraft or lower economies of scale—complicates support. Together, they tax a supply system. Now, there are new contingencies, with aerospace expeditionary forces and their partial squadron deployments. The supply system had to adapt to the increased deployment ops tempo and the even smaller support economies of scale.

Other management changes included two levels of maintenance and Lean Logistics. Two levels of maintenance reduced base-level maintenance for more efficient centralized maintenance. And Lean Logistics pressured to reduce all logistics pipelines. So with less manpower than ever before, supply is still able to move parts faster. Part of the Lean Logistics concept was more responsive depot repair. The Air Force Materiel Command (AFMC) implemented two systems to improve the depot repair process—the Depot Repair Enhancement Program (DREP) and Execution and Prioritization of Repairs Support System (EXPRESS). DREP sought to relieve maintenance of all tasks, except repair, while it established a shop service center to identify and resolve repair constraints. Relieving constraints was important because AFMC now forecasts and inducts items to repair every day instead of quarterly. Shortening the forecast horizon to 1 day means repair is more responsive to real demands, not forecasted demands (as long as there are no constraints preventing repairs). Basically, AFMC will no longer repair *buggy whips* (forecasted demands that never occur or items that have no repair constraints but aren't needed). EXPRESS also uses aircraft availability-like logic to prioritize repair. So EXPRESS makes repair more effective and efficient.

The Future

The mission that supply supports has changed drastically. There are 40 percent fewer supply people, the supply organization has changed completely, and the ops tempo has increased. About the only thing that hasn't changed is the automated supply system–the SBSS. The Air Force is in the process of modernizing the SBSS. The new system, the Integrated Logistics System-Supply, will be a refresh of the SBSS, with some processes reengineered to take advantage of new technology.

It's no wonder that Air Force readiness has declined over the last 5 years. The world has changed, and the supply system has strived to keep pace. With all these changes, there was bound to be some decline.

Everything about supply has either changed—or will shortly change—since I was a new supply officer. Well, almost everything. Two things remain constant. The supply family remains. It remains a well-educated, highly motivated, professional team. And the Air Force supply system remains a world-class system. As part of the modernized supply acquisition process, the Air Force had the opportunity to review commercial supply systems to replace the SBSS. The Air Force learned there is no system to match the SBSS and no way to match its people.

I am proud to have worn the Air Force supply/fuels badge. And despite the sometimes overwhelming changes the supply family has had to undergo, there is nothing like it.

The Supply Officer: 2010

Major General James W. Hopp

The Air Force supply officer career field has much opportunity, if the leaders and the officers in the career field are ready and willing to embrace change. If not, the career field will become redundant and could be eliminated. Why do I say this?

First, the size of the Air Force is down dramatically—from around 600,000 active duty members in 1989 to fewer than 400,000 in 2000, a 40 percent reduction in active duty end strength. The Department of Defense budget has declined 28 percent since 1990, procurement spending has decreased by 53 percent, and operations and maintenance has been reduced by 15 percent. While this is not news, the pressure to reduce the support side of the equation is continuing and will increase in the years to come. Operations and procurement of new systems appear to have taken all the cuts they can afford.

Second, the way the Air Force will provide support to new weapon systems and, to some extent, existing systems will be significantly different than in the past. C-17 Flexible Sustainment, F-117 Total System Performance Responsibility, and other concepts that provide contractor logistics support are either already in place or will be in the near term.

Third, there is a valid need for an officer corps that can provide what the commercial world refers to as *supply chain* expertise. While this is close to what many supply officers have developed into, it is not reflected in the way the career field is described or in the training. Some of these changes include major command (MAJCOM) supply regionalization, loss of base service stores and individual equipment sections, increased use of the Government-wide Purchase Card, the Defense Logistics Agency's expanding use of prime and direct vendor delivery contracts, and the evolution of the Expeditionary Aerospace Force concept. The Air Force Deputy Chief of Staff for Installations and Logistics' transformation program will drive even more dramatic changes in the logistics processes.

Next, many of today's supply officer functions are similar to, or the same as, those taught in 1963 in the supply officers course at Amarillo AFB, Texas, That may not be bad, but it does not reflect what has happened in the commercial marketplace and what needs to happen in the Air Force.

Finally, there has probably never been a better time to make a change. The Air Force is conducting a logistics transformation program, the Chief of Staff has directed an assessment of the logistics organization and career fields, there are ongoing reengineering initiatives in all logistics career fields, and the MAJCOMs are all looking for more effective and more efficcient processes for logistics support. Industry has shown they can *reinvent* the traditional supply functional experts into *supply chain* managers who have better career paths and contribute more to the operational and financial health of the company. The Air Force needs to do the same thing with its supply officer and other logistics functional career fields.

The logistics support officer should be the single point of contact for the wing commander, the logistics group commander . . . for anything and everything to do with getting parts or logistics services to satisfy their mission requirements.

Commercial Supply Chain Manager Model

Before discussing how to restructure the Air Force supply officer career field (AFSC 21SX), we need to compare it to the typical commercial, supply chain management position and highlight some of the responsibilities of the commercial supply chain managers.

Air Force Manual (AFMAN) 36-2102 describes supply officer duties and responsibilities as:

> Directs, manages, and operates supply, equipment, and fuels management systems; develops, formulates, and implements plans, programs, and policies to operate, manage, and administer current and projected supply and fuels management systems; requirements determination and computation; allowances and authorizations; inventory and distribution control; reporting; stock fund operating programs preparation; and operations operating budget preparation. May serve as an accountable officer.[1]

What are the typical duties involved in supply chain management? Companies tend to differ in how they describe the duties of a *supply chain manager*, but they all generally involve those duties described in this description and the following quote.

> Simply stated, the supply chain encompasses those activities associated with moving goods from the raw-materials stage to the end user. This includes sourcing and procurement, production scheduling, order processing, inventory management, transportation, warehousing, and customer service. It also embodies the information systems so necessary to monitor these activities.
>
> Successful supply chain management coordinates and integrates these activities into a seamless process. It embraces and links the partners in the chain. In addition to the departments within the organization, these partners include vendors, carriers, third-party companies, and information systems providers.[2]

Further, a description of the logistics professional in supply chain management includes the following quote from *Logistics! Candid Insights for Supply Chain Leaders.*

> Today, a successful supply-chain leader serves as a natural facilitator and integrator between the divergent needs of sales and manufacturing, quality and price, cost and service, and financial and qualitative measures.
>
> To assume this kind of quarterback position effectively, however, logistics professionals have to do a couple of things. For one, they must broaden their understanding of other business functions within their organization. Specifically, they need to know more about purchasing and sourcing practices, production planning, marketing initiatives, and sales programs and promotions. They also must develop a more intimate knowledge of the customer, for as the new maxim goes: supply-chain management begins and ends with the customer.[3]

While each company may structure its positions differently or give the job a different title, the responsibilities are similar. The following are three supply chain manager position descriptions.

- **Supply Chain Manager** for a $100M manufacturing company. Provides strategic direction and leadership to the purchasing and inventory groups in all activities related to the selection, procurement, receipt, and management of products and services. The successful candidate will manage inventory levels and develop a strategic materiel/procurement plan that supports

the objectives of the organization. Strong involvement with vendor evaluation and relations, negotiating bids, and qualifying the vendor base to support enterprise-wide objectives.

- **Vice President of Operations** for an international paperboard, packaging, and building material company. Responsible for driving key initiatives for the organization. Requires background and hands-on experience in the areas of logistics, transportation, customer service, store operations, forecasting, and all supporting information systems. Additional responsibilities include leading and developing customer-integrated logistics initiatives to improve company services and cost relationship with the customer. Participates in strategy development with a broad consumer/retail customer base. Creates linkage within team and across teams for all logistics, forecasting, and customer service initiatives. Ensures inventory to support both new product availability and promotion activity. Effectively manages all integrated logistics and customer service initiatives.
- **Senior Manager/Associate Partner for Supply Chain Management** for a major consulting firm. Requires strong experience in one or more of the following areas of supply chain optimization: (1) e-procurement, (2) advanced planning systems, (3) e-fulfillment (online order processing/returns), and (4) systems integration (information technology delivery of supply chain systems/implementation—integration).

While there are many similarities in the major supply chain management (SCM) functions in AFMAN 36-2105, the differences are dramatic. The commercial SCM manager has a much broader responsibility for the entire process of determining what is required; purchasing, transporting, storing, and issuing; planning production and repair of an item; and ensuring the customer is properly supported. The Air Force supply officer has no responsibility for acquisition, transportation, or production/repair planning. These functions are performed and directed by different career fields. Yet, the supply officer is the one to whom the wing commander turns to ensure the necessary parts are available to meet sortie requirements.

What Should the *Reinvented* Supply Officer Career Field Look Like?

The supply officer of the 21st century Air Force, with the principal duty of supporting the Aerospace Expeditionary Force (AEF), should be an officer who is trained to perform the traditional functions associated with logistics plans, supply, acquisition (procurement), component repair, and transportation currently performed by five separate career fields. This reinvented career field should be called the *logistics support officer*.

This *logistics support officer* should be the single point of contact for the wing commander, logistics group commander, or operations squadron commander for anything and everything to do with getting parts or logistics services to satisfy mission needs. This does not mean they actually have to do the work, but rather ensure it is done. For example, if an operations squadron needs to have a service contract for logistics support of a mission planning system and the inventory manager does not provide the support, then the *logistics support officer* should be able to determine what company can provide the best service and direct the award of the contract using e-procurement or other web-enabled techniques.

To illustrate the differences between the commercial supply chain manager's and the military supply officer's responsibilities, consider a few examples.

Acquiring parts or repairs needed on an emergency basis is another case where the logistics support officer should provide the service without having to go though the contracting activity. These steps add time and cost but do not add value. That is why they have been eliminated in industry. If the logistics support officer is the *contracting authority*, the processes will allow this support to be obtained from the fastest and most efficient source available, without the delays that result from having to pass purchase orders from office to office.

In the area of fast transportation, the logistics support officer should also be able to direct the manner and speed of the shipment to and from the base to meet operational needs and budget restrictions. For example, how many of you order from a catalog or from an online web site? You decide at the time of your order if you want to pay for premium transportation or allow the shipper to decide, based on when you need the item. There is no reason in today's e-commerce environment that logistics support officers should not be able to do the same thing.

In the commercial example, the supply chain manager would not have to go through all the *hoops* or prepare all the paperwork that must be generated to do a similar task in the Air Force. The requirements are the same, and the process should be the same. The appropriate checks and balances could be established to meet the requirements of the *Federal Acquisition Regulation* (FAR). Better still, maybe the FAR restrictions should be removed as an acquisition reform initiative to permit a more flexible and effective support process.

So How Do We Create this *Logistics Support* Officer?

First, determine what functions a logistics support officer needs to provide support to the AEF wing commander at both the home station and in the deployed operational environment.

Second, design the technical schools to teach young officers to use their brains and the skills they bring with them into the Air Force. They know how to use the web. Allow them to use sites like *buy.com, myaircraft.com, Exostar.com, aerospan.com,* and others to buy authorized items and services. Laws and regulations must be addressed to ensure correct parts and services are being procured, but this can be done using the Assistant Secretary of the Air Force Acquisition Lightning Bolt process.

Third, define what can and cannot be bought at the local level and what can and cannot be bought without a contracting officer's warrant. There may even be a point where logistics support officers have warrants up to certain levels. The list for what cannot be bought should be fairly short. It should not be used as a way to keep jobs in a career field but should be limited to items and/or services that are safety of flight or engineering critical at the field level or specifically mandated by public law.

Fourth, create a career path that begins with second lieutenants to lieutenant colonels learning the intricacies of the contracting, logistics plans, supply, and transportation fields through both technical schools and field experience. Eliminate stovepipe schools and training paths and create a consolidated career path from the start, creating a multiskilled officer. All career fields multiskill their officers today, and they can handle the complexities of the various logistics disciplines. In this way, when officers are ready for squadron command, they will be better prepared to lead a consolidated *logistics* squadron. This logistics squadron would replace the current supply, transportation, and contracting squadrons and be responsible for

supporting all facets of the wing's mission in the logistics functional disciplines.

Conclusion

You may not agree with me but at least look at both the positive and negative aspects from the standpoint of what is best for the Air Force and its officers in the 21st century. One of my greatest regrets is that I did not initiate the discussion of more dramatic changes when I was the Director of Supply. I am not sure I could have gotten anyone to listen, but we could have had some interesting discussions.

The Air Force is not a business, and there are a lot of what some call *inefficiencies* in how supply and logistics business is done today, especially in support of the deployed units. Some of these *inefficiencies* are necessary to ensure the support required to respond with little notice to contingency operations. However, I reject the argument that, because the supply officer supports the warfighter, we cannot be more effective and efficient in how we do the job. The idea that we are so different or unique we cannot use commercial models will not wash anymore.

An opportunity exists for Air Force supply (and logistics) leaders to be creative in planning how the career field should evolve. If they do not seize the opportunity, the career field will become redundant, and the career path will stagnate and could be eliminated. We owe it to the officers in the supply career field to maintain a viable, effective career path, one that supports the warfighter in the most effective and efficient manner possible. Moreover, the supply officer is uniquely positioned to be the centerpiece to implement the new SCM capabilities to support the AEF. This new career field can be the bridge between planning and execution of the reengineered AEF support patterns.

Now is the time to look creatively at how the current supply officer and other logistics functional officer career fields can be combined to better support the Air Force and provide a better career path for the officers who will follow.

Maj Gen Hopp (USAF, Retired) was the director of supply, Office of the Deputy Chief of Staff for Logistics, Headquarters US Air Force, Washington DC. He retired in 1992.

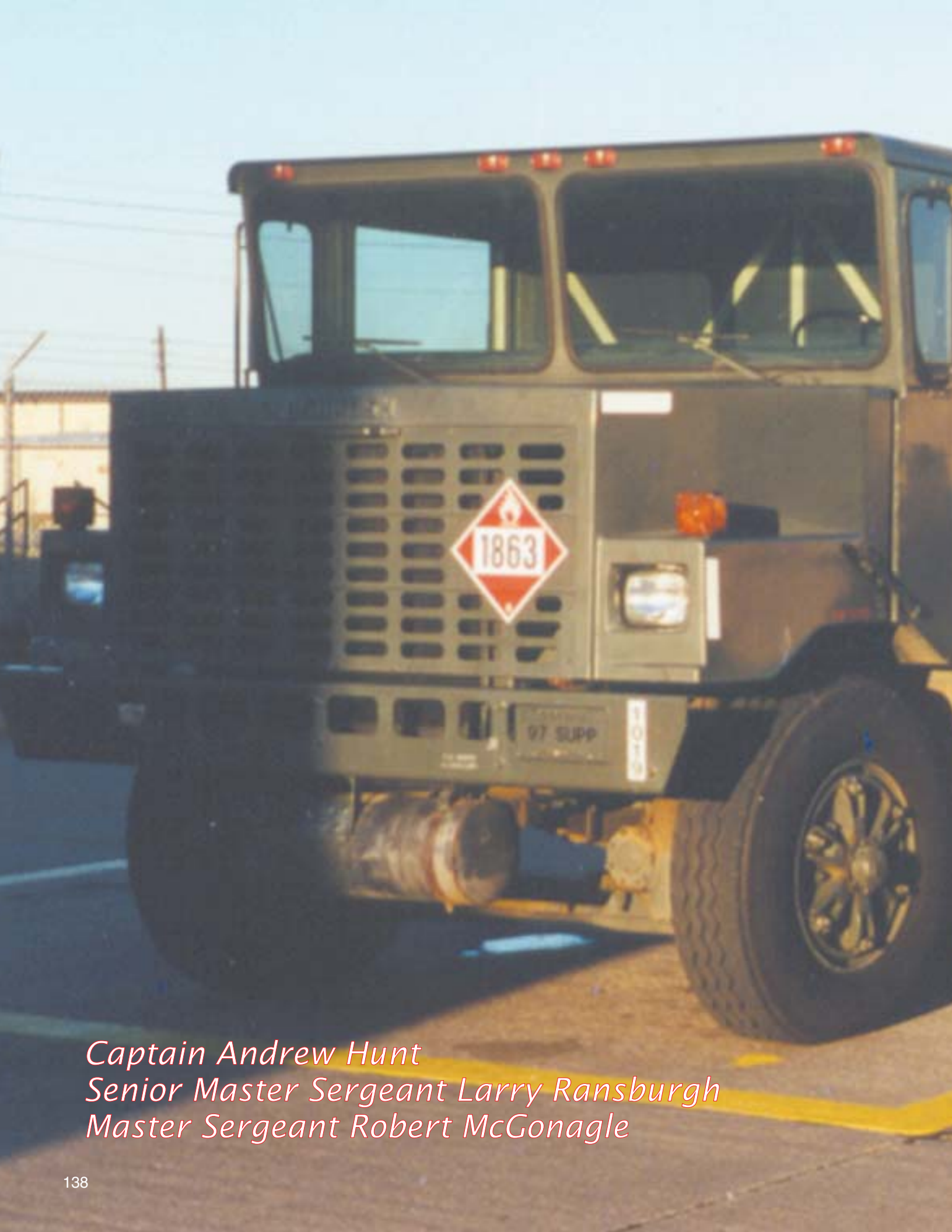
Notes

1. *Air Force Manual* 36-2105, Attachment 6, 11 Mar 98.
2. "What's the Buzz? (Supply Chain Management), Logistics Management, 1 Feb 97, 1.
3. "What's the Buzz?" 5.
4. *Air Force Manual* 36-21105.

notable *quotes*

Behind every great leader, there was an even greater logistician.

M. Cox



Captain Andrew Hunt
Senior Master Sergeant Larry Ransburgh
Master Sergeant Robert McGonagle

the Changing Environment of Air Force FUELS

"Without Fuel, Pilots are Pedestrians"

Maybe this unofficial slogan of fuels management organizations is not exactly politically correct, but it does speak volumes about the attitude and pride of the Air Force *fuelie*. While it is under the control of the supply squadron commander, the fuels flight stands alone in many ways. Its personnel have a different Air Force specialty code than the rest of the squadron (2F0XX versus 2S0XX), its facilities are often geographically separated from base supply, and no other part of the squadron has the same level of contact with the operational community. As a result, the fuels management flight is a close-knit group that takes pride in the job at hand—a job that most people unfamiliar with petroleum, oil, and lubricants (POL) consider routine. Two major components define the development of POL. First, systems used to receive, store, and distribute fuel have evolved as the mission of the Air Force has changed. Second, as new, more complex aircraft have entered the inventory, the fuels used to power them have been modified to meet new requirements.

Fuels Systems

The infrastructure of base-level fuels organizations has changed little in concept and only slightly more so in design over the last 50 years. Fuels support has always been governed by three factors: receipt capability, storage capacity, and distribution capability. Depending on the aircraft stationed at a given installation, the methods by which these three components are handled may differ. However, the differences are not often dramatic and are usually a result of technological innovation. Traditionally, fuels systems are time-proven, expensive resources, thereby limiting the Air Force to those changes that are crucial to mission accomplishment.

A 1.7 million gallon above ground storage tank

Receipt

As early as the 1950s, fuel was delivered to Air Force installations by both pipeline and rail. By 1967, a number of Air Force installations were connected to a pipeline network nearly 1,400 miles long. In the 1970s, the pipeline extended to nearly 7,000 miles, feeding 19 bases. However, not all bases were located in any appreciable proximity to an established petroleum pipeline. These bases received fuel by railcar, truck, and in some cases, barge. Today, to ensure operational flexibility, all bases must be able to receive fuel by at least two different methods. The methods of receipt have changed very little over the years, and offloading processes are still based (for the most part) on those used nearly 50 years ago.

Storage

The same consistency found in receipt is also present in fuel storage. While technological advances have evolved to provide increased tank integrity, the basic principles have remained relatively constant. Fuel tanks fall into two major categories: underground storage tanks (UST) and above ground storage tanks (AST). Tank sizes can range from 10,000-gallon USTs to ASTs that can hold more than 5 million gallons. Since fuel is not very environmentally friendly, numerous measures are in place to minimize the risk of spills. Federal regulations ensure strict compliance in the construction and use of USTs. All USTs must have leak detection, fill/overspill shutoff devices, and cathodic protection (to protect the tanks from corrosion). ASTs must also conform to regulatory measures. Each tank must have leak detection devices, fill and overspill shutoff valves, and local alarms. The tanks must also have a concrete basin with an impervious liner. These measures are designed to protect not only the environment but also the personnel handling the fuel.

Distribution

Delivery of fuel from the storage facilities to the aircraft occurs in various ways. It can be dispensed directly from either a hydrant system or a refueling truck. The type of aircraft and facilities available dictate the method used; therefore, several different hydrant systems are currently used in the Air Force.

The Type I Panero is the oldest system in the Air Force (first built in 1950), has been modified numerous times, and is currently used on 27 installations throughout the Air Combat Command (ACC). It is limited to one hydrant outlet per valve and cannot handle a simultaneous defuel/refuel. This older system draws fuel from a series of USTs, usually capable of storing 50,000 gallons per tank. Its outlet flow rate tops out at 300 gallons per minute (gpm) per outlet and is best suited to handle small, tactical aircraft such as the A-10.

The Type II Pritchard system is almost identical to the Type I in design and age and is better able to handle the high demands of older, large-frame aircraft, as well as tactical aircraft. With three outlets per valve, rather than the one outlet found in the Type I, more than one aircraft can refuel at a single hydrant valve. Another major difference is found in the defueling capability of the system. Type I systems use gravity to defuel, while Type II systems actually have the capability to do a pressurized defuel. Currently, the Type II system is used more than any other in ACC and is found on 30 bases.

Both the Type I and II systems are dificult to maintain due to their age and lack of spare parts. However, both do the job very well and will most likely continue to be used in large numbers.

The Type III Phillips Constant Pressure system, designed in the 1950s but not actually constructed until 1980, represents the first major advancement in fuels hydrant systems since the construction of the Panero system. This system is a constant-pressure loop, where any number of aircraft can receive fuel at one time(up to the gpm flow of the system). Unlike the previous two systems, it uses ASTs and can refuel and defuel simultaneously. Also unlike the Type I and II, the Type III outlets are hydraulically powered and do not suffer the electrical problems often found in the older systems. It has a greater gpm capacity at the hydrant outlet than either the Type I or II (600-1200 gpm) and is better suited to service large aircraft.

The Type IV system has not been widely implemented and is found only with certain aircraft. Built in 1992, it is primarily used in hangars or hardened aircraft shelters and is suited to service small aircraft, such as the F-117A. The flow rate of the system's hydrant outlets tops out at 600 gpm, and the aircraft's fuel system actually controls the rate. The system draws fuel from an underground fuel vault and dispenses to the aircraft through a stainless steel pantograph. Usually, the aircraft's engines are running during the refuel. There are only three examples of this system currently in service.

The Type V in-hangar system is much like the Types III and IV and is used by the Pacific Air Forces and United States Air Forces in Europe for in-hangar refueling.

The B-2 ystem, used to refuel the B-2 Spirit aircraft, is a combination of each of the previously mentioned systems. It is an in-shelter system (Type IV), refueling on a pressurized system (Type III) with a 302 valve (Type I) and rapid defuel capability (Type II).

The costs associated with replacing the old fuels systems are extremely high. Since these systems still function in an acceptable manner, near-term replacement seems unlikely.

Fuels Mobility Support Equipment

In a deployed environment, the fuels receipt, storage, and

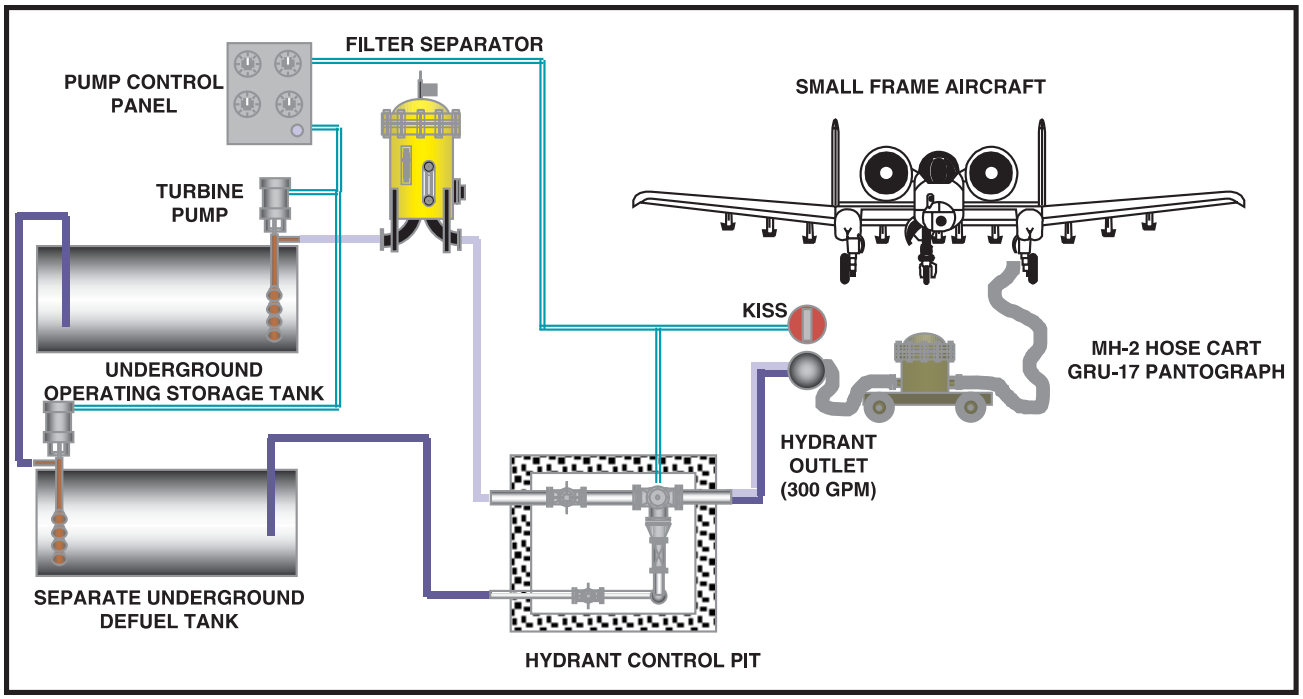


Figure 1. Panero Type I System Schematic

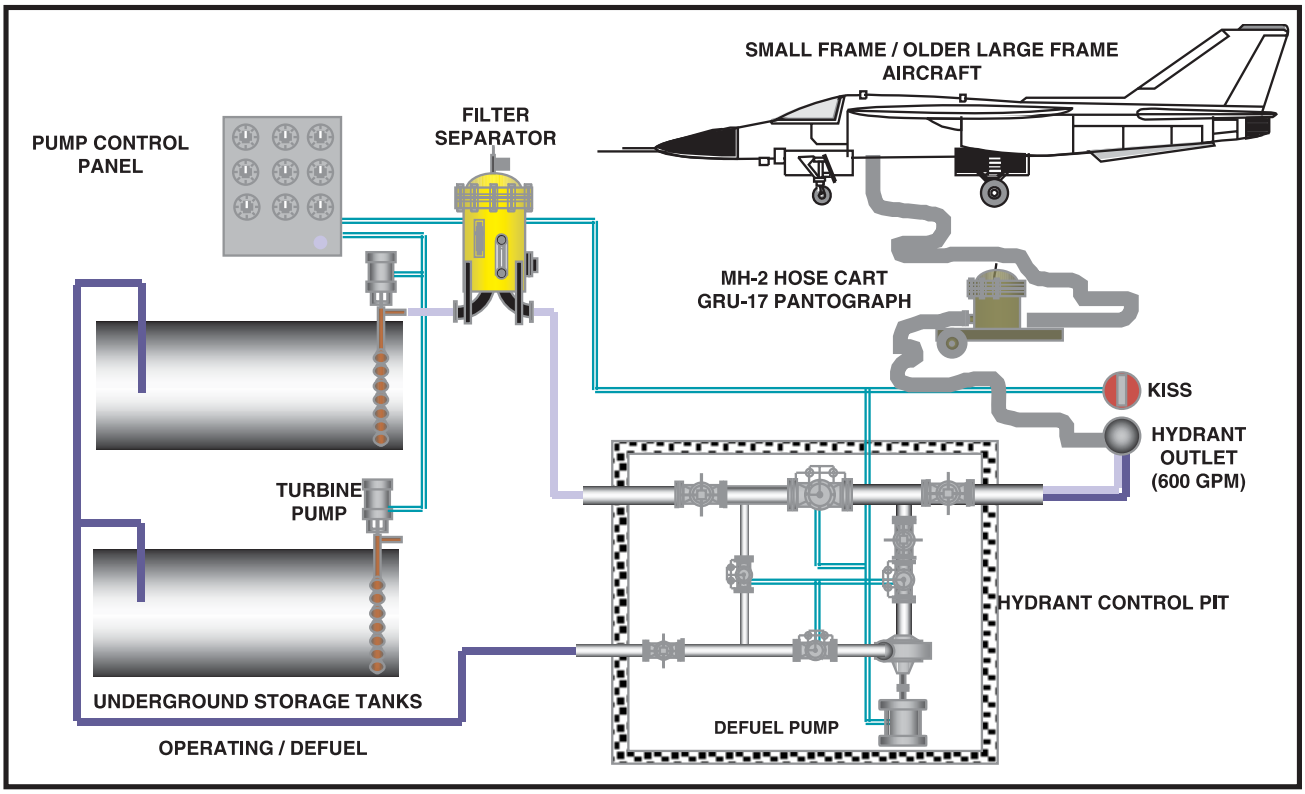


Figure 2. Pritchard Type II System Schematic

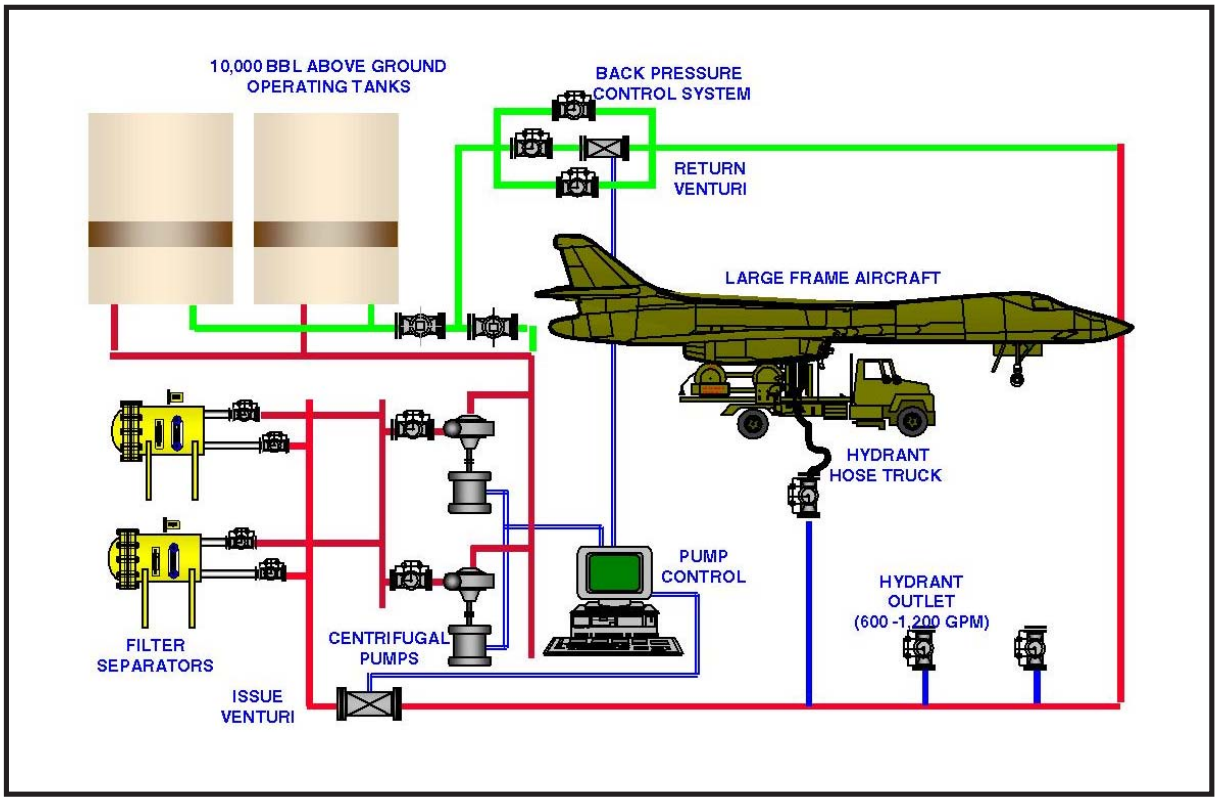


Figure 3. Phillips Type III System Schematic

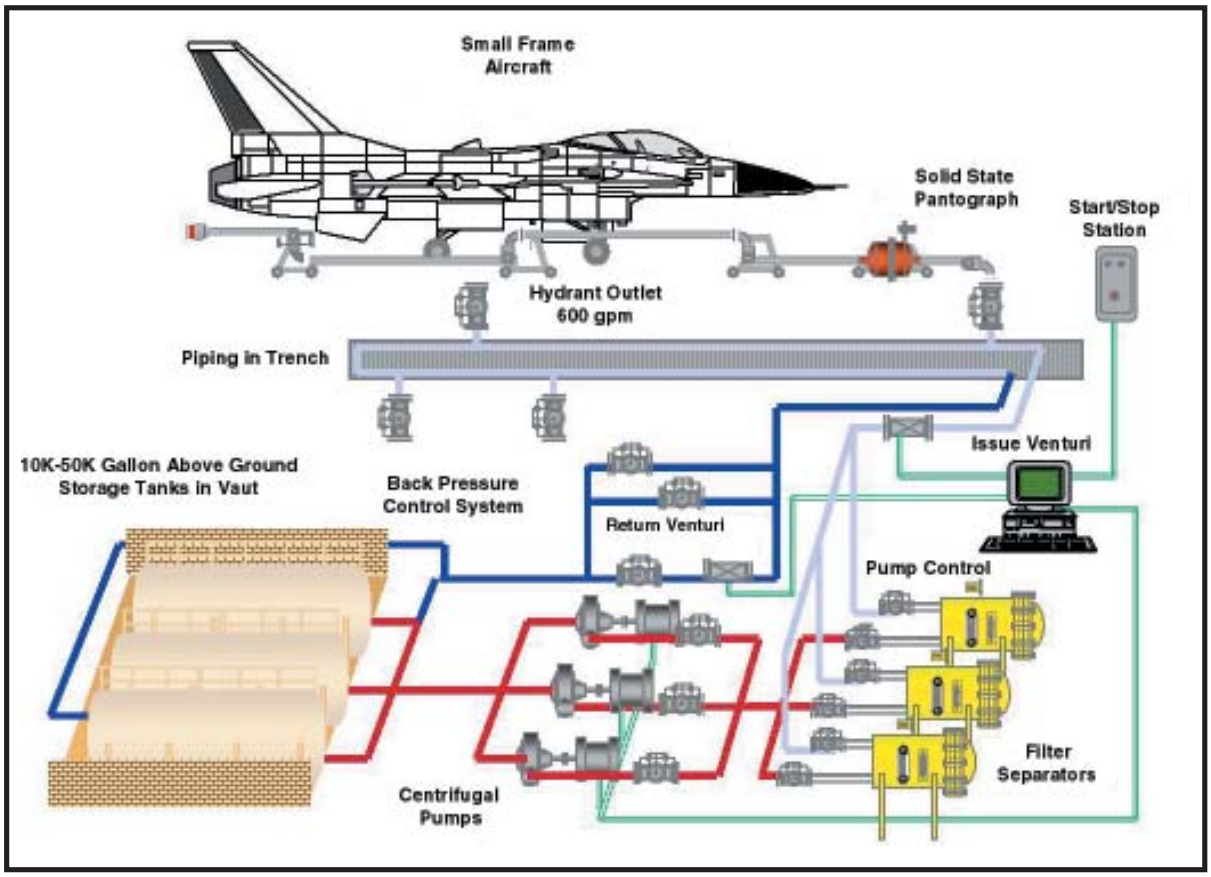


Figure 4. Type 4 System Schematic

distribution systems vary greatly from those found on established Air Force bases. In such austere environments, fuel is typically received via tank truck and unloaded into 25,000- or 50,000-gallon fuel bladders. To service aircraft, the fuel is drawn from the bladders using an R-14 Air Transportable Hydrant Refueling System (ATHRS), which serves as a fill stand, and is loaded into a refueling truck.

The R-14 ATHRS, by far the most widely used system and one of the most versatile, is a portable hydrant refueling system that can be airlifted or ground shipped anywhere in the world and made fully operational in a matter of hours. A complete system contains three identical self-sufficient modules. Each module consists of a pumping unit; two 50,000-gallon bladder tanks; and all the hoses, valves, and fittings necessary for operation. The pumping module is configured on a four-wheeled trailer and features the same components found on conventional servicing equipment. Each R-14 module can fuel one heavy aircraft at 600 gpm or two fighter aircraft at 200 gpm.

An R-14 ATHRS

50,000-gallon collapsible tanks

Collapsible, coated fabric tanks normally are provided in either 10,000- or 50,000-gallon capacity. They are constructed of single-ply, nylon material with reinforced corners and impregnated with urethane or nitrile. The interior is coated with polyester. The 50,000-gallon tank weighs approximately 1,400 pounds; the 10,000-gallon tank weighs approximately 200 pounds. Dimensions of an empty 50,000-gallon bladder are 24 feet by 65 feet. Dimensions of an empty 10,000-gallon bladder may be 12 feet by 42 feet or 22 feet by 22 feet. The tanks are tested to operate from –40 to 160 degrees Fahrenheit. If deployment plans require the use of bladders, a suitable site must be selected for them. The area should be approximately 100 by 160 feet long for an R-14 system and free of rocks and obstructions. The ground should be as level as possible, with a maximum slope of 3 degrees to prevent the tank from shifting. A dike or berm should be constructed around the tank area to provide a capacity of at least 1-3/4 times the capacity of the tanks.

The R-25 Air Transportable Hydrant Refueling System is a smaller version of the R-14. Its primary purpose is to service smaller aircraft at remote forward operating locations. The system consists of one small module with a centrifugal pump driven by a 20-horsepower, 4-cylinder gasoline engine. The R-25 is equipped with two 10,000-gallon bladder tanks and all fittings and hoses needed to fuel, defuel, dedrum, or recirculate fuel. Maximum delivery is about 300 gpm.

The R-26 Air Transportable Hydrant Refueling System is smaller than the R-25 and provides general service refueling capabilities at forward locations. It consists of one servicing module trailer with a centrifugal 100-gpm pump, a 5-horsepower, 2-cylinder engine, filter separator, meter, hoses, valves, and fittings. It can issue fuel from one 10,000-gallon bladder, two 500-gallon bladders, or four 55-gallon sealed drums.

The R-22 Trailer Mounted Transfer Pump is generally used to push fuel from a bulk storage system, tank truck, or tanker aircraft to ATHRS system bladder tanks. It is often used in conjunction with the R-14 system and can also be used with a hose cart or skid-mounted filter separator to deliver fuel directly to aircraft. It has an 85-horsepower, gasoline engine that can deliver fuel through the line at up to 900 gpm.

The Aerial Bulk Fuel Delivery System (ABFDS) enables aircraft to transport fuel rapidly to locations close to or behind enemy lines. The ABFDS consists of two 3,000-gallon aerial bladder tanks, two pumping modules, a meter, and

hoses. It is typically installed in a C-130 aircraft but can be installed in a C-141, C-5, and C-17. The tanks are mounted on a delivery platform and held securely by tiedown straps. A crossover manifold connects the two pumping modules and allows filling or evacuation of both tanks by one module. The ABFDS is capable of delivering 600 gpm with one pump or 1,200 gpm using both pumps. It is an extremely versatile system capable of offloading fuel into trucks, bladders, and other containers. The ABFDS can also be used with alternate capability equipment for filtration of aviation fuels, 500-gallon drum transport, wet-wing defueling, and aircraft-to-aircraft refueling.

A forward area refueling point (FARP) provides personnel and specialized equipment needed to establish and operate forward area refueling. Used primarily in quick-turn support of special operations aircraft, FARP provides a highly efficient way of transferring fuel from aircraft to aircraft in a nonstandard or hostile environment. FARP operations expand the role of special operations forces around the world by providing a means of hot refueling from a tanker aircraft to various types of fixed- and rotor-wing aircraft. Responsibility for the teams, equipment, and all FARP missions falls under the Air Force Special Operations Command at Hurlburt Field, Florida.

Mobile Refueling Units

Few major changes in technology have affected the Air Force refueling truck fleet. Currently, the industry standard is the Osh Kosh R-11. This 6,000-gallon capacity tanker truck can provide mobile fuels support to any aircraft in the inventory. The new trucks sport larger tank capacities, push-button transmissions, and air-conditioning, but all have the same basic filter elements found in the venerable R-5 and R-9. Perhaps the most visible change is the color of the truck. Until the late 1980s, the primary color of the refueling units was brilliant yellow. Now, they are the more traditional olive drab.

For the delivery of ground fuels, the flight relies on the C-300/301, the difference being the 301 can handle off-road conditions. These trucks have a 1,200-gallon tank and carry diesel and unleaded motor gas (MOGAS) to a variety of base customers. While there are significant changes pending in the aircraft arsenal, significant changes to the mobile refueling fleet seem unlikely.

Product Advances

Like the evolution of the fuels systems, changes in aviation gasoline have also defined the development of fuels management organizations. Specifically, two major factors precipitated the need for improved aviation fuels after World War II. First, the nature of the aircraft in the Air Force inventory underwent fundamental changes with the dawning of the Jet Age. Before World War II, a plane's average consumption rate was merely 40 gallons per flying hour. With the introduction of such aircraft as the F-80 Shooting Star, F-86 Super Sabre, and the Navy's F9F Panther, this consumption rate increased dramatically. These aircraft were complex, and the jet petroleum (JP-1) used in 1944 was simply not sufficient to power these new machines. From 1944 to 1947, aviation fuel underwent three changes that incrementally improved its performance specifications. In 1951, the Air Force employed JP-4, a fuel that would remain its mainstay for nearly 25 years.

JP-4/JP-5 and the Cold War

The development of JP-4 was an answer to the second major factor: an increased scope of aerial operations. The Cold War saw a large increase in the number of

FARP team in action near Mocoron, Honduras. Fuel is stored in small blivets.

An R-11 refuels an F-15.

locations from which the Air Force operated. To combat the Soviet threat, the Air Force stationed its aircraft at many northern tier bases. At low temperatures, JP-4 performed admirably, since its freezing point was –72 degrees Fahrenheit. However, JP-4's low flashpoint (the temperature at which fuel is susceptible to combustion from a spark) meant that the fuel was inherently dangerous. At about the same time that JP-4 became the Air Force's staple fuel, the Navy began using JP-5. JP-5's flashpoint is relatively high (140 degrees Fahrenheit), which is necessary in the highly static-charged environment of an aircraft carrier deck.

Special Fuels—JPTS and JP-7

In 1956, the Air Force recognized the need to develop certain special aviation fuels for unique platforms. The U-2 reconnaissance aircraft flew at altitudes unattainable by other aircraft. As a result, JPTS (jet petroleum—thermally stable) was manufactured to fuel the Dragon Lady. This fuel performed exceptionally well at extreme altitudes. Another special fuel was developed in 1970 to power the SR-71 Blackbird. JP-7 is (or was, depending on what version of the SR-71retirement story you believe) used only by the SR-71 and has its own KC-135Qs to serve as refuelers.

JP-8, The Air Force Mainstay

JP-8 was developed in 1979 and is still used today. This fuel is used worldwide and has increased thermal stability over the venerable JP-4. Every airplane in the Department of Defense inventory can take JP-8. Like JP-4, JP-8 contains a number of additives that enhance performance. These additives do everything from preventing icing to lowering conductivity and protecting the aircraft's fuel systems. The additives in JP-8 are similar to those found in commercial jet fuel, offering the Air Force a great deal of flexibility. Future advances involving this petroleum include JP-8+100 and JP-8+225. Each of these experimental fuels has an increased thermal stability. More economical than JPTS, JP-8+100, or some other variant, may be the logical replacement as the U-2's primary fuel.

Conclusion

Since the inception of combat aviation as a viable military tool, quality fuels support has been important. Air Force fuels personnel have accepted the

JP-8+100: The next generation of DoD fuels?

As aircraft performance capabilities continue to increase, the need for thermally stable fuel increases as well. JP-8+100 is a derivative of JP-8 with a significant increase in the fuel's thermal stability. JP-8+100 has the same anti-icing, conductivity, and corrosion-inhibitor additives as JP-8 and also contains detergents. The fuel is designed to reduce the coke and gum deposits left in aircraft engines. It actually cleans the engine as it burns. The Air Force hopes that JP-8+100 can reduce the mean time between failures of certain engine components.

While existing filter separators cannot be used with JP-8+100 since the detergents disarm the coalescer elements, preventing the removal of water from the fuel, research continues to design and construct more advanced filters. In fact, a number of potential filters have been tested, and the results are promising. Additional studies are also in progress to determine the actual cleaning ability of the fuel. The fuel is used at more than 20 active duty Air Force facilities and throughout the Air National Guard. As the initial obstacles are cleared, the Air Force will ready more airframes and locations for the use of this performance-enhancing fuel.

challenge of providing the cleanest, driest, and highest quality petroleum products to the flying units and performed in a truly professional manner. Ensuring that the right product in the right amount gets there at the right time has been the trademark of the fuels community. Rarely, if ever, does a plane miss a takeoff due to poor fuels support. This track record is indicative of the intense esprit de corps found in the fuels community. As the Air Force continues to evolve into an expeditionary organization, the tasks and challenges facing this career field will undoubtedly be daunting. However, if past performance is any indication, there is no reason to believe the mission will not be performed in the outstanding manner for which POL is legendary.

Capt Hunt and MSgt McGonagle are project managers in the Supply Division of the Air Force Logistics Management Agency. SMSgt Ransburgh recently retired from the Agency.

notable *quotes*

Strange as it may seem, the Air Force, except in the air, is the least mobile of all the services. A squadron can reach its destination in a few hours, but its establishment, depots, fuel, spare parts, and workshops take many weeks, and even months to develop.

Winston Churchill

“There I was....”

Personal Accounts from ‘Fuelies’

“A1C Lopes was servicing his fifth T-38 of the morning when he noticed that his crew chief took off running. He looked around his area and saw that everyone was evacuating the flight line . . . .”

SMSgt Mike Bradow

“Hey, you might want to move back. If there is a fire on the truck, we’ll do what we can, but if it is on the aircraft, good luck to you . . . .”

SSgt Sheldon Cash

“As I looked down the taxiway at sunrise, dozens of F-15 fighters were lined up waiting to take off. The sight of F-15s rocketing to the sky with afterburners glowing was an awesome sight for this young POL troop . . . .”

MSgt Jim Launer

"He wanted one of the KC-10s stationed with us to be refueled in 1 hour. Normally, this wouldn't be anything out of the ordinary . . . . What this aircraft was going to need was closer to 40,000 gallons . . . in less than 60 minutes . . . . "

SrA Ron Mann

"I reminded him that we had spent the last 24 hours in the air and that we were starved for news. He told me the bad news—19 dead and more than 200 hurt . . . ."

Capt Bruce Bartholomew

"We were going to go into Iran and rescue our fellow Americans, unjustly held hostage for more than a year . . . ."

SMSgt William Neckar

SMSgt Mike Bradow
5 SUPS/LGSF

There I was . . . stationed at Holloman AFB during the early 1980s. We had a very demanding mission, refueling more than 275 aircraft a day (approximately 225 T-38s and 60 F-15s per day), Monday through Friday. There were no hydrant systems installed at the time, so every aircraft was serviced with 1973 model Dodge R-9s. Every refueling unit was exactly the same, and considering the model of refueler, they were in great shape.

Keeping 32 R-9s in such great shape was the responsibility of our preventative maintenance element. Four people were permanently assigned and augmented by *Distro* as needed. Every morning, two separate vehicle checkpoint lines were formed to thoroughly check each unit before it was used for that day.

One of the daily checks for the units was the water levels in each of the four batteries (and these were not the maintenance-free ones that are so common today). Each one had six separate compartments to check, so you can see that it took a fair amount of time just to do this one item. After checking the batteries one morning, one of the team members neglected to replace the rubber mat that goes between the batteries and the box cover. This unit was used later that morning for service on the T-38 ramp.

A1C Lopes was servicing his fifth T-38 of the morning when he noticed that his crew chief took off running. He looked around his area and saw that everyone was evacuating the flight line. Lopes was still wondering what was going on when a line truck came screaming up. The driver yelled, "Your truck is on fire!" and speeds off. Airman Lopes then initiated the emergency shutdown procedures (back then, units had no deadman controls) and ran around to the passenger side of the unit. He found the battery box on fire, grabbed the fire bottle off the side of the unit, and attempted to use it. In the excitement of everything, he forgot to pull the pin. He was still looking down the nozzle for an obstruction when he remembered to pull the pin. He squeezed the handle and a small amount of agent then squirted in his eyes, practically blinding him. Luckily, he was able to see well enough to put the blaze out, saving himself and millions of dollars in equipment and aircraft.

SSgt Sheldon Cash
314 SUPS/LGSF

There I was . . . it was October 1989, and I was enlisting in the United States Air Force. After years of thinking I would never enlist in any portion of the military, I had done it and was leaving on 4 April 1990. During the next few months, I reflected on my reasons for enlisting: parental pressure, the need for an exciting career, to find myself, and to finance my education. None of my thoughts included staying in the military or going to war. Certainly, I never thought about dying for my country. I, like many others, had been conditioned to feel there was no way any country would ever threaten the United States.

After completing basic training and going to technical training, I didn't know what to think of my job as a fuels specialist. I had heard many things including, "You're going to be a gas station attendant." The day before I flew off to my first assignment at RAF Upper Heyford, United Kingdom, Iraq invaded Kuwait. The thought of going to war became very real.

The day the war started was just like many other days. I spent most of the day with my wife before I went to work at 1600. After arriving at work, we were instructed by the shift supervisor to go home and come back at 1800. We were going to start 12-hour shifts because Zarragoza, Spain, had lost its fuel contract. We would be responsible for supporting about 75 large-frame aircraft per day, including normal support to our home station aircraft. I went back to the dormitory and got a message to my wife that I would be home in the morning. At about 1930, we were told to come back and work our normal schedule. Throughout the rest of the night, we carried on as normal with the busy task of refueling aircraft. After about my sixth F-111 refuel, I was told to return to the building for shift change.

As I parked the truck and was walked through the yard, something caught me by surprise. It was midnight, and the parking lot was full of cars. As I made it to the building, I saw a big staff meeting going on. Almost simultaneously, CNN reported that the war against Iraq had begun. A funny feeling engulfed my whole body. Here I was in the military, in POL, and at war! It would be only shortly thereafter that I would realize all the reasons why I love being a member of the fuels family.

My primary job in support of Desert Storm was as a fuels

distribution operator. It was my job to get the fuel to the aircraft as quickly and efficiently as possible. Night after night, we refueled hundreds of aircraft in all types of weather, enduring the best and the worst of England's climate. At that time, the temperature was below freezing, and the gale winds from the north were beating down upon us. But we kept going. I can remember that we would load up in the back of a pickup truck, get dropped off on the pad with a hosecart, and refuel one plane after another until they were all gassed. Most of the time, the workload meant little or no break at all. At the least, we could catch a few minutes of rest in the truck between aircraft and protect our extremities from frostbite.

As I think back, none of this really mattered. We were there to support our troops in the desert, and nothing could stop us. There were things that happened to me that I will remember for the rest of my life. On the first day of the war, we were out pumping fuel to a C-5 aircraft using four trucks. It took some time to notify the dayshift guys about the long shifts, so they came in at their regular time. It was 0900, and we had been working pretty much since 1600 the day before. I remember just standing there, fueling the aircraft, about to fall asleep at any moment. But I, like my other friends, hung in there to do the job we had to do. I will say that the sight of that relief truck was the best thing my eyes had ever seen.

We also had to deal with refueling aircraft that had explosives on board. At first, it was just another refuel. But one night, a firefighter gave me a different view. I was sitting in line waiting on my turn to refuel. A firefighter came to my truck and said, "Hey, you might want to move back. If there is a fire on the truck, we'll do what we can, but if it's on the aircraft, good luck to you." He said, "The explosives on this aircraft will blow a hole in the ground about a half mile wide."

We had never had to deal with things such as this before, and it took some adjustment. Even so, we pressed on without letting anything stop us. Through all this, we still had to deal with the freezing weather. I remember coming in off the flight line with my fingers numb from the cold. I would have to dip them in a sinkful of hot water and wait for the feeling to come back. We were proud, dedicated, and very tenacious in our assurance that we were making a direct impact on the operations in the desert.

One other thing that made me proud of being a *fuelie* was the variety of support with which we were tasked. During this time, I not only delivered the fuel but also had the pleasure of controlling the storage portion of it. When I wasn't pumping fuel into aircraft, I was manning hydrant pumphouses and bulk storage fillstands. Our hydrant system was from World War II and very challenging. It consisted of two 50,000-gallon underground tanks whose contents were pumped through a single, horizontal filter separator. These pumphouses serviced five hydrant outlets through five manual Type II lateral control pits. These control pits had manual refuel/defuel valves that the hosecart operators had to physically open and close upon demand. These pumphouses were open to the elements. The interior was surrounded by a type of concrete revetment, which provided no cover from the cold, rain, sleet, or snow.

I remember coming in off the flight line with my fingers numb from the cold. I would have to dip them in a sinkful of hot water and wait for the feeling to come back.

One particular night, I was manning a pumphouse and had completed about five refuels. After the refuels, the tanks were bone dry, so I coordinated a transfer from a bulk storage site. I was sitting on the cold concrete with the snow beating down on me as I listened to the fuel flowing into the tank. There were no operational high-level shutoffs or liquid level gauges, so the only way to know when to shut the tank off was to listen for the shutoffs. The sound came like a rush of air crashing into the tank, and I quickly had to radio the storage area to shut the transfer down. Just like everything else, we did what we had to do.

Afterwards, I refueled some more aircraft until the tanks went dry again, but this time I had to receive and issue simultaneously. There was no way around it, because we were pushing the maximum ground time allowed for the aircraft carrying supplies to our troops in the theater. Time and time again, we were pushed and strained to the breaking point, only to employ all means at our disposal to meet the mission requirements.

One of the most heart-wrenching events was watching friends go off to fight the war. I was basically still very inexperienced, but I volunteered for any chance to join the war effort. I had trained day in and day out to go to war, and now was my chance to showcase my talents. I had firm religious beliefs, but on the other hand, taxpayers and my oath of enlistment had bound me to fight for this great country. I wasn't going to let my emotions get in the way. I wasn't selected to go into the theater, but I was there the night that my closest friends went to war. Unlike stateside assignments, overseas personnel become very close and dependent

on one another. The people you work with day in and day out become your family away from home. They listen to your problems, enjoy your triumphs, and pat you on the back when things are just a little too stressful for you.

Well, the day came, and I found myself helping my friends pack their gear. One of my friends had come to my house for dinner. All of a sudden, he became very distraught. He was scared and practically on the verge of a breakdown. To help him, my wife and I reassured him of his safe return home. I told him of my desire to change places with him, but the powers that be hadn't seen things my way. I told him to just go down there and employ all of the warfare training we had endured month after month. I told him I would pray for him every day and write as often as possible. Each day they were gone became longer and longer, while every so often we would hear some story through the grapevine of their trials and tribulations and get a good laugh about it. Shortly after the cease-fire ended the war, we prepared for the return of all of our friends.

Homecoming was emotional. The day was very overcast and cloudy with a cold, wet, drizzling rain. We all stood in front of the building as the distinct shape of the first fighter plane came into view and made its approach to the landing strip. One after another, the fighter planes landed to little fanfare. A crowd of colleagues and family members greeted them. As the planes taxied by, we could see the yellow bombs painted on the canopies scoring the number of successful bombing runs against the Iraqi regime. All along the front landing gear flaps were paintings proclaiming the emotions of the ground crewmembers loading the bombs and taking care of the aircraft. There were naked ladies with angel-like wings dropping bombs, with slogans like "Death to Saddam" painted underneath the pictures. The very last plane to land and come to a stop was a C-5 Galaxy with our troops inside. The door swung open, and hundreds of troops clad in desert uniforms filed out into the arms of waiting families and friends. I spotted my friend coming down the ramp sporting the biggest smile that he could muster. My wife and I yelled out his name and rushed to him, taking him in our arms and telling him that we were glad he was home. This scene was repeated over and over again as, one by one, my close friends from our little flight filed off the plane onto the ground of the RAF Upper Heyford flight line. Although this day was one to remember, our work to support the Gulf troops wasn't over by a long shot.

The people you work with day in and day out become your family away from home.

After the banners stopped flying and the aircraft art had been painted over, we still had to support the war effort. We endured another 5 months of 12-hour shifts, 6 days a week to support the contingency. This was taking a toll on all of us, but it didn't matter very much. We employed our training on a real-world basis, and we knew, somewhere out there, someone was counting on us *fuelies* at Upper Heyford to do the job.

Upper Heyford was only an overflow base for Rhein Main Air Base and RAF Mildenhall, but we refueled 75 to 100 large-frame aircraft per day. This was a spectacular feat, because we didn't have the capacity to support aircraft loads of this type. Only through pure grit and an astounding amount of teamwork did we accomplish this task under very unfavorable circumstances. I developed an undying respect for a number of my superiors and my peers. I saw superiors, whom I thought were substandard, shine in the spotlight. And I saw my peers meet the demands placed upon them and come back for more. Through all this, I reflected on my thoughts about the fuels career field in basic training, and I realized how wrong all those people were about what they thought my job meant to the Air Force. Without fuel, no aircraft could fly, no pilot could bomb a target, and no vehicle could make it to the aircraft ramp. As I sat back and pondered this, I stood tall and realized I was only a small part of the greatest family in the Air Force: the fuels family.

A lot of aircrews, crew chiefs, and civilians alike may sneer and taunt us when they think of the fuels family, but I'm here now to help the fuels family provide the best service possible to support the Air Force in contingencies all over the world. No matter where or when, there is a fuels troop standing alone on some pad somewhere, in some control room, or pumping some pit out on some flight line somewhere to ensure that the Air Force gets all the fuel it needs. I think of these people, including myself, who will sacrifice it all for any justifiable cause to ensure the mission is accomplished. Desert Storm was a big test of our war capability, and I know I will be ready for the next one. My only hope is to touch someone else's life, like some of my superiors touched mine, and make them as proud to be a POL troop as I am.

MSgt Jim Launer
51 SUPS/LGSF

There I was . . . it was 0600 on the first day of a local exercise at Bitburg Air Base, Germany, July 1984. It was President Reagan's first term and right in the middle of the Cold War. I was a young 20-year old airman first class, a new arrival to Bitburg. I was away from my small hometown in Oregon for the first time. All us R-9 drivers were dispersed and secure in our hardened truck shelters, waiting for the day's first *downs*. I stepped out of my shelter in my chemical defense ensemble to have a smoke. As I looked down the taxiway at sunrise, dozens of F-15 fighters were lined up waiting to take off. The sight of F-15s rocketing to the sky with afterburners glowing was an awesome sight for this young POL troop. With three squadrons of Eagles flying nonstop, chemical attacks, explosions, and small arms fire, the 3-day exercise was a challenge for all. *Alarm blacks* that lasted 4-hours were not unheard of, and they always seemed to happen at shift change. I wrote a letter to my parents during that exercise, and as I was studying for below-the-zone (BTZ) promotion, the letter was put in my professional fitness exam (PFE) study guide. I didn't look at that PFE for awhile (didn't make BTZ either), and when I next looked at it (studying for staff sergeant), I saw the letter. I was amazed at my naivete. By this time, I was a seasoned veteran of many exercises and was an expeditor coordinating fuel support for my own fighter squadron. I laughed at those feelings of patriotism and what I thought my contributions to the war machine were.

Looking back now, I know those feelings were true and accurate. Fuels troops played a huge role in ending the Cold War. We provided the support that brought the fall of the Warsaw Pact, and we have put out fires all over the world ever since.

SrA Ron Mann
5 SUPS/LGSF

There I was . . . it was a warm, humid night in the desert. Just like many before, except this was the start of the biggest bombing campaign since Operation Desert Storm. We didn't know it at the time, but my night-shift buddies and I were about to be tested on what we were made of. Operation Desert Fox had just kicked off. We knew something big was about to happen just by watching CNN over the last few days.

Earlier that night, the maintenance chief had stopped by to see how many folks we had on duty. This was not a normal visit. He told us what he could about the mission and what he was expecting from us tonight. After he left, we all looked at each other as if to say, "Did I hear him right?" We had 20-year old equipment to accomplish what seemed, at the time, to be impossible. He wanted one of the KC-10s stationed with us to be refueled in 1 hour. Normally, this wouldn't be anything out of the ordinary. Except that the aircraft was going from a landing load, of 50,000 pounds, to a load of 330,000 pounds. Being stationed with B-52s at Minot AFB, North Dakota, pumping 30,000 gallons was no big deal. What this aircraft was going to need was closer to 40,000 gallons, in less than 60 minutes.

After what seemed to be an eternity waiting for the plane to land, we were at our issue site, and we saw the landing lights. I drove to the flight-line expediter and asked exactly how he wanted to do this seemingly insurmountable task. He looked at me and said, "The next aircrew will be here in an hour and a half, and we have to be done before they leave tent city." Tent city is only a 10-minute drive from the flight line, and that's if you drive slowly. After a few minutes of nervous conversation, we came to the conclusion that we would rotate R-9s on one wing and the R-14 would be on the other. As the monstrous plane was taxiing to the spot where we would refuel, all I can remember thinking is, "I hope none of this equipment breaks." As soon as the engines were shut down, it was like a free-for-all. The crew chiefs started rolling up every piece of support equipment within 100 feet. The aircrew did their post flight walkaround and left. Now it was our turn.

The crew chief on my side told me to fire up the R-14. R-9s were rolling up on the other side. This is what we are trained to do. Would the air bottle last? What if a truck starts to leak? What if the aircraft starts to leak? What are my emergency shutdown procedures? Are the valves positioned correctly? As I watched this chaos unfold into a kind of ballet, I was sure we would still be there when the next aircrew arrived. It was just taking too long. R-9 after R-9 rolled by. We didn't

have the manpower to fill each truck after it was dumped on the plane. We were down to the last two trucks, and when they rolled up, the crew chief shouted from his stand, "20K to go!" No way! When I finally looked at my watch, it had only been 48 minutes since we started. I stretched out the deadman as far as I could and asked him if he was sure that he was going to get enough. He said they were filling the last tank and was sure they would get enough.

I don't know if anyone in POL has records on refueling, but if there are, we shattered it. We had just pumped more than 42,000 gallons in 53 minutes with 20-year-old equipment. Not a single problem arose during the refuel. I don't think we would have stopped anyway. After everything was wrapped up and the crew towed the aircraft to the launch area, the expediter came up to us and said that, in his 16 years of working on KC-10s, he had never seen anything like it. I was sitting in the maintenance van when the expediter called on the radio to tell the crew that the plane was ready. The guy on the other end said "Yeah, right, there is no way you put all that gas on the jet this soon." All that was left was for them to do was preflight the jet and go! If you have never been in a combat environment, not that this was a battle zone by any stretch, it would be hard to explain the feeling of gratification. I finally got to do my part during a bombing campaign. On the other side, though, there was a feeling of despair. What was going to be the final result of our accomplishment?

A lot of strangers came together that night and for the next three nights. As the operation continued, we continued to meet a challenge that I am sure none of us thought, or hoped, we would have to when we left our homes. None of us (POL) were *formally* recognized for this. There were no medals, no visit by the commander. I am not sure if that would have made much difference. No medal could replace the emotions from that night. Bottom line was that we did what we had to under difficult circumstances with equipment that should have been retired years before. All to keep a mad man in check. Yeah, it would have been nice to get a medal, but when I look back on all of it now, it is not always about having your name in the paper or on the news. It *is* about getting the job done, no matter what lies in front of you.

Capt Bruce Bartholomew WR-ALC

There I was . . . boarding the DC-10 in Philadelphia, headed for my 90-day rotation as the fuels officer at Dhahran. One of my fellow supply troops from McConnell AFB walked up to me and calmly asked, "Have you heard the news?" I replied that I had been keeping my head in a book for the past 2 hours, waiting to board, so, no, I hadn't heard the news. He informed me that a bomb had just gone off at Dhahran. Imagine, hearing the news just walking onto a jet that will take me to that place. Because I was tired, I hadn't really thought about how big the blast was or how many people were hurt. I could only think about what impact the after-effects would have on my tour.

We were clueless during the entire flight. Even the stopover at Rhein Main Air Base provided no new information about the bombing—we couldn't find a television tuned to CNN and were too bleary-eyed to seek one out. We wanted fresh air, and we wanted to stretch our legs before the next portion of our flight. When we landed in Dhahran, I remember looking out my window and seeing bright lights from the open tail of the C-5 parked next to us and the crowd of people spilling out the cargo hold area. We were bussed to a plain hangar that had been converted to a waiting area, complete with chairs. Our next step was to in-process. As we waited, I saw one gentleman walk in, dressed in desert BDUs. His head was wrapped in a turban. Chuckling to myself, I thought this was a great joke. What a neat way to welcome us to . . . wait . . . hey, that's not a turban! That's a bandage, and it's covering a head wound. Oh, yeah, the bomb.

Shortly after filling out the requisite paperwork, we were divided into squadrons and met our commanders. Ours was Major Curt Eubel. I asked him about the details of the bombing, and he looked shocked that I didn't know. I reminded him that we had spent the last 24 hours in the air and were starved for news. He told me the bad news—19 dead and more than 200 hurt. Any supply types killed? No, but three troops were cut by flying glass, two of them POL troops. We would learn later that they would be awarded the Purple Heart. It turned out that the bright lights from the C-5 were the television lights during the memorial service for those returning home. That's why the areas seemed so crowded.

After picking through the thousands of green bags, I found my luggage, and we headed to the Khobar Towers complex. It was about 3 a.m., and I was ready for bed. We walked up the four flights of stairs—the elevator was not to be used—and I walked into our

apartment. The first thing I noticed was the lack of glass in the sliding patio doors—it was all swept up on the exterior patio. There must have been glass piled 6 inches high on that patio. My next piece of business was to call my wife. I got a dial tone and proceeded to dial back to the States. I spent about 5 minutes on the phone, reassuring my wife that I was safe and would be safe during my stay. She was calm, but I could hear the worry in her voice. We said a little prayer together and exchanged our affections. After a long day, I was ready for sleep. Crawling into bed at 4 a.m., I was ready for sweet oblivion. It was disturbed at 7 a.m. by the fire alarm.

As we crawled out of bed, we were curious as to what was happening. We were told to sit tight in the stairwell—we weren't allowed to depart the building. Later, we learned there had been another possible bomb threat, and the base leadership took the threat seriously. After the *all-clear*, I headed to get ready for the day.

As the weeks unfolded, I learned more about the bombing and its effects on people's lives, the buildings, and the Air Force.

SMSgt William A. Neckar ACC/LGSF

There I was . . . at MacDill AFB. I arrived there in September 1979 and was chosen to go into Mob Sup, (Mobility Support). The only knowledge of Fuels Mobility Support Equipment (FMSE) and Aerial Bulk Fuels Delivery Systems (ABFDS) I had was from someone being chosen for the ABFDS school while I was stationed at Langley AFB from 1974 to 1976. The only thing I knew about the R-14s was from a test question when I first tested for staff sergeant at Guam in 1976.

There was only one thought going through my mind the day I was shown the equipment I was to be working with: "What a bunch of junk!" R-14s, R-25s (yes, I remember them), R-22s, and R-26s (I remember them, too) were lined up on the flight line adjacent to the aerospace ground equipment (AGE). The AGE equipment looked wonderful compared to what we had! I was able to poke my finger through the 50K bladders that were stored in the slings of the R-14s. These were the old, heavy duty Buna Nitrile quarter-inch thick, 1,200-pound tanks. There was dry rot from the tires to the seals, and fuel was leaking constantly.

The ABFDS and 3,000-gallon bladders were kept in old World War II hangars with roofs caved in and gaping holes. There was asbestos laying all over the top of the bladders, FFU-15Es, R-13s (yes, there was such an animal), and the ABFDS. Inside this huge rat-infested hangar were boxes filled with hand pumps, 500-gallon sealed drums, and gasoline nozzles.

As a member of Mob Sup, I was required to attend the Air Transportable Hydrant System (ATHRS) and ABFDS courses at MacDill. I was a mediocre student who only cared if I passed. I had *DG* (done graduated) the ATHRS class in November 1979 and the ABFDS class in March 1980. This was the era of the Iranian hostage situation, where we (the United States) were negotiating to get our Embassy personnel released from their captors.

Since November 1979, Mob Sup had beeen involved with sending select ABFDS operators and equipment on special assignments that no one could talk about. We were sending miles of 2- and 3-inch hose up to Eglin AFB to test new ideas in fueling techniques. All these actions were shrouded in mystery, and speculation ran rampant at times, while at other times it was taken as just another day.

Well, I'd graduated my ABFDS class at the end of March and was pretty happy with myself when two of the volunteers for *the secret stuff* told the boss, "We're married and don't want to go on this mission." That left two openings for us from MacDill. (There were six positions from MacDill and six from Hurlburt Field.) I was chosen for one of these positions. I think my selection came largely from jumping up on my supervisor's back and putting a *Hindu Headmount* on him.

We were picked up by a C-130, along with an ABFDS package, and flew to Hurlburt for predeployment. We joined up with the other four fuels troops from MacDill and six from Hurlburt and were still speculating on our mission, which led us to our daily *staff meetings* at the NCO club. (Yes, there once was an NCO club and not an enlisted or all ranks club.) Our escapades at the NCO club were short of debauchery but still a lot of fun. There were still Go-Go dancers in some of the clubs in those days, and a stage-front table was the POL forte. Beer and tequila flowed pretty freely, and subtlety was not a POL trait in those days. We weren't expelled from the club, but it was suggested we not return. Fortunately, we were only days from departure.

I attended my first official briefing for our mission the day before we left Hurlburt. We had to show orders and identification cards and be bumped up against a list to get into the theater for the briefing as it was Top Secret. We were told the unclassified name of our mission was EC-79.

The next day, we loaded up on a C-141 bound for some unknown

destination. All us troops and equipment made for a cramped flight, but we fared all right. We landed in the early hours of the morning at Ramstein Air Base and were herded into a cramped waiting area for about an hour or so. We were tired, hungry, and grumpy. We got the okay to go up to the chow hall (yes, it was called a chow hall in the *old* days), which opened early just for us. We had a literal feast of eggs, pancakes, and three different kinds of sausages. This got rid of the hunger and grumpies, but we were still tired. We trekked back to the waiting area and eventually were told to board the aircraft. We were going through the passenger terminal line when an airman first class noticed we weren't manifested. He wasn't going to let us board the plane. The airman tried hard to do his job and keep us off the plane, but his supervisor told him to go home for the day. I can't imagine how he felt about that, but it made us feel important.

It was a long flight to Egypt, although we didn't know where we were until the door opened and we were given a quick brief by the camp doctor:

> Welcome to Wadi Kena, Egypt. It is hot and dry so drink plenty of water. Always carry a canteen full of water with you. Do not wave at the locals with your left hand as it's considered an insult. You will be staying in a hangar separated from the base population. Do not speak to anyone outside of your group. You will be fed at your hangar and do not need to go to the main compound. There are outhouses built alongside your hangar, and there will be water buffaloes hanging on a tripod outside the hangars.

Boy, did this sound spartan or what?

I got off the plane with the rest of the group but had an overwhelming need to hit the head. I asked where it was, was pointed in the right direction, and walked in on one female sitting on the pot and another washing her hands. I stopped dead in my tracks and started apologizing profusely when the female at the sink stopped me and said, "Don't worry about it. It's a co-ed bathroom." I thought to myself, "This is the life." Little did I realize how fast things would go downhill.

We were taken down to a hangar at the end of the runway that was hit by Israeli tank fire (or so I was told) during the 1967 war with Egypt. The walls were caked with human dung, and the place was a real sty. We were told to clean it all up and start setting up cots with mosquito netting. We were also told not to roam around at night because of the wild dogs. It was getting better and better by the moment.

I stopped dead in my tracks and started apologizing profusely when the female at the sink stopped me and said, "Don't worry about it. It's a co-ed bathroom."

We checked out our equipment for the next couple of days and were told we would be leaving soon and to be ready. The day before we left, we uploaded our ABFDS and filled the bladders with 3,000 gallons of fuel in each. We were ready to go when we were hit by a little surprise. We had to also carry our tents, wood, sleeping bags, cots, and anything else we could get on board. We piled everything against the forward bulkhead from the floor, on top of the bladder and up to the ceiling. The last thing we loaded were the Special Forces motorcycles, which were strapped to the fuselage. (Good thing we didn't have a kitchen sink!)

We were up and ready in the early morning hours, and breakfast was brought out to our hangar. Right after we ate, someone jumped up on the front of a jeep and with a gravelly voice said, "All right, men!" Whoa, that got our attention. He gave us a great pep talk on what we've been training for, whom we were going to get, and why we were doing it. I was so pumped up that I got on the wrong bus heading for the wrong aircraft. We were packed not only with equipment but also with people. The only problem was there wasn't anyplace to strap yourself in. We had people standing all over the equipment, wherever they could find a place to stand. Our aircraft was so overloaded that the struts were emitting an ear-piercing shriek every time we hit a little bump in the pavement. I don't know how heavy we were, but I can tell you that it took every inch of that huge, long runway for us to get off the ground. We barely cleared the telephone lines outside the perimeter of the fence! We didn't know where we were going, but we were going to get there come hell or high water. We flew for around 10 hours and finally landed on a small patch of land in the middle of the ocean. We still didn't know where we were (well, most of us anyway).

We stayed there for a couple of days, and then came the day of the *event*. We were briefed on where we were going, what we could expect, and what to do if we were separated from our aircraft. *Bring plenty of water; sanitize yourselves of all identification; and above all, keep your survival vests on. If separated, follow the mountains into Pakistan, avoid contact with the Iranians, and try to blend in.* We were finally going to do what we were trained to do.

We were going into Iran to rescue our fellow Americans, unjustly held hostage for more than

a year. We lined up outside our assigned aircraft and had our pictures taken for this momentous occasion. We loaded up after the photos. It was near dusk when we took off. Again, seating was at a premium. It was *sit anywhere you can and don't worry about buckling in*. We were terrain flying, hugging the ground as much as possible, pulling positive and negative "Gs" like there was no tomorrow. I started getting a little queasy after a couple of hours and was wondering when the hell we were going to land. My adrenalin was pumping furiously through my veins. You have to imagine what it's like, flying in the dark, with only the red illumination of the interior lights, the windows taped up so no light could escape and none to enter. You're surrounded by grim men on a grim mission to the middle of the desert, not knowing where or when you are going to land, knowing full well that your life depended not only on the men you were with but especially on the pilots guiding the C-130 through the air over hostile territory. This is one of the times men turn to God and pray. The long flight gives you time to reflect on your life, wondering if it was a good life or if it was squandered away.

Finally we hear the wheel doors open and almost immediately we're on the ground. Our pulses are racing, and adrenalin is flowing like a flash flood screaming down a wash. We take our hoses and filter separators off the ABFDS and position them as we were trained to do. The night is cool and clear, and you can see a lot better than you imagined. We finish our hose deployment to the four refueling points and wait, and wait, and wait. It seems like an eternity but is more like a couple of hours before the first helicopter shows up. The 'copter comes in from behind us, about 300 yards down range. The tips of the rotors appear to have lights on them. Sand and dust are kicked up in a maelstrom of evil engulfing the craft. It takes a while before the pilot can see again. He edges forward and is swallowed in another malevolent cloud of desert sand. This goes on for about 20 minutes before the RH-53 gets to the refueling point behind the first C-130 Bladder Bird. The chopper is fueled *hot*, with engines running. The next one comes in with the same results, wind whipping the morass of sand around and in the hovering bird. I went up to an air combat controller and suggested that the choppers come down over the refueling points so there wouldn't be so much difficulty taxiing in. He told me, "It's not in the scenario." Talk about rigidity. It was then a bus pulled up behind our C-130. It was filled with Iranians, coming back from who knows where, and was stopped on the road by the Delta Force troops. The bus was brightly lit and had tassels adorning the windows. The passenger's faces were filled with awe as there was a Delta Force troop standing in front with a large weapon, which I did not recognize. I was asked what to do with them, as no one knew who each other was out there in the dark. I got the load, and he told them to bring them to the aircraft to our left.

You have to imagine what it's like, flying in the dark, with only the red illumination of the interior lights, the windows taped up so no light could escape and none to enter.

We had refueled all the helicopters at this point, rolled up our hoses, and were ready to pack it all in when the combat controller came over and told me we had to refuel another helicopter. I asked which one, and he pointed to the first helicopter that came in. I told the loadmaster and pointed to the helicopter. It lifted lazily over the pilot-side wing of the C-130 and flew right into the cockpit!

It was one of the most horrific sights I have ever seen. I stared, with mouth agape, at the flaming inferno that started to engulf both aircraft. I remember the flames billowing skyward and blowing our way and people streaming out of the back of the C-130, like ants whose hill was disturbed by an irreverent child. This haunts me to this day and will forever be etched on my mind. I saw someone come out of the cockpit on the copilot's side of the C-130. He was aflame, staggered a few steps, and fell to the ground. At that point, our aircraft gunned the engines and jerked forward. The four 100-gpm, army filter separators fell off the ramp to the ground. My C-130 was taxiing away from the flaming aircraft and me! I was truly getting concerned at this point, as I had removed my survival vest and placed it on top of the ABFDS. I was looking for Bobby "Damn" Dryer when Jerry Franks grabbed my shoulder and said, "C'mon, Bill, we have got to get out of here." I said, "I'm not leaving till I know if Bobby Dryer's okay." He said, "Bobby ran by you 5 minutes ago." With that I took off running with him toward our aircraft, which by this time had turned around and was getting ready for takeoff. We ran to the crew door and were among the last people aboard. There were a couple of singed airmen aboard (Marines) who needed medical attention. The Delta Force medic helped them as much as possible.

It was a grim feeling aboard that aircraft, flying back in the early morning hours. Few words were spoken as I surveyed the new

assortment of aircrews and Delta Force members who had joined us as a result of the catastrophe. I had heard of the Delta Force, the elite group of Army soldiers who went on special missions around the world. I saw them as the *grim reapers* of the Army, but as I looked at them individually, they looked more like you and me, except for the beards and long hair.

We landed back at Messeria, stayed there for a day or so, and moved on to Egypt and then over the Alps and back to Ramstein Air Base, Germany. I got to stay there for a few days and hitched a ride on a plane back to the States and eventually wound up back at MacDill where I was destined to be involved in some other ventures that also brought *experiences* I will never forget.

DEDICATED TO
THE UNSUNG HEROES OF THE
FLIGHT LINE

MOST PEOPLE DON'T CARE, NOR
REALIZE, AS WELL
ABOUT THE JOB DONE BY BASE POL.
TO THE PILOTS AND CREWS,
REFUELING'S A BORE
AND THE REASON, I FEEL, IS THEY DON'T
KNOW THE SCORE.
FROM DRAWING BOARD TO PRODUCTION LINE,
IT TAKES LARGE APPROPRIATIONS
TO BUILD A GREAT AIRCRAFT, AND GET IT ON STATION.
AND LOST IN THE SHUFFLE, AT LEAST THAT SEEMS THE RULE,
IS THE NEED FOR THIS "BIRD" TO BE FED GOOD CLEAN FUEL.

THE ENGINEMEN SETTLE FOR NO LESS THAN PERFECTION
AND THE RADAR MEN STRIVE FOR MUCH FINER DETECTION,
BUT EXPOSED TO THE CORRECTIONS OF EVERY KNOWN TOOL
THE AIRCRAFT GOES NOWHERE WITHOUT THE RIGHT FUEL.

BUT POL'S JOB CAN BE VERY COMPLEX,
FROM RECEIVING AT BULK TO THEIR QUALITY CHECKS.
THEY, TOO, TUNE EQUIPMENT WITH NO ELEMENT OF GUESS
TO INSURE THAT PUMPS RUN AND FILTERS COALESCE.

THEY CHECK MANY SAMPLES BY CHEMICAL TEST,
AND THEIR QUALITY CONTROL PLAN IS ONE OF THE BEST.
FROM LEAD ACETATE PAPER TO ISOMETRIC TITRATION,
THE FUEL RUNS THE GAMUT TO MEET SPECIFICATION.

THE PROCESS SEEMS SIMPLE:
YOU PUT IN A CALL
TO THE POL DISPATCHER,
WHO CHECKS THE CHART ON THE
WALL.
HE SENDS OUT A UNIT IN ACCORDANCE WITH THE ORDER,
BE IT JP, OR AVGAS, OR DEMINERALIZED WATER.

SO THE NEXT TIME YOU OBSERVE AN AIRCRAFT GO OFF
FULL BORE DOWN THE RUNWAY, WITH NARY A COUGH,
AND RISE IN THE AIR, A MOST THRILLING SHOW
POL PLAYED A BIG PART IN MAKING IT GO.

AUTHOR UNKNOWN

(*Korea: Supply Lessons Learned* continued from page 25)

Bulk storage facilities, too, were inadequate. Air Force facilities used 10M-barrel (42,000 gallons) tanks, which were too small for terminal operations. According to the official report, 40M-barrel tanks would be sufficient.[17]

Conclusion

Air Force supply and fuels support of combat operations in Korea was, for the most part, adequate. Getting the right amount of spare parts was the biggest obstacle. The failure of senior leaders and planners to use prior experience caused a great many problems for supply organizations in the theater. This, coupled with the lack of trained individuals at ZI depots, meant providing adequate support was, at best, difficult. Had the wholesale level of supply (the depot) been willing to fulfill requirements on a flexible basis (based on the scope of operations), there might have been less confusion. Due to the nature of aerial warfare in Korea, POL was able to function well. Like many conflicts before, and many since, aerial POL support was not mentioned as a trouble area for planners, though there were areas for improvement (storage, pipeline systems).

The Korean conflict was an important stage in the development of Air Force logistics and supply. This was the first time American combat aviation was separated from the Army, and there was a great deal of uncertainty on how to get the right things. Additionally, the emergence of the jet fighter in the conflict presented more obstacles, as demand rates, consumption factors, and other planning items were unknown for these new vehicles.

Nevertheless, the Air Force supply organization was able to survive the conflict and has continued to evolve. A decade and a half later, the Air Force would be embroiled in another, far more damaging conflict. The lessons learned by Air Force logistics personnel would prove invaluable in a tiny country called Vietnam.

Editor's note: The information in this article is part of a 2 June 1954 report from the Assistant for Logistics Plans, Office, Deputy Chief of Staff, Materiel. Direct quotes are cited. Any changes in the actual wording were made to fit the constraints of the article and should not be construed as original thoughts of the editor.

Notes

1. Brig Gen W. T. Hudnell, USAF (Retired), "Logistics Lessons Learned from USAF Experience in Korean Conflict," Headquarters United States Air Force, Washington DC, 2 June 1954, 1.
2. Hudnell, 12.
3. *Ibid.*
4. *Ibid.*
5. Hudnell, 17.
6. Hudnell, 18.
7. *Ibid.*
8. Hudnell, 20.
9. Hudnell, 26.
10. *Ibid.*
11. Hudnell, 30.
12. Hudnell, 33.
13. Hudnell, 45.
14. Hudnell, 46.
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16. Hudnell, 67.
17. Hudnell, 68.

(*Supply in Vietnam* continued from page 41)

45. Project Corona Harvest, III-1-150.
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60. Joint Logistics Review Board, Monograph 15, 21.
61. Joint Logistics Review Board, Monograph 15, 44.
62. McNamara, "Petroleum to South Vietnam," 43.
63. *Ibid.*
64. Joint Logistics Review Board, Monograph 15, 139.
65. Joint Logistics Review Board, *Logistics*

45. Project Corona Harvest, III-1-150.
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(*Supply Chain Management* continued from page 107)

performance data going back to October 1998. The tool can be accessed via the AFMC SCM web site at http://scm.wpafb.af.mil/.

The tools described above were developed to allow the SCMs to understand performance in support of the command supply support METs. Other tools have also been developed to assist the SCMs. These include TRACKER—a web-based tool designed by the AFMC Logistics Plans, Programs, and Integration Division—which allows real-time visibility of requisitioned parts in the overall USAF logistics system; System Modernization and Research Tool, a web-based tool designed by Oklahoma City ALC that provides current status on cost, schedule, and technical performance; and the Keystone Sales database, which provides easier access and visibility of sales data. Previously, SCMs could only use these tools by loading the latest program disc that was mailed to them via an FTP site. Now, all these tools can be accessed from a single point on the Internet, via the AFMC SCM web site.

The AFMC SCM program was established to ensure lasting cross-functional process changes are made to the way AFMC carries out its function of providing reparable and consumable spare parts to the warfighter. Moreover, the purpose of the AFMC SCM CAP is to ensure systemic constraints that inhibit optimum support to the warfighter are identified and fixed. This will help smooth out variability of demand, allow AFMC SCMs to be more effective in their management of the Defense Logistics Agency and other key suppliers, and ensure the flow of spares through the reparable supply chain is consistent with customer demand.

Nevertheless, the significantly improved back-order performance, which directly relates to improvements in base IE and SE of parts, has significantly reduced the number of requisitions to which AFMC source of supply depots need to react. Moreover, AFMC's overall average LRT to requisitions back ordered to the depots has been reduced by 10.4 days since March 1998. Based on the fiscal year 2000 SMBA Material Support Division Budget Estimate Submission, a single day's improvement in the average AFMC LRT results in a $33M savings in inventory requirements. Due to LRT's 10.4-day improvement, the SCM program has reaped a dollar savings of $343M since it began in March 1998.

The recent Kosovo conflict provided an insight into the potential for significant further savings that can be accrued from improving and speeding up the velocity of reparables through the depot and contractor repair lines. During the Kosovo campaign, the average LRT for items required in the Kosovo theater fell to 11.9 days (the SMBA Strategic Plan goal for fiscal year 1999 was 41 days). This improvement was largely a result of focusing on Kosovo requirements and by *strong-arming* the logistics system as necessary. The AFMC SCM program should be a catalyst for process improvements that will result in increased reparable velocity for all items required by the warfighter at the lowest cost.

Wing Cmdr Thorogood is the chief of the Supply Chain Management and Analysis Branch, AFMC/LGIL.

Notes

1. *Management Actions Create Spares Parts Shortages and Operational Problems*, GAO Report GAO/NSIADAIMD-99-77 April 1999.

. . . about the agency

who are we?

Using a broad range of functional, analytical and scientific expertise, the Air Force Logistics Management Agency (AFLMA) tackles the Air Force's toughest logistics problems and produces solutions that improve both combat and war-winning capability.

AFLMA's mission is to increase Air Force readiness and combat capability by developing, analyzing, testing, evaluating and recommending new or improved concepts, methods, systems, policies, and procedures to enhance logistics effectiveness and efficiency. AFLMA's main goal is to solve today's logistics problems with a dedicated commitment toward shaping tomorrow's logistics environment.

AFLMA's key strength is its people. They are handpicked professionals from logistics functions, operational analysis sections, and computer programming shops. Virtually all AFLMA personnel have advanced degrees, a number of which are doctorates. In addition, the Agency has state-of-the-art and leading-edge computer support, analysis, and simulation capabilities.

This combination of skilled people, advanced equipment and analysis capabilities gives the Agency the competitive edge in tackling the toughest Air Force logistics problems.

AFLMA

Air Force Logistics Management Agency

Generating Solutions Today, Shaping Tomorrow's Logistics

Air Force Supply/Fuels

Providing Outstanding

WORLD

Support WIDE

The BADGE

The falcon at the center of the badge symbolizes the Air Force. It also symbolizes the strength, dedication, and devotion to duty by supply/fuels personnel who support the generation and employment of aerospace forces across the spectrum of warfare. In its talons, the falcon is holding a key and a bolt of lightning.

The bolt of lightning represents military strength and wartime readiness. The key symbolizes the security, safekeeping, and control of supplies in the old *Quartermaster Corps* tradition.

The crossed key and lightning bolt indicate that military strength and wartime readiness can only be achieved through support provided by professional supply/fuels personnel.

The globe is symbolic of the extensive range of worldwide supply and fuels support. The olive branch surrounding the badge symbolizes the peace aerospace forces provide through a professional supply corps.

The three levels of award are signified by the star centered above the falcon, for senior level, and a star surrounded by an olive branch, for master level.