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Force Support for the Expeditionary Air Force

Captain
Ronald N. Dains

I don't ever, ever, ever want to hear the term logistics tail again. If our aircraft, missiles and weapons are the teeth of our military might, then logistics is the muscle, tendons, and sinew that make the teeth bite down hard and hold on—logistics is the jawbone! Hear that? The JAWBONE!

Lieutenant General Leo Marquez[1]

Attend any professional sports event, and you will find fans wearing the names of their favorite team members on T-shirts, sweatshirts, and possibly tattooed onto their skin. Normally, the names are of football quarterbacks or running backs, baseball pitchers or home-run hitters, or the most current basketball phenom. Very seldom does one see names of second-string punters or centers, guys with low batting averages, or the basketball guard who was traded for the fourth time in the current season. You do not see enthusiastic fans sporting the name of the team's equipment manager, bus driver, or stadium janitor on a garment either. This is part of our American heritage, which holds that we associate achievement with a *hero* or *winner*. In the movie *Patton*,[2] George C. Scott eloquently reenacted General Patton's address to the Third Army. In this address, he elicited a surge of patriotism and *can do* spirit by stating, "Americans love a winner. Americans will not tolerate a loser."[3] He drew on the power of positive association. Unfortunately, the things or people we associate with often hold little regard for the sacrifices made by so many people behind the scenes. This psyche pervades our Air Force today. While healthy in most respects and, indeed, critical to creating a *winning* team, it may be detrimental in the long run if people lose sight of their roles and responsibilities by focusing their efforts on proving their worth solely through methods of association.

Visit an Air Force base today, and you will see Air Force members in a green, gray, or blue flight suit, depending on their function as flight crew or space and missile operations. Some military members may also wear polo shirts or wind suits with embroidered logos specific to their organization. Nonsurgical personnel may be wearing scrubs at clinics and hospitals. You may sense that people, in general, have an aversion to being found in blues or, heaven forbid, battle dress uniform (BDU). This is not to question the validity or functional necessity of the clothing. Rather it questions the rationale commanders, managers, and policy makers use to justify the need and expenditures to provide these special items. Are we focusing too much on the seemingly pervasive need to associate with *winners* (read those in *flying career fields*) and thereby foregoing association with the larger Air Force team? Or are we maintaining a clear view of the Air Force mission, membership in the profession of arms, and merely attempting to boost morale?

We, as an institution, are allowing individuality (perhaps with morale in mind) to slowly erode our sense of mission and esprit de corps. How do we, as Air Force leaders, motivate our people (especially those in support functions) to value their role on the larger Air Force team while allowing the power of association to remain as a normal, healthy organizational behavior? The sheer numbers of people in the nonflying career fields should make this leadership challenge relatively easy. Of the 363,724 officer and enlisted members in the Air Force in January 1999, only 39,982 were

(Continued on page 37)

BIG WEEK

EIGHTH AIR FORCE BOMBING 20-25 FEBRUARY 1944

If any indisputable logistic lesson can be drawn from World War II, it is that in any major war involving industrial powers, no nation can hereafter emerge victorious without substantial and sustained superiority over its enemy in the quality and the quantity of its weapons and supporting equipment.[1]

Major General O. R. Cook, USA

The night of 19 February 1944 found England shrouded under a heavy cloud cover, but the weather over Germany was breaking. While the murk might complicate getting away and possibly landing, General Spaatz had made his decision—"Let 'em go."[2] What was to be called the Big Week (20-25 February 1944) had begun. The next day, 20 February, saw the largest force of aircraft up to that time take off and head for targets in Germany. England literally shook under the roar of engines—some 1,004 bomber aircraft plus their fighter escorts.[3]

The primary objective of Big Week was to direct a strategic bombing campaign against the Luftwaffe that would destroy its means to continue the war and, as a result, gain air superiority before Operation Overlord.[4] Bomber operations were conducted principally by the Eighth Air Force, with support from both the Fifteenth Air Force and the Royal Air Force (RAF). In-theater logistics support, the key element that allowed the Eighth Air Force to kick off Big Week, came from the VIII Air Force Service Command (AFSC). An order of magnitude measure of this logistics effort is seen in the number of bomber aircraft generated—VIII AFSC made 1,292 bombers available, an unprecedented number. However, many other facets of logistics support, often on a scale never seen before, were also necessary for Big Week. These include preparation—industrial mobilization, unit buildup and beddown, stateside logistics support,

HOW LOGISTICS MADE BIG WEEK BIG

MAJOR JON M. SUTTERFIELD

facility expansion and modernization, training and equipping of personnel, and organization of air logistics activities. As is often the case, much of the planning, preparation, and execution of the Eighth's bombing operations was subject to uncertainties that made logistics support difficult and required improvisation on the part of both logistics organizations and logistics leadership.[5]

The Foundations of Eighth Air Force Logistics

Armies do not go out and have a fight and one guy wins and the other loses and the winner takes all. Throughout history victorious commanders have been those that knew logistics when they saw it. Before any plans can be made to provide an army, logistics must be provided first. History has changed a lot, but logistics has been the crux of every one of these changes, the nail that was missing, which lead to the loss of a country lead to a lot of those decisions.[6]

Major General Hugh J. Knerr, USAAF

Industrial Mobilization Planning

Organizations and planning that focused on industrial mobilization were primarily the result of the National Defense Act of 1920 and the Industrial Mobilization Plan of 1924. The Defense Act established the War Department Planning Branch, Army and Navy Munitions Board, and Army Industrial College. It also directed the Assistant Secretary of War to prepare mobilizations plans. The Industrial Mobilization Plan of 1924 called for instantaneous industrial mobilization upon declaration of war (M-day), based on the assumption that civilian leadership would not accept gradual mobilization prior to a declaration of war, and for military control of the economy. The plan was revised in 1934. A variety of flaws plagued mobilization planning efforts and the 1934 plan itself. These include incorrect assumptions (no civilian support for gradual mobilization), not addressing the needs of the civilian populace or potential allies, and military control of the civilian economy. Further, the operations staff that prepared the plan failed to seek input from either civilian leadership or industry and did not consult with relevant military logistics planning or support activities. Industrial mobilization planning in the post-1920 period was superficial at best and, therefore, "The muddling that had accompanied World War I mobilization was being repeated."[7] Even as late as 1940, when President Roosevelt wanted some 50,000 aircraft produced per year, there was no guidance as to what types should be produced.[8]

Army/Army Air Forces Logistics Planning

In September 1941, faculty from the Air Corps Tactical School drafted Air War Plans Division Plan No. 1 (AWPD-1) to address what would be needed should the United States go to war.[9] In August 1942, AWPD-1 was rewritten to address the requirements for conducting an air offensive against Germany, and this resulted in a new plan known as AWPD-42.[10] In the fall of 1942, the US Army Air Force (USAAF) staff made aircraft utilization projections by aircraft type—which included allocations for attrition, transit, reserves, training, and modification—for November 1942 through December 1944, totaling in excess of 65,000 aircraft.[11] However, neither AWPD-1 nor AWPD-42 addressed the needs of the RAF, logistical requirements beyond personnel end-strength, or anything more than a generic total of munitions required. Operational planning took precedence over logistical planning, which resulted in war plans that were incomplete at best. "The organization and proper position of the logistical arm had long been a subject of debate in the Army and the Army Air Force (AAF)."[12] Recommendations by the commanding general, Army Service Forces (ASF) for standardizing organizations and procedures to improve efficiency and effectiveness were misunderstood and rejected by the War Department. Lack of doctrine resulted in each theater commander establishing complex, unique logistics organizations. Further, the Army's lack of emphasis on logistics training prior to the war—due to outright neglect—resulted in too few personnel with an extensive knowledge of logistics and its functions. Ultimately, during World War II, "Large headquarters with ill-defined and duplicating functions were the rule and achieved only partial success in coordinating supply . . . ."[13]

In the summer of 1943, the Bradley-Knerr committee made an extensive study of air force installations in Europe and published the Bradley Plan, which became part of the Air Force Buildup Plan. The plan, largely written by Major General Hugh Knerr, prescribed the manning and organization of air units and installations. A key feature of the plan was the requirement to establish third echelon maintenance activities (subdepots or service groups) manned by Air Service Command (ASC) personnel at each operational base. Third echelon maintenance would be augmented as necessary by depot field teams dispatched from fourth echelon (depot) maintenance organizations (base area depots and advance depots) to take care of abnormal battle damage repair loads. The Air Force Buildup Plan provided for coordinated buildup of combat units, increased flow of materiel, expansion of maintenance and supply installations, and increased stateside Air Service Command personnel. Shortly after the Bradley plan was adopted, Knerr was selected to command the VIII AFSC in the United Kingdom (UK), where it became his task to put the plan into operation.[14]

Industrial Mobilization

At the onset of and continuing well into World War II, industrial mobilization was hampered by a proliferation of organizations and procedures.

In 1940, President Roosevelt created an advisory commission to address industrial mobilization. Roosevelt appointed William S. Knudsen, a General Motors executive, as the commission's advisor for industrial production, and the commission reported directly to the President. The commission, however, was largely ineffective.[15] Military efforts to control the mobilization effort and the Army and Navy Munitions Board's autonomy contributed to the commission's difficulties and led to Roosevelt's disenchantment with it.[16] While every effort to gain control of the economy would be thwarted by the President, there can be no doubt this activity behind the scenes created more problems than it solved and negatively influenced civil-military relations. The one bright spot in the commission's performance was giving industry the incentive to build munitions factories by allowing them to amortize all construction costs over a 5-year period. This was the brainchild of Donald M. Nelson, the chief merchandizing executive at Sears and an advisor to the committee.

The President replaced the advisory commission with the Office of Production Management (OPM) on 7 January 1941 and appointed Knudsen as its director general, undoubtedly contributing to the OPM's ineffectiveness, as he was not considered a strong leader. The OPM lacked authority and was plagued by organizational design defects resulting in duplication of effort, so it could not dictate to industry, which still preferred to cater to the civilian population. Even Roosevelt's declaration of national emergency on 27 May 1941 did not enhance the OPM's clout. However, despite all its problems, the OPM accomplished a great deal. It surveyed industry to determine output by examining the potential to standardize production processes. In March 1941, it prioritized raw material usage and production of nondefense items. At the same time, the Army and Navy Munitions Board prioritized production of specific defense products. Considering the long lead times required for procuring and manufacturing machine tools, the OPM's identification of a shortage in this area early in the mobilization effort is clearly significant.[17] The OPM also initiated retraining programs to increase the pool of skilled labor and encouraged industry to hire women.

In April 1941, the President created the Office of Price Administration and Civilian Supply. However, when the organization's leader decided to end automobile and major appliance production for the civilian population, a decision with which the President disagreed, Roosevelt moved the civilian supply function to the OPM by creating the Supply Priorities Allocations Board. Donald M. Nelson, appointed to head the board, still worked for Knudsen as part of the OPM but possessed particular authority his boss did not, the authority to set priorities. The board set out to first establish an allocation process and then set priorities within the allocations. In late 1941, industrial production rates were stagnating because of prioritization problems with both raw materials and the mix of consumer-to-defense goods produced as a result of the OPM's general lack of authority. Nelson, in his role as head of the Supply Priorities Allocation Board, cut back on production of automobiles, appliances, and raw material for civil sector use. While the reorganization that created the Supply Priorities Allocations Board did prove to be essential to satisfying the defense requirements for the Victory Plan, the board was often rendered ineffective by government officials who sought assistance from department secretaries or the President whenever things did not go their way.[18] In addition, the board was challenged with coordinating with the Services—who still retained their procurement authority—the Joint Chiefs of Staff, and other powerful organizations.

In January 1942, Roosevelt created the War Production Board (WPB) and appointed Nelson as its chairman. The War Production Board absorbed the OPM, Supply Priorities Allocation Board, and National Defense Advisory Committee. However, these organizations continued to perform a role under the WPB umbrella. During the war, the advisory committee grew to more than 20,000, with many of these people located at defense manufacturing facilities across the country. Throughout the war, Nelson and his staff were occupied by three problems as they tried to increase production.

- Supplying raw materials from which war materiel and essential civilian products were made.
- Providing the plants and equipment in the factories to manufacture the *tools of war*.
- Staffing the plants with enough people who had the right skills.

Unfortunately, the WPB, like its predecessors, suffered from the lack of real authority to make decisions affecting the civilian populace. Its authority was further diluted when the President created the Office of War Mobilization. It did, however, have "the power to compel acceptance of war orders by any producer in the country and could requisition any property needed for the war effort."[19]

A key example of the effect the proliferation of industrial mobilization organizations and procedures would have on operational logistics is seen in munitions production. Beginning in early 1942, General George C. Marshall headed the Combined Chiefs of Staff, with authority over the munitions allocation process; however, Prime Minister Churchill and President Roosevelt retained the authority to resolve disagreements.[20] The Army and Navy Munitions Board determined military munitions requirements, and the Munitions Assignment Board controlled the assignment of all military hardware. The President and his various civilian organizations controlled resource allocation and the means of production. Clearly, with no fewer than four large organizations involved in munitions planning, the beginnings of major difficulties were created that would hinder the effectiveness of Allied bombing from late 1943 onward.

In spite of many difficulties, the industrial output of the US grew almost geometrically into 1944. However, demand consistently exceeded production because of "overestimation of capacity by those responsible for producing materiel."[21]

In sum, while the military put much effort into planning, plans were often incomplete because they were formulated in a vacuum. Military leadership did not seek advice from industry leaders or consult with elected officials. The proliferation of civilian, civil-military, and military organizations—often with overlapping functions and lacking authority—resulted in duplication of effort, confusion, and frustration. Further, the military attempted to gain control of the economy, contrary to the desires of the President, adding to the problems. Clearly, all of this was counterproductive and retarded the efforts to build and sustain the logistics support necessary to conduct large air operations like Big Week. Major General O. R. Cook, Deputy Director of Service, Supply and Procurement, summed it up well:

> It is, therefore, imperative that advance plans provide for more effective civilian war agencies. Most serious duplications, wasteful methods, and complex procedures existed during World War II, when the organization of these agencies was largely improvised. Their very multiplicity impeded the accomplishment of essential activities.[22]

The Pillars of Support

Several military organizations provided logistical support to the Eighth Air Force and VIII Air Force Service Command in the United Kingdom. The USAAF's Air Service Command provided stateside depot, technical, research and development, and acquisition support to the Eighth, while the ASF Service of Supply (SOS) provided the Eighth with items common to the Army and the USAAF. Although the Eighth and VIII AFSC together had a very large logistics capability and capacity, they

depended on the ASC and the ASF for supplies and support and could not have succeeded without their assistance.

On 17 October 1941, the Air Service Command was activated and made responsible for acquisition of weapon systems and provision of fourth echelon (depot level) maintenance support to the warfighting commands.[23] Headquarters USAAF established maintenance policies and procedures, while the Air Service Command issued technical instructions.[24] However, there is evidence that field commanders occasionally issued guidance without ASC coordination.[25] In early 1942, the Air Service Command also became responsible for providing airbases with third echelon (subdepot or intermediate-level) maintenance support.[26] By June 1943, ASC's work force of 50,000 worked day and night to support the war effort.[27] The expansion of ASC's depots and acquisition effort was vital to the Eighth's ability to generate and sustain Big Week raids.

The aviation industry in America had focused on research and development during the interwar years. This focus tended to result in the production of aircraft in small lots, so the ASC acquisition function faced the challenge of trying to convert the industry to a mass production ethos.

> In 1940, when President Roosevelt set a goal of producing 50,000 aircraft per year and funds were appropriated in large amounts, severe acquisition problems developed. Many of the carefully developed procedures relating to advertising and competition had to be set aside simply because of a shortage of time.[28]

Additionally, on 9 April 1942, Congress simplified accounting and contracting by appropriating funds for war materiel directly to the Service departments.[29]

"World War II demonstrated the importance of scientific research in a spectacular manner. Never in the history of warfare were there more rapid and far-reaching scientific and technological developments in weapons."[30] Some of the most significant technological developments were the identification of suitable material and process substitutions to satisfy military requirements. Synthetic rubber is a good example of a substitution that was made in World War II. Much time and effort was required to research and develop suitable substitutes, but they played an important part in providing the logistical support necessary to sustain combat operations. In hindsight, Cook observed, "A most important logistic lesson is that our safety depends on the continuation of this close collaboration in the development of new instruments of war."[31]

Improvements in supportability were also gained through the combination of engineering expertise and quality maintenance. "By strict adherence to the best standards of inspection and routine maintenance, it was possible to lengthen the time interval between overhauls and thus to increase the force available for operation."[32] As early as July 1941, greatly reduced maintenance and supply demand resulted from lengthening aircraft inspection intervals by 25 percent.[33] The official history maintained:

> During the earlier years of the war . . . the desperate need for aircraft in most theaters argued so strongly for repair of the crippled or damaged plane that air depot and service groups were strained to provide the special skills, equipment, and materials to meet the demand.[34]

The spare parts shortages that existed through the end of 1942 made this problem more acute, and the difficulty was not overcome until late in the war.[35]

Between 1931 and 1939, the Air Corps had fewer than 2,000 aircraft, and the depots' small capacity was adequate as they overhauled an average of 166 planes and 500 engines annually.[36] USAAF expansion after the summer of 1940 was so rapid the Air Service Command found it almost impossible to meet the steadily growing maintenance demands. The USAAF did not initiate depot expansion plans until late 1940; therefore, by 1941, the depots were wholly inadequate. From January 1942 through January 1944, depot modernization and expansion, along with the addition of eight depots and many subdepots, meant that capacity outstripped the availability of qualified technicians.[37]

There were just not enough skilled technicians to meet demands, and there was no time to properly train unskilled laborers. The Air Service Command found itself in competition with the more attractive war industry employers in recruiting civilian laborers and generally suffered from a lower priority for civil service personnel fills. A training program for military personnel, which graduated hundreds of thousands of technicians, and special technical training programs for civilian employees recruited to work in stateside depots only partially alleviated the personnel shortage.[38]

The Air Service Command also turned to the private sector for solutions, increasing depot capacity by contracting for training and transport aircraft maintenance and adopting mass production methods to improve productivity.[39] Production line techniques alleviated some problems associated with integrating unskilled labor into depot and flight-line maintenance functions worldwide. A task performed by one mechanic was broken down into several simple steps to quickly make new employees productive. Conveyor belt systems were used to support engine overhaul, repair of parts and accessories, and even some phases of aircraft inspection and repair.[40] Depot management statistically measured and monitored production to identify areas for improved productivity and often adopted the innovative ideas of technicians for improving tools, equipment, and processes. The combination of special civilian training programs, use of military personnel in depots and contractors to augment depot capacity, and process improvements remedied the depot personnel shortage and improved quality and productivity.[41]

ASC acquisition, engineering, research and development, and depot maintenance activities were beneficial to the Eighth Air Force operations. The improvements made within the Air Service Command improved the Eighth's and VIII AFSC logistical support capabilities to some extent. Whether in the form of a new aircraft, a repaired part, an aircraft modification, or a technical directive to maintainers, ASC performance directly impacted the Eighth's performance.

Similarly, the Eighth's performance directly reflected that of the Army Service Forces. General Marshall's reorganization of the War Department as America entered the war had created three separate but equal commands under the Chief of Staff. The new commands were the Army Ground Forces, USAAF, and the Army Service Forces. In the theater, the SOS commander supported the operational USAAF commanders. However, many commanders felt the Services of Supply infringed upon their responsibilities, and many misunderstandings occurred.

The Army Service Forces established command in the UK in 1943, with headquarters functions split between London and Cheltenham, resulting in inefficiency. "This split in SOS HQ was brought about by the desirability of having SOS planning staffs

near the various other planning agencies in London and by the inability of facilities in London to accommodate the entire staff."[42] Communications support was inadequate and travel was time consuming, so the geographical separation caused acute problems.[43]

> . . . SOS was the "rear area" organization of the theater. Under field service regulations, the rear areas of a theater were organized as a "communications zone," an autonomous theater-within-a-theater. The communications zone commander was responsible to the theater commander for moving supplies and troops from the zone of the interior forward to the combat zone. In this regard, he relieved the theater commander from . . . rear area activities . . . . In the European Theater of Operations (ETO), however, there was as yet not a combat zone—the entire theater was essentially a rear area. This geographic coincidence . . . exacerbated the ambiguities over . . . logistical roles.[44]

The USAAF maintained its own supply system for things unique to its mission. Therefore, split USAAF supply support responsibilities existed as supply support of common items was provided by the ASF Services of Supply. This split was a source of great contention.[45]

Knerr, commanding general of the VIII Air Force Service Command and later the United States Strategic Air Force (USSTAF) Deputy for Administration, was responsible for all USAAF logistics in the United Kingdom. He hotly contested the Army's tables of organization and tables of equipment that placed artificial limits on authorized manpower and equipment. Knerr wrote in 1945, "The tables of organization and tables of equipment are a convenient and simple means for a staff agency in the United States to do its job easily, but they place the people in the Theater of War in a straight jacket."[46] He provided many examples of the impact strict adherence to these tables had on the war. Problems included shortages of vehicles to move ammunition, vehicle maintenance and ordnance equipment, and high-explosive bombs due to increased usage during late 1943. These problems made the execution of Big Week more challenging for the Eighth's logisticians. More important, the latter problem meant that not every bomb dropped would produce the desired effect, increasing requirements to revisit targets.[47] Knerr believed the Army should reinvent its manpower and equipment authorization policies. He wanted the Army to use authorization tables more flexibly, like the USAAF supply tables, treated more as guidelines than strict policy.[48] Although Knerr tried to resolve many of these problems before February 1944, the Army did not adopt his suggestions.

ASC and ASF Services of Supply support was critical to the Eighth and VIII AFSC, but the theater logistics organization evolved throughout the war and was characterized by functional overlaps and power struggles. Even after the VIII AFSC shouldered the responsibility for supply distribution, the Army Service Forces provided it some supply support.

Eighth Air Force Logistics

> *Let us, the next time, have our logistics prepared before we plan to operate. We managed to skin by, in this last war, particularly in training personnel, on the logistic side by pulling ourselves out by our bootstraps . . . . Here 273 groups were set up but not a Depot Group was thought of. That meant that the very late start that was made had to be taken care of in the theater, and in the European theater our logistic establishment in the Burgenwood (sic) area was simultaneously a training school and the support for the operating pilot. But that is a bad situation to be in.*[49]
>
> **Major General Hugh J. Knerr, USAAF**

An enormous effort was required to receive, support, and sustain the US bomber units, and British support was the key to success in massing strategic bombardment forces within striking distance of Germany. The British provided the materials for and constructed 91 of the 138 airfields required for American flying operations, allowing the forward deployment of USAAF units.

> The buildup of American air and ground forces in Britain (Operation Bolero) was determined by the logistics constraints the British-American coalition faced before the Normandy invasion. During the first year or so of its operational status from August 1942, Eighth Air Force's buildup was greatly helped by Britain's industrialization and the RAF's maturity.[50]

However, logistical sustainment of the deployed units was also critical in order to increase pressure on Germany and step up those efforts during Big Week. These efforts could only be made if flyable airframes and the right munitions were available. Unfortunately, the emphasis at home on aircraft acquisition overshadowed problems of supply and maintenance, which received inadequate attention from USAAF senior leadership until they became acute.[51]

As evidenced by the data in Table 1, the in-theater logisticians found a way to conquer obstacles and get the kind of results necessary to support an effort with the magnitude of Big Week. Although some of the success is attributable to the improvements made stateside, most of the credit goes to the American and British logisticians in the UK and those braving the Atlantic sea lines of communications. Dramatic improvements across the spectrum of logistics were made in less than 1 year, enabling the Eighth to sustain crippling bombing missions against Nazi Germany from Big Week onward.

Leadership and Organizational Evolution

The USAAF established the VIII AFSC to provide the Eighth's combat units with supply, intermediate- and depot-level maintenance, and transportation support. However, in many respects, the AFSC concept was in direct conflict with the ASF Services of Supply.[53]

Air service groups provided intermediate-level maintenance support for two combat groups, possibly with the squadrons dispersed. One air depot group supported two air service groups. However, in Europe, an entire combat group, sometimes two groups, usually operated at a single airfield, complicating intermediate-level maintenance operations.[54]

Activity	Dec 42	Nov 43
Aircraft Assembled	12	463
Engines Overhauled	35	714
Aircraft Modified	5	619
Tons of Bombs Delivered	2,329	18,000
Propellers Repaired	65	375
Supply Tonnage Received	4,000	20,600
Truck Tonnage Hauled	2,700	22,194

Table 1. VIII Air Force Service Command Production Comparison[52]

VIII AFSC established two depots in England and one at Langford Lodge, Ireland.[55] A government contracting oversight gave Lockheed control of all personnel working at the depot in Ireland, which further complicated operations.[56]

General Knerr spearheaded the logistics efforts within the Eighth up to and beyond Big Week. His past experiences in corporate America, combined with those gained while part of the Bradley-Knerr Committee, did much to influence the logistics organizations and processes supporting the Eighth flying operations. Knerr arrived in Britain in July 1943 as the deputy commander, VIII AFSC.[57] AFSC was separate from the Eighth and subordinated to the numbered air force A-4 (logistics) staff, resulting in conflicts between staff office and operating agency. Knerr pressed for a reorganization of the Eighth, consistent with the recommendation he made to the Bradley Committee, elevating AFSC to a status equivalent to other staff functions. He also sought to consolidate A-4 and AFSC headquarters and reorganize Headquarters Eighth Air Force around two deputies—one for operations and one for logistics. Knerr believed a commander in constant contact with his two deputies could eliminate the need for much staff work and get results by being able to make major decisions quickly. Knerr took control of the Eighth A-4 staff on 11 October 1943, while still acting as deputy commander of VIII AFSC. Shortly after that, he took command of the AFSC. Knerr, by December 1943, "absorbed the personnel and functions of A-4 to become, in effect, the sole logistical agency entitled to act in the name of the commanding general, Eighth Air Force."[58]

Unfortunately, the Eighth took staff and other resources from VIII AFSC, without warning, to stand up the Twelfth Air Force in October 1943. This unforeseen loss of resources degraded VIII AFSC capabilities for some time.[59] VIII AFSC anticipated the activation of IX AFSC, so when this occurred, it did not affect VIII AFSC as the need to support the Twelfth had.[60]

Reestablishment of the Ninth Air Force in Britain prompted further organizational changes. In late December 1943, General Carl Spaatz, commander of the newly created US Strategic Air Force, established a two-deputate structure, administration and operations. The deputy for administration would direct the logistics efforts of the Eighth and Ninth, while the deputy for operations would direct the strategic operation of both the Eighth and the Fifteenth.[61] With the birth of the USSTAF organization, Knerr became the deputy for administration. Knerr stated, "We had a good demonstration of the smooth operation of that partnership thesis during this war in Europe, and we should never forget that lesson because it produced results."[62] Under this new command structure, Knerr made the final preparations and executed support of the Eighth bombing operations during Big Week.

Workloads resulting from initial combat operations, however, were greater than anticipated. In April 1943, VIII AFSC modeled itself after the Air Service Command by establishing three operating divisions—supply, maintenance, and personnel. This organizational change replaced the traditional general staff structure and produced a more effective operation. AFSC also decentralized operations in conjunction with this reorganization, allowing headquarters to focus on management and process improvement. In 1943, logistics organizations and processes were specialized and optimized, and the reduced threat of bombardment in the UK allowed for more efficient centrally located functions. However, VIII AFSC sustainment of the Eighth's combat operations became a major problem, and the "anxious examination of the factors affecting the rate of bombing operation in the fall of 1943 had emphasized anew the basic importance of its varied functions."[63] VIII AFSC had not addressed all the organizational overlaps, inefficiencies, and difficulties. Despite great organizational improvement, its effectiveness suffered.

Infrastructure, Personnel, and Training

"Britain contained a core of civilian workers with maintenance and supply management skills" but "logistics met with an immediate shortage of British labor at ports and construction sites."[64] Although the number of USAAF personnel in Britain increased by 300 percent in 1943, buildup of AFSC personnel lagged behind that of combat forces and handicapped logistics.[65] Despite the fact that 1,000 Eighth Air Force personnel completed technical schools each month in 1943, Knerr noted the biggest problem he faced in 1943 was a shortage of personnel, and those he did have required training. He solved the problem, at least for the maintenance function, by cycling personnel through the air depot groups for formal training. Once trained, they were reassigned to air service groups, and "maintenance was no longer a problem."[66]

In late 1943 and early 1944, thousands of unskilled and untrained workers were shipped to the UK to help man rapidly expanding depots. In order to use new personnel quickly, production-line methods were instituted. Although this approach was not efficient, there was no other way to productively employ these people more rapidly.[67]

In June 1941, a factory representative section was established in London, and when the VIII AFSC was activated, it became responsible for the section. The factory representatives assisted the RAF and the USAAF with technical problems in the field and at depot. By May, it had 222 civilians representing 34 different American manufacturing companies. Then, as now, the factory representatives were invaluable in sustaining operations.[68]

Supply

"The decision in 1939 . . . to put almost all of the funds made available to the Air Corps into complete aircraft explains in large part the critical shortage of spare parts which persisted through 1942."[69] Throughout 1942, aircraft grounded for lack of parts was a concern throughout the USAAF.[70] To make matters even more stressful for VIII AFSC, on 1 December 1942, the unanticipated withdrawal of supplies and essential personnel to support the Twelfth created much chaos.[71]

Through most of 1943, the Eighth's logistics system suffered shortages because of shipping losses and the support it provided to the Twelfth. "Shortages of spare parts for such items as superchargers, bombsights, and trucks (which themselves were in short supply) were frequent."[72] However, by the beginning of 1944, more than 190,000 supply items were cataloged, spares were at satisfactory levels, and "no aircraft was long on the ground for lack of spare parts."[73] The improvement is attributable to the synergistic effects of:

- Decreases in shipping losses.
- Redeployment of Ninth Air Force to Britain.
- Local purchase and manufacture.

- Improved transportation, maintenance, and supply distribution processes.
- The learning curve.
- ASC service life extension and economic repair policies.

US forces in the UK relied on merchant shipping that was subject to German U-boat attacks. U-boats caused the loss of 6.3 million tons of cargo in 1942, but losses steadily declined in 1943 and afterwards. Cargo reaching the UK increased from some 50,000 tons in May 1943 to about 1 million tons in December 1943, while monthly losses decreased from more than 700,000 tons in November 1942 to approximately 100,000 tons in June 1943.[74]

Although cargo losses subsided, problems with manifests and cargo markings often delayed deliveries to units. In 1942, ships commonly arrived in the UK without the SOS having received a copy of the manifest or loading information. Even when documentation was received in a timely manner, it was often too general, making planning almost impossible.[75] Actions were taken to standardize markings and documentation, and dramatic improvement was realized.

> As late as the first quarter of 1943, only 46 percent of the manifests and Bills of Lading were being received five or more days before the arrival of the ships, and 24 percent were not received at all. However, during the month of April 1943, 80 percent were received five or more days ahead of ships, and in May 90 percent. Thereafter, delays in receiving documentation ceased to be a serious problem.[76]

SOS unfamiliarity with USAAF markings and procedures delayed distribution of supplies and prompted VIII AFSC to establish in-transit depots at sea and aerial ports. Further improvements in distribution were realized by dividing the British Isles into two geographic zones. Northern Ireland was later established as a third zone. In-transit depot zoning was based on the capacity of the geographic area to receive supplies, and ships in the United States were then loaded with supplies based on zones, reducing the amount of intratheater transportation required within the UK.[77]

Consequently, VIII AFSC distributed all USAAF supplies received in the UK. With respect to the Eighth, the Services of Supply provided wholesale supply support, and VIII AFSC provided retail supply support.[78] On 14 December 1943, VIII AFSC reported that in-transit depots could deliver bulk supplies from the port to a depot or base within 72 hours. They also reported that 88.5 percent of requisitions were satisfied immediately and requisitions for items not on hand were being filled in less than 24 hours. These process improvements may seem simple, but they did wonders to make the flow of USAAF supplies to and within the UK more efficient and reliable.[79]

It took the USAAF nearly 2 years to develop an effective supply statistics system to aid in spare parts requirement forecasting. As early as 1942, supply planning was accomplished using automatic supply tables based on peacetime consumption rates for 30-, 60-, 90-, and 180-day stock levels in 20-, 40-, and 80-aircraft units. The tables were developed and implemented to help reduce pipeline times for high demand parts with low availability—some were, in fact, taking up to 2 months to obtain from the United States.[80] Supply conferences were held in April and November 1943 to fine tune the tables.[81]

In September 1943, the Air Service Command discontinued automatic resupply shipments for all but new aircraft types. An agreement to ship 50 percent of the 6-month requirement as soon as possible and the remainder 60 days later resolved the problem. Further process refinement averted both shortages and overstocks, and depots were authorized 90-day stock levels of specialized aircraft parts. Subdepots were authorized 6-month levels of common supply items. The prepositioned pipeline stocks were used to fill supply demands at all echelons of maintenance.[82]

In October 1943, the VIII AFSC began to use 3-month forecasts to account for the effects of sortie rates, enemy opposition, repair facilities, and other factors that were not accounted for by the automatic supply tables. Supply transactions were recorded manually, and by late 1943, the aircraft fleet size made it evident that automation was necessary. However, automation did not occur until after 1944. As a result, Big Week did not enjoy the speed and efficiency of an automated supply demand forecasting process.[83]

The amount of equipment being shipped to support the Twelfth caused acute equipment shortages in the Eighth, hampering beddown and support of new units arriving in theater.

> During the early part of 1943, the movement of air echelons to the United Kingdom prior to the movement of ground echelons, service units, and their equipment, contributed to low serviceability. A new unit, for example, seldom reached a serviceability rate higher than 50 percent during the first month of operations.[84]

To alleviate theater shortages, the USAAF began to require units deploying to the UK to ship their own equipment 1 month before deployment.[85] Given the lead times associated with the manufacture of peculiar support equipment items, this policy maximized the number of combat ready aircraft during Big Week.

Before February 1943, all requisitions were passed through HQ VIII AFSC, slowing the process and making it inefficient. After February 1943, the supply channels for Air Force-unique supply items were decentralized. Only those needs that could not be satisfied by military supply within the theater were passed to HQ VIII AFSC and filled, preferably by stateside ASC depots. If ASC could not satisfy the demand, local purchase was used as a last resort.[86] Supply stocks after the winter of 1943-1944 were adequate, and overages were shipped back to the United States.[87] Reinvention of supply demand processing procedures, beginning in February 1943, improved supply support.

In a fine example of cooperation and teamwork, the "British dispensed all the petroleum, oil, and lubricants (POL) in Britain, even though most of it came from the United States under lend-lease."[88] Further, British POL manpower brought some relief to VIII AFSC personnel shortages.

By May 1942, it was apparent that operational requirements would not permit the delays associated with waiting for parts from the United States, so local procurement was begun. The Army SOS established the General Purchasing Board in May 1942 for the purpose of locally procuring goods and services.[89] Shortly thereafter, the SOS commander granted VIII AFSC limited procurement authority.[90] This decentralized procurement tool gave logisticians powers similar to today's International Merchant and Procurement Authorization Card program.[91] Also, by early 1943, local manufacture of some spare parts by European theater of operations depots aided in partially alleviating shortages.[92]

A mutual aid agreement establishing reverse lend-lease with the British was signed 23 February 1942. In the first 2 years of the war, approximately 422,721 tons of supplies were procured from the British.[93] "From June 1942 to July 1943, the British provided US forces in the UK half or more of their quartermaster, engineer, Air Corps, medical, and chemical warfare service supplies."[94] During the war, the United States received more than $6.7B worth of goods and services from the British through reverse lend-lease.[95]

The supply support received from the British was significant as the United States suffered losses of 100,000 to 700,000 tons of shipping per month from late 1942 to mid-1943. Logistics personnel made good use of local purchase, local manufacture, reverse lend-lease, and pooled common supplies. These resources brought relief to weary maintainers by reducing the number of aircraft part cannibalization actions required to satisfy supply shortfalls while maximizing the mission capable rate. The RAF's extensive use of US-built aircraft allowed the RAF and USAAF to create a large pool of common supplies in early 1943. VIII AFSC eventually took over procurement responsibility for the common supply pool, and many items were obtained from UK sources, reducing pipeline time and transport burdens.[96] It would not have been possible to execute Big Week in February 1944 if it had not been for the materials the United States received from the British through local purchase and reverse lend-lease, coupled with the synergistic effect of pooling common aircraft supplies and local manufacture capabilities.

Maintenance and Munitions

During 1943-1944, the average life of an Eighth Air Force heavy bomber was 215 days, during which it flew missions on 47 days and was undergoing maintenance, repair, or modification on 49 days.

> The quality of maintenance was often the margin of difference between the life or death of an aircrew or the success or failure of a mission. The greatly increased rate of operations, the high incidence of battle damage, and the growing complexity of military planes during World War II made maintenance one of the most vital functions in waging of air war.[97]

Maintenance system operations were flexible, and the amount of maintenance was determined by the availability of equipment, supplies, and manpower.[98] Prior to mid-1944, heavy bomber maintenance organizations were constantly challenged by having to expend labor and parts to keep war-weary aircraft flying, since replacement aircraft were not available in sufficient quantities to stabilize aircraft availability with respect to losses.[99] Fighter and medium bomber serviceability was higher than that of heavy bombers "primarily because of a much lower percent of battle damage and less extensive modification requirements."[100] Large theater depots also put increased flexibility into theater maintenance, relieving VIII AFSC organizations on the airbases of a wide variety of labor intensive tasks.[101] In late 1943, General Knerr established subdepots at various operational bases to enhance field maintenance capability. He also implemented a mobile aircraft repair team concept to support onsite repair of aircraft too badly damaged to fly to the depot. In existence between 1943 and 1945, mobile repair teams comprised of supply and repair trucks and specially trained personnel were very important to base maintenance activities. Because the mobile repair teams repaired damaged aircraft that landed off station and aircraft damaged beyond the bases' maintenance capabilities, base maintainers could concentrate on minor repairs and aircraft regeneration.[102]

Further, Knerr reorganized the VIII AFSC and instituted a system to monitor and control aircraft production. He established "statistical reporting and control procedures at all bases" so commanders knew what the situation and requirements were.[103] This included, beginning in September 1943, collecting 3-month sortie forecasts from the combat commands to forecast and adjust depot workloads in order to reduce backlogs.[104] Late in 1942, the British agreed to let Americans replace British workers at the Burtonwood depot, and "under American leadership and production methods the production of engines and instruments increased at a rapid rate."[105] Depot capacity was also increased when Warton Air Depot was activated in September 1943. Several smaller subdepots, known as advance depots, were activated at selected operational airbases to further enhance field capabilities.[106] Knerr's reallocation of repair and modification work in December 1943 took advantage of the efficiency of specialization by spreading backlogs and making the depot in Ireland responsible for aircraft modification kits.[107] The necessity of modifying all incoming aircraft frequently reduced theater aircraft serviceability rates as much as 16 percent.[108] "Following this reorganization, the volume of work accomplished was vastly increased."[109]

Lockheed Corporation, under US contract, manned the Irish depot. Lockheed's depot support was considered advantageous because it provided in-theater specialized engineering work, modifications, development of special tools, design changes, and kit manufacture for all types of USAAF equipment.[110] Finally, "Between 12 and 20 February 1944 no bombing missions had been flown; hence the backlog of aircraft in repair had been diminished, and an unprecedented number of bombers were available."[111] This period of inactivity was the result of poor weather conditions that restricted flying operations. Maintainers took advantage of the situation to generate the 1,292 aircraft that were available entering Big Week.[112]

The Eighth had a sufficient tonnage of munitions and quantities of ammunition available to support Big Week. However, disagreement centered on the types of munitions available and the types the flying units needed to destroy the targets assigned. Knerr believed the disagreement was due to improper communication of field requirements to munitions production plants in the states. The shortage of desired bomb types began in December 1943 and was not corrected by 1 April 1945. The lack of proper bomb types to support Big Week, given the bombing accuracy of the B-17 and B-24, degraded mission effectiveness.[113]

Transportation

Knerr attempted to address airlift problems, which he had foreseen, by trying to secure the dedicated airlift he had apparently been promised. In the summer of 1943, he wrote, "Not more than 3 percent of the required airlift has ever been forthcoming in the United States from that promised service."[114] With the exception of inter- and intra-island air service, the Eighth was relieved of airlift functions. These functions had been placed under the Air Transport Command sometime in the summer of 1943. Knerr later wrote in his lessons learned, dated 10 May 1945, that air cargo had been delivered to places where it was "extremely

difficult to assemble and process" and that units and equipment were separated from each other, delaying unit mission execution in the theater.[115] A military airline was formed by the Eighth for moving troops and supplies throughout the UK and proved its merit by moving an average of 300 tons of cargo and 2,500 personnel per month in 1943.[116]

The Army Service Forces controlled what was shipped via sea to the UK. Knerr felt the Army Service Forces mismanaged sea shipments, and although it never happened, he believed the Air Force should have been allocated dedicated sealift.[117]

Knerr addressed many key logistical problems in 1943. Not the least of his efforts included resisting the return of the Truck Transport Service to the Service of Supply because "until the Air Forces took over segregation and distribution of their own supplies from shipside (sic) to consuming unit, they starved."[118] A shortage of vehicles added to interservice squabbles over control of the ground transport function. "A truck shortage adversely affected distribution, although it was mitigated by Britain's fine transportation system."[119] In addition, the Eighth's trucks were pooled into a single organization and were effective and efficient in moving supplies from port to base and laterally between bases.[120]

Concerning transportation, the Eighth made the best of a bad situation.It operated an intratheater airlift service but depended on Air Transport Command for intertheater airlift. This combination of intertheater and intratheater support apparently satisfied the Eighth's airlift needs despite its dependence on another command. Despite the sealift problems Knerr believed the ASF created, he never was able to secure dedicated sealift.

Eighth Air Force Logistics—The Bottom Line

World War II, as exemplified by the Eighth's tremendous efforts up to and through Big Week, "dramatized as never before the importance of the essentially undramatic functions of transportation, supply, and maintenance and lent new strength to calls for centralization of responsibility."[121] From 1942 right on through Big Week, improvements were constantly sought in all logistical functions to make them more responsive and effective. Many of the accomplishments were achieved because of Knerr's leadership. Although logistics organizations and process deficiencies still existed in late February 1944, many problems had already been addressed and yielded the logistics capability to initiate and sustain operations the size of Big Week. The improvements made within all the logistical functions, combined with continuous process improvements, put the *big* into Big Week.

Success Reaped the Hard Way

> *Perhaps the most significant lesson of World War II is that the military potential of a nation is directly proportional to the nation's logistic potential. The first hard fact to be faced in applying that lesson is that our resources are limited. The next is that the slightest delay or inefficiency in harnessing our logistic resources may cost us victory.*[122]
>
> **Major General O. R. Cook, USA**

Logistics indeed made Big Week *big* with respect to the Eighth's bombing operations. The Eighth generated 3,880 bomber sorties that delivered 8,231 tons of bombs to targets throughout the Third Reich. The number of operational bombers declined to about 900. However, within 5 days after Big Week ended, maintainers had returned about 150 of the approximately 200 bombers with battle damage back to a combat ready condition.[123] Big Week was *big* because, although Allied air superiority was not won until later, as General Spaatz noted, it did spell the beginning of the end for the Luftwaffe daylight fighter force.[124]

Leadership greatly influenced the logistics capability and support the USAAF was able to establish in the UK. On the negative side, it took a long time for the civil-military organization to evolve into an effective one, and it appears the military spent more time trying to take charge of the economy than to work within the President's system.

General Cook remarked:

> Time is the most precious element in logistics preparation for military security. Measures must be prepared in advance for the all-out, logistic mobilization that must be completed between the time when the danger threatens and the time that war actually strikes.[125]

Indeed, the military did not adequately plan for industrial mobilization, which contributed to the myriad of problems encountered.

Congress' streamlining of acquisition procedures and granting of obligating authority to the armed services greatly reduced lead times associated with the major procurements necessary to prepare for and prosecute the war. However, military management of acquisitions was not perfect. In 1942, there was an imbalance between the number of whole aircraft procured and the spare parts required, resulting in a parts shortage. Fortunately, the spare parts situation improved by 1943, and maintainers had the spares needed to support Big Week.

ASC research and development activities enabled technologies to be exploited and, thus, improved combat capability through a controlled aircraft modification program. Technology insertion was a positive influence on logistics.

Functional overlaps, process inefficiencies, and what could be labeled *intraservice rivalry* between the VIII AFSC and AFS Services of Supply caused many of the processes critical to providing and sustaining aircraft maintenance to break down. VIII AFSC addressed most of the problems during 1942 and 1943, but Knerr, because of his overall dissatisfaction with ASF support, made every effort to make the Eighth as logistically independent from the Army as he could, and he got results.[126]

VIII AFSC suffered personnel and training shortages. The leadership's adoption of production-line maintenance processes was not the most efficient use of personnel, but it did allow for speedy incorporation of unskilled workers into the depots and service groups.

"Host nation support, or whatever resources happen to be in the place one fights, can contribute greatly to a logistics system's capability."[127] British airfield construction allowed the United States to mass bomber units on the island. Interservice supply support was critical to the Eighth's maintenance. Finally, British dispensing of POL made efficient use of manpower, which was important to the undermanned VIII AFSC.

Civilians also provided critical support to the logistics team. Civilians in ASC worked acquisition programs and provided supply and repair support. The Lockheed employees at Langford Lodge depot provided in-theater support in a much more timely manner than would have been possible had they been located in

the United States. Factory representatives further enhanced theater maintenance capabilities. In-theater depots, subdepots, and intermediate-level maintenance organizations provided in-depth aircraft repair service independent of stateside organizations. In addition, they developed and provided limited but valuable local manufacture capability, alleviating parts shortages. By the time Big Week arrived, these organizations had evolved and could provide effective logistical support to the combat units, thus enabling sustained bombing raids of 1,000-plus bombers.

Knerr was the single greatest influence on the capabilities and effectiveness of the Eighth's logistics. From the time he served on the Bradley-Knerr Committee to plan the organization and buildup of forces through his tenure as the US Strategic Air Force Deputy of Administration, he constantly improved all logistical functions. His institutionalization of statistical monitoring and requirements forecasting was used effectively to minimize depot backlogs. His implementation of mobile repair teams for battle-damaged aircraft helped sustain the bomber fleet. Finally, he championed making the logistics and operations functions equal at the headquarters level, giving logistics the clout needed to ensure their logistics considerations were taken into account and that logistics and operations were synchronized. "Responsiveness and flexible logistics support requires a management system that consciously links operations and logistics."[128] A good example of Knerr's effort to synchronize operations and logistics was his ability to get 3-month sortie forecasts that were used to plan logistical support.

The processes of producing or allocating munitions, or both, were broken because units did not always have the types and quantities of munitions needed to destroy the assigned targets. Big Week was *big*, but it did not pack the punch it had the potential to because of the many munitions substitutions.[129]

Ship escorts, establishment of distribution zones, ship loading based on destination of goods, improved documentation and communication, establishment of in-transit depots, VIII AFSC's pooling of trucks for supply distribution, and theater controlled intratheater airlift were very positive influences on operations.

Eighth Air Force logistics prior to Big Week was the story of *brute force* logistics. Knerr's effort to synchronize logistics and operations and provide responsive, effective, and efficient logistics serves as the benchmark for all airmen. At the end of the day, the logisticians conquered many challenges through innovation and adaptation that yielded improved productivity and paved the way for Big Week. Indeed, Big Week would not have been *big* were it not for the dedicated efforts of the logisticians for months and years prior to 20 February 1944.

Notes

1. Maj Gen O. R. Cook, "Lessons of World War II," Lecture to Air War College USAF HRA, K239.7162241-22, 10 December 1947, 4.
2. Edward Jablonski, *Airwar*, Garden City, New York: Doubleday and Company, Inc, 1971, 52-53.
3. USSTAF, "Materiel Behind the 'Big Week'," *USAF HRA, 519.04-1*, 20-25 February 1944, 4. On 20 February 1944, Eighth Air Force had fighter escort support from both Eighth and Ninth Air Force units, totaling 902 sorties.
4. Stephen L. McFarland and Wesley Phillips Newton, *To Command the Sky*, Washington, DC: Smithsonian Institution Press, 1991, 168-169.
5. Jacob A. Stockfisch, *Linking Logistics and Operations: A Case Study of World War II Air Power*, Santa Monica, California: RAND, 1991, v.
6. Maj Gen Hugh J. Knerr, "Strategic, Tactical, and Logistical Evaluation of World War II," Lecture to Air War College,USAF HRA, K239.716246-18, 19 October 1946, 3.
7. Alan L. Gropman, ed., *The Big "L": American Logistics in World War II*, Washington DC: National Defense University Press, 1997, 10-15, 94, 98-100. The War Industries Board, established in 1917, was the focal point for the nation's resource and acquisition management. The Board, short-lived, was abolished in the wake of post-World War I acquisition reform that replaced streamlined procedures with peacetime bureaucracy.
8. Gropman, 21.
9. Maj H. Dwight Griffin, et al., *Air Corps Tactical School: The Untold Story*, Washington DC: US Government Printing Office, 1995, 45.
10. Haywood S. Hansell, Jr, *The Strategic Air War Against Germany and Japan, A Memoir*, Washington DC: Office of Air Force History, 1986, 62-63. AWPD-1 called for 61,799 aircraft, of which 4,328 were to be based in Britain, and required 2,118,625 Army Air Forces personnel. AWPD-42 included munitions requirements and called for a total of 8,214 aircraft, including a 50 percent reserve, to be based in Britain.
11. "AC/AS Plans: 1942-1945," *USAF HRA, 145.92-18*, 1943.
12. USASF, *Logistics in World War II: Final Report of the Army Service Forces* (Washington DC: US Government Printing Office, 1947, 247-250.
13. *Ibid*.
14. "Materiel Behind the 'Big Week'," 1-2.
15. Gropman, 9-31.
16. *Ibid*.
17. Gropman, 23-25.
18. Gropman, 25-31.
19. Gropman, 31-35, 38, 55.
20. Gropman, 265-283.
21. Gropman, 31-35, 38, 55.
22. Cook, 7.
23. Lois E. Walker and Shelby E. Wickam, *From Huffman Prairie to the Moon*, Washington DC: Office of History, 2750th Air Base Wing, Wright-Patterson Air Force Base, Ohio, 1986, 146-147.
24. AAF Historical Office, *"Army Air Forces Historical Studies No. 51: The Maintenance of Army Aircraft in the United States 1939-1945," USAF HRA, 101-51* (1945), 133. In February 1942, improvements in engine construction enabled overhaul schedules to be changed. Only when inspection revealed it was necessary were aircraft reconditioned. In 1943, the *obsoletion* policy requiring the retirement of combat aircraft after 6 to 8 years of service was changed and replacement was not required until "whenever superior equipment was available."
25. Maj Gen Hugh J. Knerr, "Knerr Correspondence," USAF HRA, 519.1613, October, November, December 1943. Although the commanders who did this probably felt operational necessity justified their actions, they increased the complexity of logistics support by creating nonstandard configurations. Their actions negated the advantages of interchangeable parts and lengthened the time it took for VIII Air Force Service Command intermediate and depot maintenance activities to return affected aircraft to service.
26. Wesley Frank Craven and James Lea Cate (eds.), *The Army Air Forces in World War II, Vol 6, Men and Planes*, Chicago: The University Press of Chicago, 1955, 391.
27. Walker and Wickam, 145.
28. Gropman, 123.
29. Gropman, 122, 282.
30. Cook, 18.
31 *Ibid*.
32. Craven and Cate, *Vol 6, Men and Planes*, 389-392. "The basic data from which policies and instructions were derived came from reports which flowed in from the depots and stations and from various inspection activities . . . . Although jurisdiction of ASC did not extend overseas, it was responsible for providing service units, equipment, and supplies for all AAF commands."
33. *Army Air Forces Historical Studies No. 51*, 134-135. The suggested overhaul time for the B-17 increased from 4,000 flying hours or 30 to 60 months of service in 1940 to 8,000 flying hours or 84 months of service in 1944.
34. Craven and Cate, *Vol 6, Men and Planes*, 393.
35. *Ibid*. By 1944, aircraft production allowed replacement of heavily damaged planes by new ones, and battle damage repair became less

critical. ASC was then able to establish criteria for determining whether or not it was more cost effective to repair or replace badly damaged aircraft, and the job of the depots "became mainly one of modification and overhaul."

36. Craven and Cate, *Vol 6, Men and Planes*, 389.
37. *Army Air Forces Historical Studies No. 51*, 121, 124, 136-139.
38. Craven and Cate, *Vol 6, Men and Planes*, 395. In 1941, there was an urgent need for more and better maintenance, and the quality of maintenance continued to be low during the early months of the war due to a lack of adequately trained engineering officers and civilian mechanics to man the depots. In part, this was caused both by the increased production pressure associated with the parts shortage that existed through 1942 and the fact that ASC was the lowest priority command for personnel fills.
39. Craven and Cate, *Vol 6, Men and Planes*, 391, 395.
40. Craven and Cate, *Vol 6, Men and Planes*, 396.
41. *Army Air Forces Historical Studies No. 51*, 118-122, 127-128, 135. During the period January 1942 through January 1944, stateside depot maintenance facilities returned approximately 25,000 aircraft and 90,000 engines to service. In 1943 alone, 236,622 aircraft visited the 200-plus subdepots for repair and other work. Finally, an Air Inspector survey conducted in the summer of 1943 attested to the fact that the Eighth Air Force was satisfied with the third and fourth echelon maintenance support it was receiving from ASC.
42. General Board United States Forces, European Theater, *"Logistical Build-Up in the British Isles," USAF HRA, 502.101-128, 9 June 1953*, 4.
43. *Ibid*.
44. Gropman, 345.
45. *Logistics in World War II*, 248, 341. Within the ASF, "there was an unnecessary overspecialization in types of service troops, thereby making it difficult to secure maximum flexibility in the utilization of service personnel." Although it was believed units comprised of both USAAF and Army personnel would improve the situation and some experimenting with this type of organization was done, the idea "was not pushed vigorously."
46. Maj Gen Hugh J. Knerr, "Air Force Logistics," *USAF HRA, 519.8086-1*, 10 May 1945, 2.
47. "Air Force Logistics," 6-7
48. "Air Force Logistics," 2.
49. Knerr, "Strategic, Tactical, and Logistical Evaluation of World War II," 4-5.
50. Stockfisch, 18.
51. Craven and Cate, *Vol 6, Men and Planes*, 390.
52. USSTAF, *"Notes for Supply and Maintenance Chapter,"* USAF HRA, 519.057-4, 1942-1945, 10.
53. *Ibid*.
54. Stockfisch, 19. Further complicating an already complicated task, commanders of combat units wanted command of Air Force Service Command intermediate-level maintenance (air service group) activities on their bases. This quickly became the practice, diluting the authority but not the responsibility of the VIII Air Force Service Command commander.
55. Knerr, "Knerr Correspondence."
56. "Notes for Supply and Maintenance Chapter," 6.
57. *Biographical Data, Personnel Index, USAF HRA, 519.293-1*, 1945. Knerr, a graduate of the US Naval Academy, became an Army artillery officer in 1911. He joined the Air Corps near its birth and retired from active duty in 1939 only to be recalled in 1942, having spent the interim years at the Sperry Gyroscope Company "in work that . . . proved invaluable both to him and to the Military Service."
58. Craven and Cate, *Vol. 2, Europe: Torch to Pointblank—August 1942 to December 1943*, 742-743. As a member of the Bradley Committee, in the spring of 1943, Knerr had prepared a special report on air service in Africa. In the report, he advocated the elimination of the problems caused by the logistics function being subservient to the staff and operations functions by the simple expedient of elevating the agency to the staff level of command.
59. Stockfisch, 18-19.
60. Notes for Supply and Maintenance Chapter, 6-11.
61. Notes for Supply and Maintenance Chapter, 752.
62. Knerr, "Strategic, Tactical, and Logistical Evaluation of World War II," 5.
63. Craven and Cate, *Vol. 2, Europe: Torch to Pointblank—August 1942 to December 1943*, 742.
64. Stockfisch, 18, and Gropman, 346.
65. Gropman, 364.
66. USAF Historical Research Agency, "Notes on an Interview with Maj Gen Hugh J. Knerr," USAF HRA, *168.2-12*, 24 November 1947, 1-2.
67. Craven and Cate, *Vol 6, Men and Planes*, 395-396.
68. "Civilian Technicians and Representatives," *USAF HRA, 519.8023*, 1941-1945.
69. Craven and Cate, *Vol 6, Men and Planes*, 390.
70. Craven and Cate, *Vol 6, Men and Planes*, 394.
71. "Notes for Supply and Maintenance Chapter," 2.
72. Stockfisch, 19. "During early 1943 spare parts for 50-caliber aircraft machine guns became so scarce that the total supply was pooled in a single depot with telephone requests being doled out by special truck delivery."
73. "Materiel Behind the 'Big Week'," 3.
74. Gropman, 347-348, 359, 361-363, and Maj Gen William E. Kepner, "Supply (Congressional Committee)" Kepner Collection, USAF *HRA, 168.6005-84*, 3 June 1945, 2.
75. "Logistical Build-Up in the British Isles," USAF HRA, *502.101-128*, 9 June 1953, 25-26. "Entries on the manifest such as '1000 boxes of Quartermaster Class I supplies' were not uncommon."
76. *Ibid*.
77. "Notes for Supply and Maintenance Chapter," 3, 128.
78. *Ibid*., 3.
79. Knerr, "Knerr Correspondence."
80. "Notes for Supply and Maintenance Chapter," 3.
81. "Stock Control in the ETO," USAF HRA, *519.8024-1*, 1945, 1, 8-9.
82. "Stock Control in the ETO," 25, 31.
83. "Stock Control in the ETO," 3-5, 10.
84. "Notes for Supply and Maintenance Chapter," 5.
85. "Notes for Supply and Maintenance Chapter," 4.
86. "Stock Control in the ETO," 15-16, 19-23, 36-37. Combat group demands not met were first sent to the air service group, then the depot. If neither organization could satisfy the demand, it was then sent to headquarters VIII Air Force Service Command. A three-tier supply priority system was established, in which priority was based on urgency of need. Aircraft grounded for lack of parts were given highest priority, and those requirements were sent via teletype to the air service group. If the air service group could not fill the request, a teletype was sent to the air base depot, and if it still could not be satisfied, a cable was sent to the responsible stateside depot.
87. "Notes for Supply and Maintenance Chapter," 5. AOG rates fell from 5 percent in December 1942 to 2.3 percent in November 1943.
88. Stockfisch, 19.
89. General Board United States Forces, European Theater, *Logistical Build-Up in the British Isles*, 15.
90. "Stock Control in the ETO," 22-23. Local purchases were limited to 25 pounds sterling ($100), required written approval of the station commander, and could only be done when urgency of need did not permit procurement through the British Equipment Liaison Officers. Station purchase (for example, contracting) officers had standing authority to make purchases not exceeding 5 pounds sterling.
91. Deputy Assistant Secretary of the Air Force (Contracting). *Contracting Toolkit: IMPAC*, 5 January 2000 [Online] Available: http://www.safaq.hq.af.mil/contracting/toolkit/impac/.
92. "Notes for Supply and Maintenance Chapter," 2.
93. "Stock Control in the ETO," 19. Reverse lend-lease arrangements were used to make routine purchases exceeding 25 pounds sterling and were processed through the commanding general, VIII Air Force Service Command and the RAF Equipment Liaison Officers.
94. Stockfisch, 18.
95. Gropman, 273, 277.
96. "Notes for Supply and Maintenance Chapter," 4.
97. Craven and Cate, *Vol. 6, Men and Planes*, 388, 394.
98. Craven and Cate, *Vol 6, Men and Planes*, 389.
99. Stockfisch, 43-44.
100. "Notes for Supply and Maintenance Chapter," 4. For example, medium bomber serviceability went from 29 percent in July 1943 to 92 percent in November 1943.
101. Craven and Cate, *Vol. 6, Men and Planes*, 391.
102. "Notes for Supply and Maintenance Chapter," 6, 11. Transport of aircraft via truck to depot in the UK was infeasible due to the physical

(Continued on page 39)

A maxim has it that we seldom fight the war for which we plan. Recent history strongly suggests it is likely that the next contingency we face will be one we have not considered explicitly.

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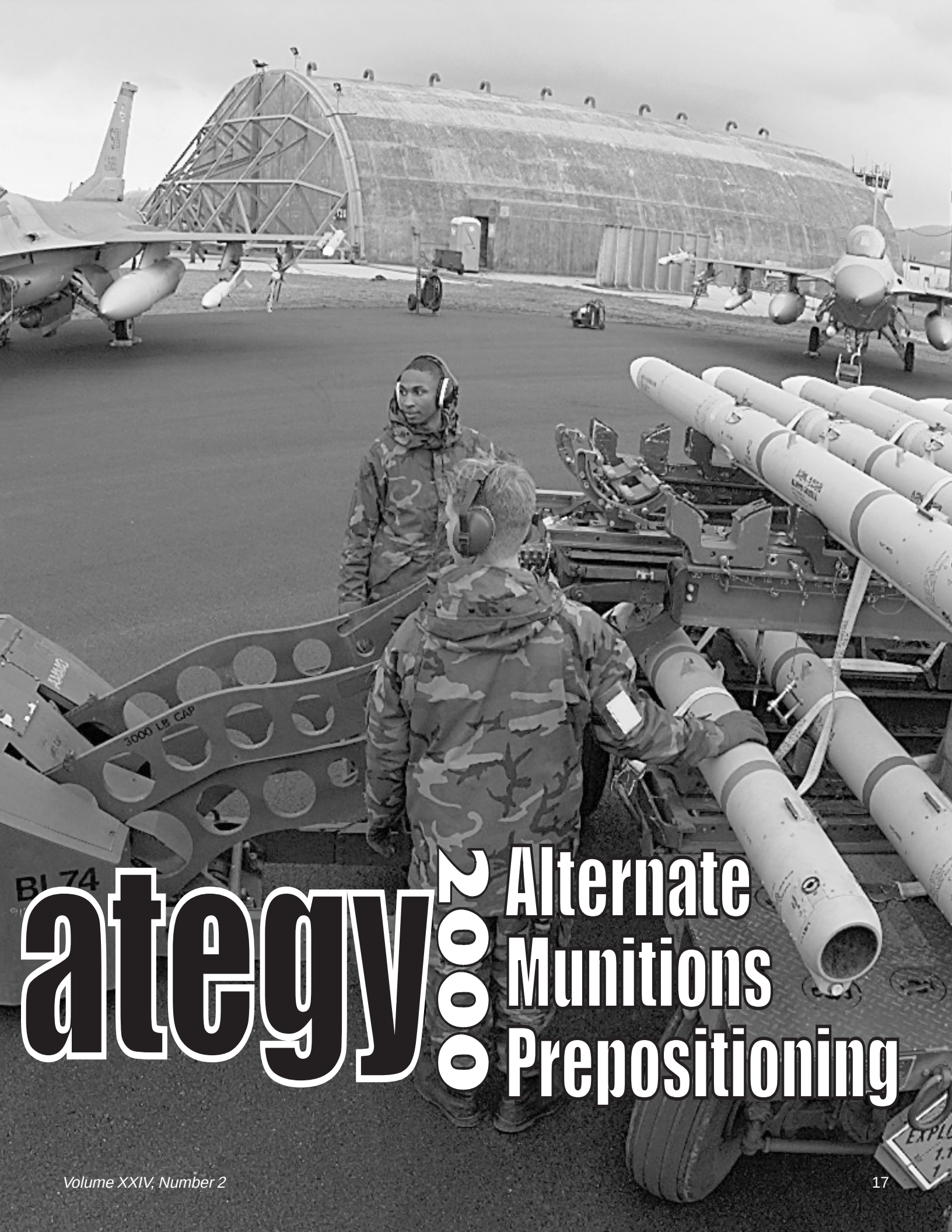
Operational Certainty and Planning

The Expeditionary Aerospace Force (EAF) concept—with its reliance on rapidly deployable, immediately employable, and highly flexible force packages to serve as viable substitutes for continuous forward presence—requires new combat support practices. RAND EAF research in this area has been focused on (1) new combat support practices that enable the EAF concept, (2) identifying options to satisfy combat support requirements over a wide range of expeditionary scenarios, and (3) assisting the Air Force to adapt its support system from one supporting a permanent overseas force to one that supports the EAF operational concept.[1]



ategy 2000

Alternate Munitions Prepositioning

A maxim has it that we seldom fight the war for which we plan. Recent history strongly suggests it is likely that the next contingency we face will be one we have not considered explicitly. Facing up to this likelihood requires planning that is robust against the widest possible range of scenarios, including things that can go wrong. Robustness results from actions taken both before and during a contingency. To achieve robustness, investment levels and prepositioning assets must be determined during peacetime. Strategies for prepositioning war reserve materiel (WRM) include placing materiel at forward operating locations (FOL), at forward support locations (FSL), or at continental United States locations. FSLs can be established at fixed sites on land, or they can use afloat prepositioning ships (APS). Decisions about prepositioning assets affect employment time lines and lift requirements associated with contingencies and determine the Air Force's capability to respond to contingencies around the globe.

Robust planning for war reserves can be distilled into three issues:

- What kinds and quantities of resources should the Air Force acquire and have on hand to meet continuous peacekeeping roles, as well as major theater wars (MTW)?
- Where should these resources be stored in peacetime?
- What strategies should be employed in crises for supporting deploying units with war reserve assets?

This article does not address the full range of questions implied by these three points. Rather, it focuses on aspects of the second point and illustrates how this issue can be approached by evaluating air munitions against a range of scenarios. The scenarios are variations on a Desert Storm-sized campaign occurring in one of five geographic locations, with differing amounts of warning, and in the face of several kinds of disruptive unexpected events. Prepositioning air munitions on the ground and in ships and the use of transportation assets were considered. Outcomes were evaluated according to the adequacy of munitions stocks to meet 30 or more days of operations.

JICM and Exploratory Modeling

The evaluations were accomplished using the Joint Integrated Contingency Model (JICM).[2] JICM is a comprehensive, deterministic simulation in which higher level decisions and actions are specified by the user. Execution details are left to the adaptive logic of the program, which employs an extensive database of information about geography, military activities, and objects such as ships and aircraft. Although JICM can adjudicate battles on land, sea, and in the air, only its capabilities to simulate mobility operations leading to estimates of the day-by-day quantities of munitions delivered to operating bases were used.

One approach to dealing with uncertainty is to plan against a single scenario that is so demanding it encompasses all other cases that might eventuate (normally an erroneous assumption). *Exploratory modeling* takes the opposite view. Rather than deny the existence of uncertainty, it provides an approach to confront both uncertainty and a lack of knowledge head on. Operationally, it entails examining a broad range of cases that cover the extremes of beliefs about the possibilities that could eventuate, combined with a broad range of choices. Instead of choosing a policy that is in some sense *optimal* for a fixed environment or scenario, the objective is to find alternatives that are robust against a wide range of conditions.[3]

Although there has been criticism that exploratory modeling is just old-fashioned sensitivity analysis, it encourages a valuable and possibly novel approach to planning. Exploratory modeling generally requires that many cases be evaluated. This has only become possible with modern computing environments (the number of cases run in this study was close to 180,000).

That exploratory modeling projects typically involve running huge numbers of cases raises the question of how to go about analyzing the results. The solution lies in having some kind of computer-generated graphical display appropriate to the problem. This study employed a program called DataView.[4]

Scenarios and Alternative Prepositioning Strategies

Presently, the Air Force has a substantial amount of munitions prepositioned in Southwest Asia (SWA), and a fairly large amount is aboard three ships stationed in the Indian Ocean and Mediterranean Sea.[5] When the National Command Authority orders the Air Force to respond to a contingency, munitions on the ground have to be moved to operating bases by rail, truck, or air. At the same time, ships begin moving toward ports. After ships dock and unload at ports with limited berthing and unloading capacity, the munitions must be moved to bases. Transporting munitions can be an immense task in itself, involving issues such as the availability of equipment, host nation approval, qualification of personnel to prepare munitions packages for pallets, and so forth. The analysis focused explicitly on the number and position of APS and their effect on WRM stocks throughout the first month of a contingency.

In generating the results, it was assumed that the requirement for munitions would depend on the planned arrival of forces in theater according to current deployment plans for Southwest Asia and a specified target set. It was also assumed that the mix of munitions both on the ground and in APS would be carefully chosen, so only the aggregate tonnage of munitions was considered during the course of the study. Of course, the quantity of munitions required for a contingency may vary, so cases were examined where the WRM requirement varied 25 percent from planned levels.

The main sources of uncertainty considered were warning time (the time between the decision to act [C-day] and the commencement of hostilities [D-day]) and the theater of operations (location of the contingency). The five theaters considered were Southwest Asia (Saudi Arabia), South Asia (Myanmar), North Africa (Tunisia), the west coast of Africa (Congo), and west South America (Chile). Among these, only Southwest Asia has approved data on targeting, force beddown, and time-phased force and deployment.

In addition to these uncertainties, a variety of other things can go wrong, so seven *surprises* were included in the evaluation.[6]

- Aero. *AeroPort* danger, in which enemy action poses a danger to aircraft delivering munitions to operating bases resulting in delivery by land (and not air) from rearward bases.

- Late. Ship late, in which the ship that is supposed to arrive first is delayed by 5 days.[7]
- Land lines of communication (LLOC). LLOC curtailed, in which enemy action reduces the throughput capacity of the surface transportation network by 75 percent.
- Port. Seaport attack, in which an attack on a seaport halts operations at the primary port until damage can be repaired.
- Sabo. Sabotage, in which 5,000 tons of munitions on the ground are destroyed before combat begins.[8]
- Sunk. Ship sunk, in which the ship that is supposed to arrive first to a theater is lost along with its cargo
- Horm. *Hormuz* chokepoint, in which enemy action delays passage through the Strait of Hormuz (the surprise affects only the Southwest Asia scenario).

In combination with this range of scenarios and surprises, several initiatives to promote robustness and responsiveness were evaluated. The most important of these was to change the prepositioning of WRM, primarily by increasing the number of APS. For the study, a shipload of munitions was taken to be 17,000 tons. At the time of the study, there were about three shiploads worth of munitions prepositioned on shore in Southwest Asia, in addition to the three ships. Alternatives considered involved adding one or two additional ships, while reducing the amount of munitions on land accordingly, to maintain the 102,000 (six times 17,000) tons overall.[9]

Alternative APS positioning was also investigated. The National Command Authority, for example, may have advance indications of the need to deploy, and APS could move accordingly to a *forward-leaning* posture. Further, the option of replacing break-bulk APS—which would take 4 days to unload, with *roll-on, roll-off* (RORO) ships that were faster and could be unloaded in a single day—was tested. The assumption was made that one APS would always be a lighter aboard ship, or LASH, to ensure deep-water unloading capabilities. The study also considered increasing the airlift for moving munitions by the equivalent of 30 C-17s operating for 30 days for greater responsiveness.

Table 1 presents the locations of the APS, regardless of where the contingency takes place. The middle column gives the locations assumed in the base case. The right-hand column depicts a modified basing used in analyzing a forward-leaning (FWD) option for this scenario.

In the non-Southwest Asia scenarios, forward basing means that two ships begin moving in order to be 1 day from docking on C-day.

Demand for Air Munitions and Scoring Scheme

A natural way to evaluate the performance of logistics support for an operation is to compare the availability of material to the demand. A planner would want to ensure adequacy of supply by providing for safety stocks above the projected demand while recognizing that supplying materiel beyond a reasonable level of protection is wasteful. The daily requirement for munitions was established by using the Air Force's Conventional Targeting Effectiveness Model (CTEM) for munitions that are strictly target-driven. For munitions requirements that the CTEM does not estimate, requirements were developed using estimates of the regional commander in chief. These requirements were translated into tons of munitions required for each day of operation.

Number of Ships	Normal Basing	Forward Basing
2	IO, IO	PG, MI
3	IO, IO, MED	PG, MI, IO
4	IO, IO, MED, SP	PG, MI, IO, MED
5	IO, IO, MED, SP, LA	PG, MI, IO, MED, SP

IO—Indian Ocean (Diego Garcia)
MED—Mediterranean Ocean (Rome)
SP—CONUS Atlantic Coast (Sunny Point)
LA—CONUS Pacific Coast (Los Angeles)
PG—Persian Gulf (United Arab Emirates)
MI—Masurah Island, Arabian Sea (Oman)

Table 1. Locations of Afloat Prepositioning Ships

Evaluations of alternatives against scenarios with JICM were based on the worst days in terms of munitions on hand over the first 30 days of operation. Specifically, at the end of each day, the tonnage of munitions on hand was compared with the demands for succeeding days. For example, having at least 5 days of supply on hand every night for each of the first 30 days would be satisfactory. On the other hand, it would be highly unsatisfactory if there are as many as 3 occasions out of the 30 when the inventory is inadequate to meet the following day's requirements. Expanding the foregoing, a straightforward system involving a nine-point scale for conditions between and including these extremes was adopted. Table 2 indicates the nine-point scoring scale and the color codes employed. The abbreviation *DOS* is short for *days of supply*. For example, *7* DOS means the amount of munitions required for the following 7 days.

Scenarios in which there was excess movement of stock were not explicitly considered, but it was obvious that too much WRM ashore in Southwest Asia adversely affects support system performance elsewhere.

Analysis of Prepositioning Options with DataView

The study explored variations of these nine factors:

- First surprise, if any.
- Second surprise, if any.

Color Code	Score	Condition
	9	At least 7 DOS on hand every night
	8	At least 5 DOS on hand every night
	7	At least 3 DOS on hand every night
	6	At least 1 DOS on hand every night
	5	Less than 1 DOS on one or more nights; never stocked out
	4	Stocked out 1 night
	3	Stocked out 2 nights
	2	Stocked out 3 nights
	1	Stocked out more than 3 nights

Table 2. Colors and Scores Based on Days of Supply

- Theater (Southwest Asia, South Asia, North Africa, West Africa, and South America).
- Warning time (C-day to D-day) of 10, 20, or 30 days.
- Shiploads (17,000 tons) of air munitions ashore in Southwest Asia.
- Number of afloat prepositioning ships.
- Whether FWD is in effect.
- Whether all APS but the LASH are RORO.
- Whether additional airlift is used to move munitions.

To fully appreciate the power of DataView, one must work with it interactively. Since DataView produces three-dimensional displays, a user can (interactively) choose three factors for the X, Y, and Z axes and pick specific values for the remaining factors. For the figures in this article, the three axes were associated with the first three factors in the list above. Each figure is the result of setting specific values for the remaining six factors. Figure 1 is the DataView presentation for the case of 20 days' warning, three shiploads of munitions ashore in Southwest Asia, and three prepositioning ships. None of the options represented by the last three factors is in effect.[10]

The five squares in the lower left corner (None and None) indicate outcome scores with no surprises for the five scenario locations. For the Southwest Asia and North Africa contingencies, indicates there are always at least 5 days of supply on hand. For the South Asia and West Africa scenarios, means that there was at least 1 night with less than 3 days' supply on hand but there were no days with stock outs either. The South American war is just too far away to be satisfactorily supplied by the munitions we assumed to be available, and means there are at least 3 nights with stock outs. (Were the United States to become involved in a war in Chile, alternative sources of munitions might be available.) Because all the munitions are near the Southwest Asia theater, none of the surprises, or even combinations of surprises, cause that case to be worse than (although, with less warning, the Hormuz and other surprises cause Southwest Asia outcomes to be colored differently). The worst set of surprises comes when a ship is sunk and the port is contaminated or munitions on the ground are lost to sabotage.

That all the Southwest Asia outcomes are suggests that munitions are well positioned to fight an MTW there. But that level of performance is unachievable in any of the other theaters considered. This suggests that achieving a more robust posture might be possible if less tonnage were kept on the ground in Southwest Asia and more put in afloat prepositioning ships.

Figure 2 shows the outcomes under all the same conditions as above, except that two of the three shiploads of munitions are placed on ships located according to the last line in Table 1. Observing the color shifts between the two figures suggests there are some improvements in the non-SWA scenarios.[11]

The forward-basing strategy outlined in the right-hand column of Table 1 additionally improves responsiveness. The results are in Figure 3 where, at worst, there are a few cases showing stock outs on 1 or 2 nights when the port is attacked.

Proceeding with additional improvement measures, replacing break-bulk ships with RORO ships eliminates all the squares. If, in addition, the extra strategic airlift is provided for moving munitions, all cases are .

Since only total tonnage was considered in this analysis, the mix of munitions to be stowed aboard ships was not explicitly considered. Optimal mixes of munitions required for different theaters can vary considerably.[12] This suggests the Air Force should load munitions prepositioning ships homogeneously, lest a ship loaded for a particular scenario is the first to arrive at a scenario for which its load was not intended. Current loading of Air Force munitions prepositioning ships indicates that such a policy is already in effect.

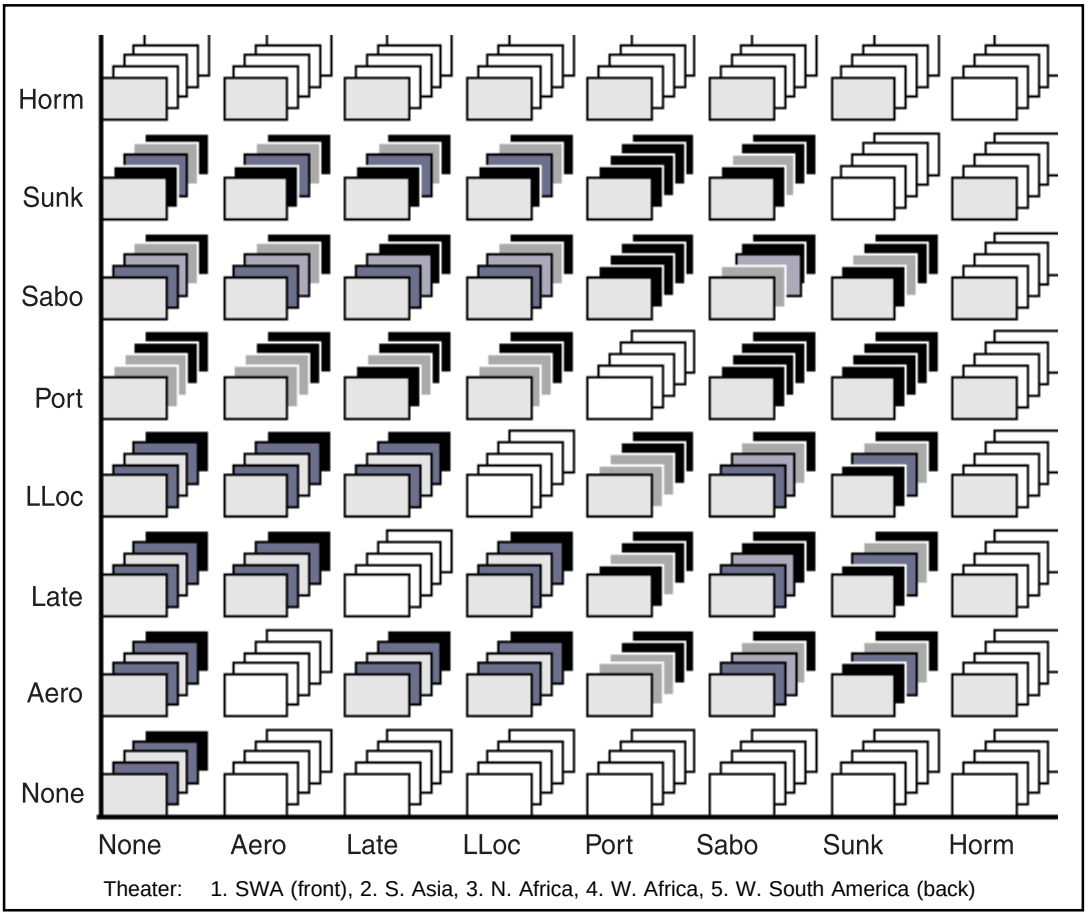


Figure 1. 20 Days, 3 Ashore, 3 Afloat

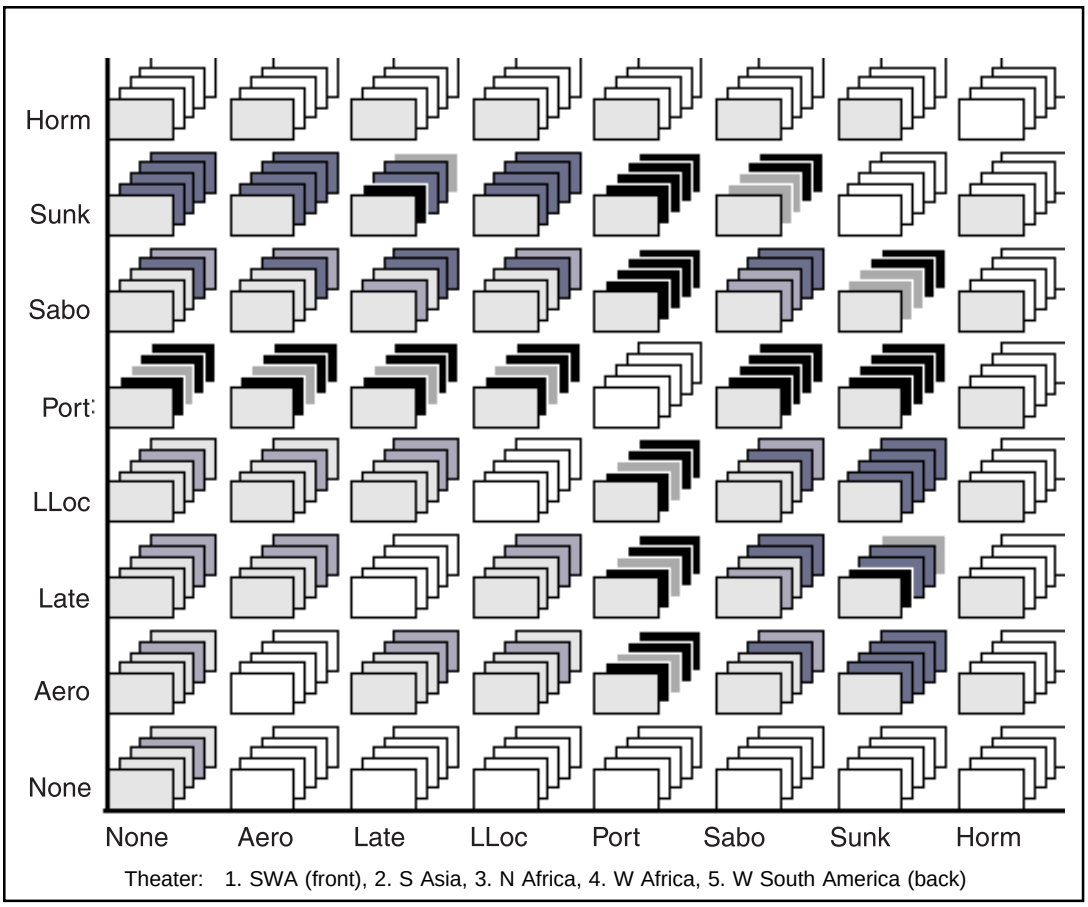


Figure 2. 20 Days, 1 Ashore, 5 Afloat

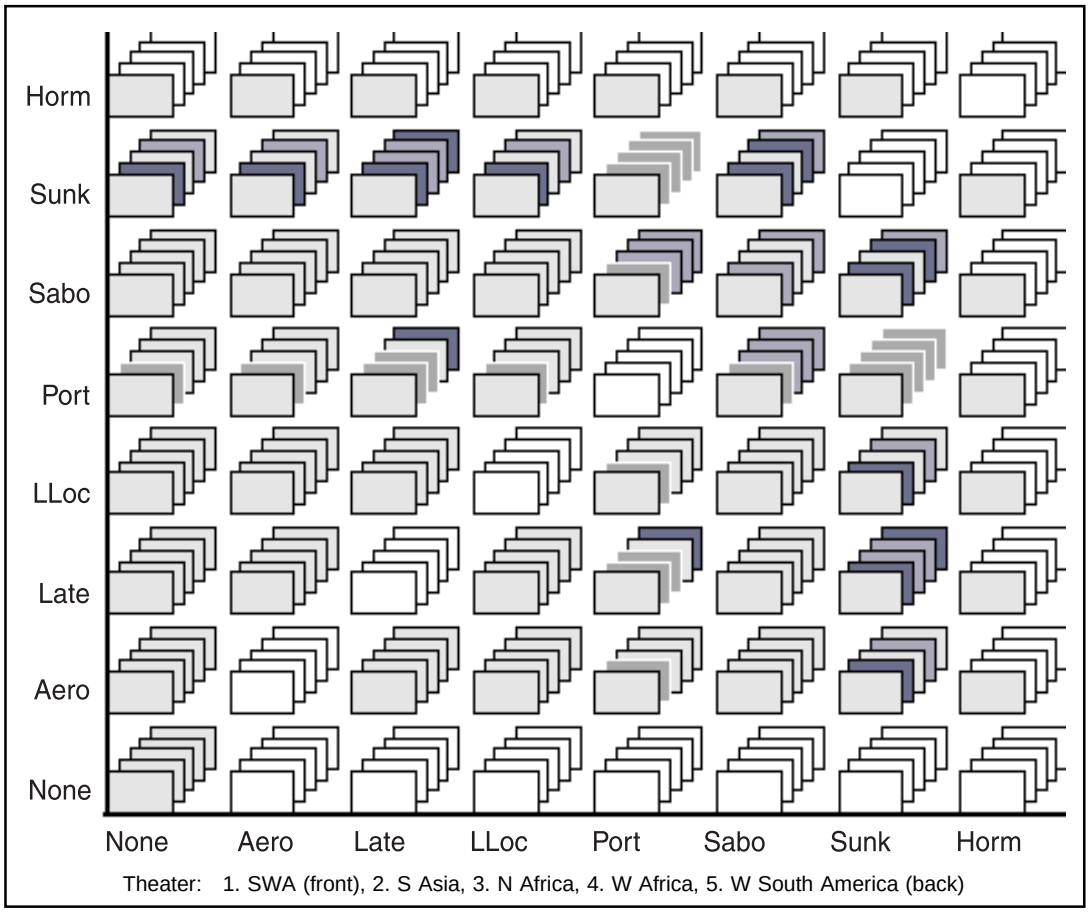


Figure 3. 20 Days, 1 Ashore, 5 Afloat, FWD

Experiences with APS During Operation Noble Anvil

During Operation Noble Anvil (ONA), the Air Force flew about 2,000 bombing runs (with a total of about 6,000 sorties) and dropped about 16,000 short tons of munitions. Because of the unique aspects of ONA—rich infrastructure of the theater, proximity of well-developed FOLs, duration and intensity of the conflict, and the enemy's strength—one should be circumspect about drawing too many conclusions from it. It is worthwhile, however, to reflect on what the experience suggests about potential strengths and weaknesses of the Air Force's preparations to face future (and different) conflicts.

As outlined, the ammunition prepositioning fleet is an important asset because in many conceivable scenarios the munitions requirements cannot be met with in-theater assets alone. Yet, it took about 9 weeks from the United States Air Forces in Europe (USAFE) request that munitions on the *MV Captain Stephen L. Bennett* be made available and arrival of the final trainload at its destination. Figure 4 shows the time line of events associated with the *Bennett*. The horizontal scale indicates weeks from the start of air operations. The initial delay between the USAFE request and JCS authorization might be attributed to the lack of urgency in resupplying munitions, given the quantity of the prepositioned materiel in the theater and initial expectations that the campaign would not be a long one. The *Bennett* sailed from its station

(Continued on page 40)

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Global Access

Strategy 2000

A global access strategy that includes maintaining core assets and developing new political and technological opportunities can help the United States manage and develop access and basing options both now and in future years.

Defense basing decisions reflect both military needs and political conditions. For much of its history, the Air Force has relied heavily upon forward basing, maintaining a substantial portion of its *tactical* forces[1] at permanent bases outside the United States. The primary purpose of this strategy was to counter a possible attack by the Soviet Union and its allies, but this strategy also had political dimensions. However, it was only possible with political support at home and in host nations. It would not have been possible had the United States and its allies disagreed on the need to or means of containing Soviet power. Ultimately, the collapse of the Soviet Union and the implosion of the Warsaw alliance removed the military and political conditions for extensive foreign basing.

Despite the subsequent drawdown from a global to a US-based force in the past decade, the Air Force has waged a growing number of operations of various scales on every continent in the same decade. It has done so while maintaining its role as a deterrent to attacks and preparing to respond wherever US interests are challenged.

The growing number of operations in locations around the world has led the Air Force to reconstitute itself as an expeditionary aerospace force, or EAF. The EAF goal is to deploy forces anywhere in the world and begin sustained operations within 48 hours. However, such goals will be difficult to meet with current processes and technologies, particularly where resources are not prepositioned at forward operating locations (FOL). RAND and AFLMA research has shown that the level of resources at FOLs affects employment time lines. Naturally, greater prepositioning at FOLs reduces employment time lines. This research has also shown that forward support locations (FSL) can help reduce the need for prepositioned materiel and aid the shift from surge to sustainment operations in a contingency when used for intermediate maintenance activities and for storage of munitions, supplies, or other war reserve materiel.[2]

The continuing need for forward basing of the logistics infrastructure, even as more operational forces are based in the continental United States, means that logisticians must be involved in addressing questions of access to bases and other facilities outside the United States. To address such questions, logisticians must understand both operational and political constraints. As the scenarios change in nature and location, so do political and logistical needs and conditions. These may see the warfighting ally of today refuse to cooperate tomorrow, even to the point of denying the United States access to its resources located at FOLs and FSLs abroad.

What are the conditions that would lead a potential ally to permit or resist US access and basing? Given these, what strategies should the United States use to manage its future needs for access and basing? We reviewed some expeditionary operations that encountered substantial political difficulties and how the difficulties affected access and basing. These operations demonstrate the variables that lead other nations to grant or resist US requests for access and basing, as well as how the United States can maintain and develop new access and basing options.

All branches of the US military must confront access and basing questions for operations abroad. The Army and Air Force are equipped and configured primarily to fight within theater. The Marines' *raison d'etre* is conducting expeditionary operations "from the halls of Montezuma to the shores of Tripoli." Even Navy ships, largely free from the need for foreign bases, require access to foreign ports and facilities for resupply and other support.

Nevertheless, access and basing issues are most salient for the Air Force. Fighters and attack aircraft like the A-10, F-15, F-16, and F-117 have operating ranges of 300 to 500 nautical miles. While aerial refueling can extend the operating ranges for these aircraft, they cannot operate effectively when based thousands of miles from theater.[3] The Air Force has also suffered the most pronounced limitations because of access problems, most recently in operations against Iraq.

The Politics of Recent Expeditionary Operations

Expeditionary operations in the 1970s, 1980s, and 1990s illustrate the political issues that must be confronted in access and basing. Access difficulties may not halt operations outright, but they do impede effectiveness.

Operation Nickel Grass. In 1973, the Air Force conducted an airlift to support Israel during the Yom Kippur war. This operation was severely hampered by the refusal of nearly all the European allies to permit US aircraft to cross European airspace or use their facilities while en route to or from Israel. Only Portugal cooperated, grudgingly granting access to Lajes Air Base in the Azores. Without this assistance, the airlift, which Egyptian president Anwar Sadat cited as one of the reasons he requested a cease-fire, might have been impossible.[4]

European allies refused to cooperate with this mission because they feared reprisals from Israel's enemies. Indeed, the subsequent Arab oil embargo was targeted toward both the United States and Portugal but not other European allies. Portugal, however, was willing to curry the favor of the United States by supporting *Nickel Grass* since, at the time, it was isolated globally because of its colonial war in Africa.

Operation El Dorado Canyon. In 1986, the United States launched airstrikes against Libya in retaliation for alleged terrorist activities. These operations included F-111 and EF-111 aircraft flying from the United Kingdom (UK). France and Spain refused to permit flyovers, thus forcing US aircraft to fly from the UK around the Iberian Peninsula to Tripoli in a one-way journey of 2,700 nautical miles. Flying over France would have cut this journey to 1,500 miles, and flying over Spain and around France would have cut it to 1,900 miles (Figure 1). The refusal of France and Spain to permit flyovers for this operation nearly doubled the distance aircraft had to travel to perform the mission. Upon reaching Libya, many US aircraft had difficulties with their targeting systems, and tired aircrews made errors in aiming ordnance. While on a strategic level the attack may have succeeded, on a tactical level, the access problems prevented it from accomplishing as much as had been hoped.

The United Kingdom supported this mission, in part, because of the special relationship the US and UK have nurtured. This included the sharing of intelligence that persuaded the United

Figure 1. Schematic Mission Profile for *El Dorado Canyon*. The refusal of France and Spain to permit flyovers for this operation almost doubled the distance aircraft had to travel to perform the mission.

Kingdom of the need for the mission. France and Spain refused support because they feared being targeted by terrorist reprisals.

Persian Gulf Operations. In 1990, the Iraqi invasion of Kuwait galvanized a coalition sharing interests in preventing further Iraqi aggression, ousting Iraq from Kuwait and, if possible, toppling Saddam Hussein. US diplomatic pressure, coupled with American intelligence convincing Riyadh of an Iraqi threat to Saudi Arabia, persuaded the Saudis to permit an enormous deployment of US forces there. Following the Gulf War, several nations in the region, including Saudi Arabia, broke with tradition and permitted the United States to maintain some presence. Yet the United States has been unable to formalize its security relationship with Saudi Arabia. Continued US involvement in the region has led to conflicts between the United States and its regional allies. These conflicts have caused serious problems for military planners many times since 1996. Saudi Arabia and Turkey have refused to support US actions against Iraq or permit the use of US forces for such actions, forcing the United States to rely on less effective cruise missile strikes rather than land-based airpower. These refusals arose as the political climate changed from one in which regional allies needed US help to contain and reverse Iraqi aggression to one in which they questioned whether US strategy against Iraq would prevent ultimate reprisals by Saddam Hussein. Domestic politics also limit how much regional allies are willing to cooperate with US actions against an Arab state.

Operations in the former Yugoslavia. US responses to crises in Bosnia and Kosovo have involved US airstrikes against Serbian forces. Although the North Atlantic Treaty Organization (NATO) authorized and conducted these operations, Greece, a longstanding member of the alliance, refused to allow NATO flyovers or use of bases in Greece for these operations (Greece did provide logistical support and allowed humanitarian overflight). In contrast, Albania and Bulgaria, which are not NATO members, and Hungary, which became a NATO member only recently (after Bosnian operations but before the Kosovo crisis), cooperated with NATO in Kosovo. All three nations permitted flyovers, and Hungary and Albania hosted both NATO and US forces.

Albania had the most compelling reasons for supporting the United States since ethnic Albanians in Kosovo were suffering the most. Hungary was interested in strengthening its new ties to the alliance, despite domestic political concern that its support could endanger the large ethnic Hungarian community within Serbia. Greece, whose position in the alliance was longstanding and secure, faced no such incentive to ignore the opposition of its predominantly orthodox population to NATO operations. Bulgaria, while facing the same ethnic political considerations, was willing to ignore these in hopes of building stronger ties to the United States and NATO.

The Political Variables of Access

The recent history of Air Force expeditionary operations points to six key variables affecting the options available to logisticians and planners when confronted with access and basing decisions. Logisticians can neither affect nor ignore these variables. An optimal location with a mix of resources for an FOL or an FSL is worthless if political constraints prevent its use. Logisticians, therefore, must take into account the political variables that affect access and basing possibilities. Three that work to favor cooperation from other nations are:

- Close alignment and sustained military connections.
- Shared interests and objectives.
- Hopes for closer ties with the United States.

Three that work against cooperation are:

- Fear of reprisals.
- Conflicting goals and interests.
- Adverse domestic public opinion.

Understanding these variables can help logisticians devise an optimal access-and-basing strategy for supporting expeditionary operations.

Close alignment and sustained military connections. States that have longstanding security relations with the United States are more likely to support its actions. The best example of this is the *special relationship* shared by the United States and the United Kingdom over the last 60 years. The United Kingdom was the only US ally to support *El Dorado Canyon,* and UK aviators flew alongside US forces against Iraq and Serbia. Nevertheless, close alignment does not guarantee cooperation in access and basing. Many NATO allies have denied access and basing for US operations, and even the United Kingdom refused to support *Nickel Grass*. Still, the formal alliances, treaties, and diplomatic understandings the United States has developed around the world will remain an integral part of its global access strategy.

Shared interests and objectives. States sharing identical interests and objectives with the United States are more likely to support its operations and grant access and basing. Even allies as reluctant as the Saudis will provide access and basing when they perceive common interests and objectives. For agreement on interests and objectives to lead allies to grant access and basing to the United States, it must cover both ends and means. The Saudis, for example, may agree with the United States on an ultimate goal of toppling Saddam Hussein, but they will not cooperate with means that they see as ineffectual, counterproductive to their long-term interests, or possibly stimulating an ultimate reprisal. The United States can, however, use its intelligence to develop cooperation on access and basing. American intelligence on the threat Iraq posed to Saudi Arabia helped persuade that nation to accept the presence of American forces in 1990. It also persuaded the United Kingdom to support *El Dorado Canyon* in 1986.

Hopes for closer ties to the United States. States looking to improve their relationships with the United States or perceiving their security to depend on the United States are likely to cooperate with US military actions, including access and basing. Portugal in 1973 and Hungary in 1999 had unique interests leading them to support military operations that other more *reliable* US allies refused to support. Kuwait has perceived its security to depend on the United States and, hence, has cooperated with US actions against Iraq.

The United States may be able to develop future access and basing options with other nations hoping for closer ties. The Philippines, for example, has expressed renewed interest in closer ties with the United States, likely because it seeks support

in their dispute with China over the Spratly Islands. The United States has expressed no interest in reestablishing a permanent military presence there and has stated that its only interest in the Spratlys is to keep open sealanes. Nevertheless, this political situation offers the United States a means of solving many of its access and basing problems in Southeast Asia.

Fear of reprisals. Fear of reprisals nearly changed the course of Middle East history by almost thwarting *Nickel Grass*. French and Spanish fears of terrorist attacks, were they to support *El Dorado Canyon*, greatly limited the effectiveness of that operation. Fear of reprisals also figures in the reluctance of many regional states to provide the United States with access and basing for actions against Iraq. In many cases, there is little the United States can do to assuage these concerns. US forces can help protect a host country from direct military retaliation, but the United States has had little success battling terrorism, and it is usually not in a position to insulate its partners from the effects of economic sanctions. The fear of reprisal among US allies will continue to be a barrier for access and basing.

Conflicting goals and interests. Conflicting interests can eliminate prospects for cooperation. They made Turkey reluctant to support US retaliation against Iraq for the latter's offensive against Kurdish rebels in 1996. Greece and Macedonia refused to support the US-led response to the Kosovo crisis, in part because of their differing views on what constitutes Balkan stability.

Domestic public opinion. Domestic public opinion can limit access and basing options. It led Greece to oppose the US-led response to the Kosovo crisis by refusing NATO access to Greek airspace. It has made the Saudis sensitive to Islamic complaints that a continuing US military presence is incongruous in the nation of Mecca and Medina. In 1986, it forced the United States to remove a tactical fighter wing from Spain in the face of rising anti-American sentiment, exacerbated by the participation in *El Dorado Canyon* of two KC-10 refueling stations that had been based there. Domestic public opinion may yet force the United States to reduce or eliminate its military presence in Okinawa, Japan.

Basing and Access Options

Each of these political variables affects the five different approaches the Air Force has for managing access and basing issues to the point that none, by itself, is adequate for a complete global access strategy. Logisticians must recognize how the political variables affect the five *pure* basing alternatives in developing a hybrid access-and-basing strategy that helps the United States exploit favorable variables and control unfavorable ones.

The five *pure* alternatives for access and basing are:

- Expanding the number of major operating bases abroad to increase the likelihood that forces will be present where and when needed.
- Identifying one or more reliable allies in each region of the world and counting on them to cooperate when asked.
- Proliferating security agreements and alliances to broaden the set of potential partners in any given contingency.
- Negotiating and securing long-term extraterritorial access to bases, such as that gained by leasing Diego Garcia from the United Kingdom.
- Relying on extended-range operations from US territory.

Expanding major operating bases abroad. To contain the Soviet threat, the Air Force built and stationed dozens of major operating bases around the world. After the Cold War, the Air Force reduced this network. Expanding the current network of major operating bases by rebuilding the former one is, theoretically, an option for supporting operations around the globe.

There are, however, several barriers to such a strategy. There are no popular constituencies for it, either domestic or foreign. Unless host countries assume some of the costs for these bases, finding the money to build or reopen these facilities would be extremely difficult. Even if these facilities were built or reopened, there is no guarantee that they will always be of use in expeditionary operations. Having forces stationed in another nation does not ensure they can be used how and when the US desires.

Identifying more reliable allies. The United Kingdom has been a stalwart to the United States, particularly in supporting *El Dorado Canyon* and in policing no-fly zones over Iraq. Can the United States identify other such allies around the world whose cooperation will nearly always be forthcoming for expeditionary operations? Unfortunately, this is unlikely. Candidates for such relationships are rare. The special relationship between the United Kingdom and the United States includes a strong cultural attachment, a common history, and a very close security alliance dating back to World War II. There is no other nation that shares such strong ties and common perspectives with the United States. This relationship does not exist with nations in Asia and the Mideast, where access and basing problems are most pronounced.[5] Furthermore, even the reliable United Kingdom has refused to cooperate with US operations such as *Nickel Grass*. The United States can and should try to nurture close relationships with other countries, but it should not build its overall access strategy on this single option.

Proliferate security agreements and alliances. By expanding its network of alliances and other security arrangements, the United States has been able to expand its access and basing options for expeditionary operations. The recent expansion of NATO, for example, helped convince Hungary to support the US-led response to the Kosovo crisis. The success of the Partnership for Peace program has also given the United States new options for access and basing.

There is not, however, consistent domestic support within the United States for expanding foreign alliances. Support for recent NATO expansion may have been a one-time occurrence, based more on public familiarity with the role of the alliance in US security than any desire to expand security arrangements more generally. Isolationism in American politics is a recurring theme that can limit global engagement.

Furthermore, much of the benefit to access and basing from expanding security arrangements comes before such arrangements are formalized or when they are still new. A desire for improved relations with the United States may motivate a potential partner more than a longstanding formal alliance, just as such a desire led Hungary, a new NATO member, to support the US-led response to Kosovo while long-time NATO member Greece did not.

Negotiate and secure long-term extraterritorial access for bases. The 99-year lease for Diego Garcia Island, which the

United States gained from the United Kingdom as part of the lend-lease arrangement of 1940, has been invaluable in supporting operations in the Persian Gulf. It might be possible to lease from the Philippine government one of the many desolate, uninhabited islands in the archipelago and build a major operating base there. Such a base would be ideal for supporting military operations in Southeast Asia.

The possibilities for acquiring such extraterritorial access, however, are rare. The United States gained Diego Garcia only when the United Kingdom faced its darkest hour against Nazi Germany. The United States also enjoys extraterritorial access at Guantanamo Bay in Cuba, but this is a remnant of a colonial past. Many *available* locations might be uninhabitable due to unhealthy climates, flooding, lack of livable land, or an absence of fresh water. These problems can be overcome, but the costs can be high.

Relying on extended-range operations from US territory. A final option for access abroad is to eliminate the need for it by relying on US-based airpower. B-52 bombers operating from Louisiana and B-2s operating from Missouri were used in attacks against Iraq and Serbia. The growing capabilities of the Air Force heavy bomber fleet will make it more important in future operations.

There are, however, two problems with exclusive US basing for expeditionary operations. First, the Air Force currently has almost 2,000 fighter and attack aircraft with small operating ranges and less than 200 long-range bombers. It plans no new procurement of long-range combat aircraft in the next 20 years. Exclusive US-basing means that about 90 percent of the Air Force combat aircraft would be useful in only the most exceptional scenarios. Furthermore, the larger payloads of heavy bombers flying 30- to 40-hour missions that begin and end in the United States generate less than one sortie per day. Their heavier payloads do not always match the number of weapons that smaller planes flying more sorties can place on target.

Second, for many expeditionary missions, operating mainly from a US territory is not a practical option. The goal of some expeditionary operations is not to put ordnance on target but to support complicated and intensive peacekeeping or humanitarian operations on the ground. Such operations could not be accomplished without regional access and basing. US territory should become increasingly important as a base for operations abroad, but it cannot be a complete solution to the access problem.

Designing an Effective Global Access Strategy

None of the *pure* strategies above can, by itself, provide the Air Force, in particular, and the military, in general, with all their access and basing needs. Nevertheless, planners can select elements of these individual approaches to develop a hybrid strategy meeting present and future needs. The four components of this strategy are maintaining core assets, developing new processes and technologies that expand access and basing options, exploiting new opportunities for access and basing, and addressing immediate concerns in Southwest Asia and the Pacific Rim.

Maintaining core assets. We offer three recommendations for the Air Force to make the most of its core assets for access and basing. First, the United States should maintain its current major operating bases in Europe and Asia for use as FOLs. These are fairly secure and reliable bases for operations in nearly all regions of interest to the United States. These bases have been helpful in providing rapid response to past contingencies, and they should be in the future, particularly since the Air Force cannot currently meet expeditionary deployment time lines without substantial prepositioning of resources at FOLs.

Second, in establishing FSLs to support FOLs, logisticians should select locations where access is guaranteed or most likely. These locations could serve as strategic and theater airlift hubs as well as repair facilities for key components such as engines or critical avionics units. Current RAND analysis also suggests that forward support locations can greatly improve logistics processes for EAF operations.[6]

A small number of forward support locations in Alaska, Guam, Puerto Rico, Diego Garcia, and the United Kingdom could put most of the world within range of a C-130 carrying a 12-ton payload of supplies and equipment (Figure 2). Those in Alaska, Guam, and Puerto Rico, being on sovereign US territory, would offer assured access. Assured access is available on Diego Garcia until at least 2039. FSLs in the United Kingdom do not offer completely assured access, but they would be on the territory of the most reliable US ally. All would be outside the range of the offensive capabilities of likely future adversaries.

A third core asset the United States can exploit in a broader access-and-basing strategy is its relationships with key security partners worldwide. Training exchanges, joint exercises, and temporary deployments help maintain the relationships that can be of great value in a crisis. Because deployments for training and exercises often include facility improvement, they offer opportunities to enhance an access-and-basing infrastructure as well as relationships.

Developing new processes and technologies. Improvements in process and technology can help the Air Force expand its access and basing options. Increases in crews and tanker support could permit an expeditionary unit to operate with about the same effectiveness at ranges of 1,000 to 1,500 nautical miles as it would have operating about 500 miles from a contingency.

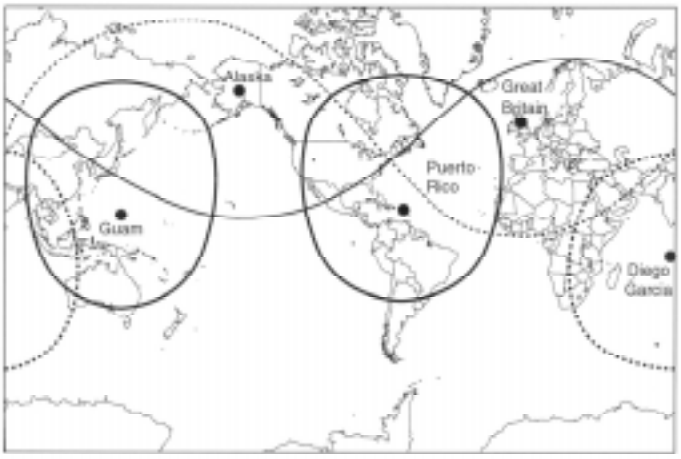

Figure 2. Coverage Available from Five FSLs. Most of the world is within a 3,000-mile radius from one of these five potential FSLs, putting most of the world within the operating range of a C-130.

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Personnel Information Career

Logistics Officer Manning—A Growing Concern for Commanders

Visit just about any logistics organization, and it will not take long to notice a vacant office or two. Ask commanders about it, and they will be the first to point out the lack of officers, especially field grade officers. Manning levels have been slowly eroding over the last few years, and units are now feeling the pinch. Units that once enjoyed 100 percent or higher manning levels now feel fortunate to be manned at 75 percent. It has not always been like this. What happened to bring us to this point?

The Air Force has undergone major changes since the end of the Gulf War. The 1990s saw half our overseas bases and a quarter of the bases in the continental United States closed; a major realignment of major commands (MAJCOM); and more than 30 percent of both the active military and civilian force leave the Service through selective early retirement, reduction-in-force, voluntary separation initiatives/selective separation board incentives, and normal attrition. No one has to be reminded that both the operations tempo and personnel tempo are up sharply since the Gulf War, especially those of us in logistics. In addition to being intimately involved in the deployment and reception business, logistics officers have seen their share of deployments. The top two officer career fields in the mission support arena for average monthly percentage of personnel deployed in 1999 were logistics fields—aircraft maintenance and transportation, with 18 percent and 14 percent respectively. Supply and logistics plans finished the year at a little more than 6 percent each, slightly above the Air Force average of 5.6 percent.

So here we are, almost 10 years after the drawdown began, with fewer people to handle the workload. Although there is cause for concern with company grade officer manning, the biggest area of concern is field grade manning. Across all logistics disciplines, field grade manning is at its lowest levels in years. Authorized versus assigned manning for majors in aircraft maintenance is 76 percent, logistics plans is 63 percent, supply is 70 percent, and transportation is 71 percent. As a result, grade substitutions are fast becoming the norm rather than the exception. It is not unheard of to have a major select filling a lieutenant colonel billet or a captain filling a traditional major's billet, such as squadron maintenance officer or aerial port flight commander.

Retirements will play a pivotal role in field grade manning over the next few years. As of December 2000, 83 percent of core logistics lieutenant colonels were retirement eligible, the second highest percentage of all mission support career fields. In 2000, the transportation career field alone will lose 17 percent of its total assigned lieutenant colonels to retirement. Because the 1979 and 1980 year groups were relatively large, we can expect upwards of 600 of those officers to retire in the next 2 years, further reducing the field grade experience pool.

With this shortage of officers, how do we at Logistics Officer Assignments ensure our field units are fairly and equitably manned with the available field grade officers? We deal with this dilemma by adhering to a concept known as *entitlements*. The Air Force uses entitlements to manage its resources during times of personnel shortages. Some requirements, such as Air Staff billets, short tour needs, and joint positions are considered must-fill positions. Those positions will be manned at 100 percent. MAJCOM and wing level positions are manned to entitlement levels, which are different for each career field based on assigned manning. The major entitlement for aircraft maintenance is 73 percent, transportation is 66 percent, supply is 58 percent, logistics plans is 47 percent, and the 21L entitlement is 70 percent for lieutenant colonels. For example, if a MAJCOM is authorized 10 majors in aircraft maintenance, that MAJCOM is entitled to 7.3 majors, which we will round down to 7 majors. In an assignment match cycle, we ask each MAJCOM to prioritize its requisitions, and we work to fill them in their prioritized order. The decision to man a particular wing at or above entitlement level and allow another wing to dip below entitlement level is left up to MAJCOMs. It is important to stress that our goal at the Personnel Center is to man the MAJCOMs to entitlement levels or above, but despite our best efforts, we are not always successful. Unexpected retirements and officers exercising their 7-day option can unravel even the best-laid plans.

So what is the answer? Is anything being done to fix the problem? Since its implementation in late 1998, the Air Force Assignment System (AFAS) has been used to keep pace with manning shortages. The AFAS balances Air Force needs, officer professional development, and officer preferences to match the most qualified people to the right jobs. In addition, AFAS, along with effective MAJCOM management of entitlements, offers a way for the Air Force to optimize mission needs versus officer desires. The Air Force is also holding two major promotion boards this year, and the results from the first board held in January are promising. Support officers, as a whole, did very well, and logistics will soon have a lot of new field grade officers. There is no official word on the number of major and lieutenant colonel promotion boards the Air Force will hold next year, but an announcement should be forthcoming. The only real answer is time. Accessing officers at a higher rate than in past years, coupled with the Chief of Staff of the Air Force's focus on retention, should, over time, help alleviate the current shortage.

(Major William R. Donovan, Chief, Transportation Officer Assignments, AFPC, DSN 665-4024)

Best Value in Source Selections

Captain
Jonathan L. Wright

Fleet Admiral King once admitted, "I don't know what the hell this logistics is that Marshall is always talking about, but I want some if it." Yes, logistics. Recall Hannibal needing food for his elephants, think about Rommel crossing the African desert and running out of fuel, and remember the maintenance men who supported the Berlin Airlift. The maxim applies in every case, as the capability relies on logistics not only as a force provider but also a force *multiplier*. As history shows, the warfighter's logistical support also includes reliance on contractor assistance. Today's flag officer might remark, "I don't know what some of this *best value contract* stuff is, but I want some of it." This article explains the *stuff* and how to obtain it. As manpower constraints combine (or collide) with fiscal limitations, an appropriate balance must be struck between people and money. The need to spend funds *smartly* is paramount in the *faster-cheaper-better* acquisition reform triad. Major requirements deserve the most careful attention and consideration in determining which contractors will augment our capability to support the warfighter. This means choosing the most advantageous offeror's (aka contractor's) proposal in an A-76 study for installation support. It means selecting the right offeror to manage major command-wide base maintenance contracts. It also means picking the best proposal for the next generation aircraft. With this in mind, the Federal Acquisition Regulation (FAR) allows other acquisition methods besides the famous *lowest bid* avenue, known as sealed bidding via invitation for bids. The Air Force occasionally uses sealed bidding where no negotiations are permitted with the offerors, and the bids are open and announced in a public forum. However, the predominant Air Force approach is negotiation, which capitalizes on a variety of tradeoffs. Using any one of these tradeoff techniques constitutes a source selection—choosing an offeror for the contract award on the basis of an integrated assessment of noncost factors as well as cost or price. Negotiation and tradeoffs allow the Air Force to achieve a best value decision, which may not always be the lowest priced offer.

But this must be a fair process for the qualified offerors. Integrity is built into the process because the Air Force uses public dollars to fund contracts and, therefore, is subject to the Procurement Integrity Act and Joint Ethics Regulation.[1] This makes purchasing in the public sector different from commercial purchasing practices. Offerors have the right to protest certain aspects of the source selection if the team appears to act in a manner that is not in the public interest or outside the bounds of fairness. Therefore, certain safeguards exist. Many of them come from case law and require a team of veteran experts to navigate through the complexities, which is why it is important to have legal counsel on board.

Best Value Tradeoffs

So what is the best value? The Air Force FAR Supplement defines it as the "expected outcome of an acquisition that, in the Government's estimation, provides the greatest overall benefit in response to the requirement."[2] The decision integrates factors that determine successful and affordable contract performance. So how do you determine best value? No formula exists, but different types of tradeoffs facilitate the decision.

Before determining the most appropriate tradeoff, market research can answer the questions affecting this determination. Market research means determining if a solution exists within the commercial marketplace and ascertaining marketplace conditions. With market research, the team may construct and refine Air Force requirements and methods. For example, they may ascertain that past performance plays a considerable role in industry and thus emphasize past performance more than the technical evaluation (henceforth known as *mission capability*) in the tradeoff.

The Best Value Continuum

Market research reveals what the commercial marketplace offers and the

risk conditions related to successful contract performance. The acquisition approach depends upon the requirement and situation, so tradeoffs come in many forms. The contracting officer uses business judgment to determine the most appropriate acquisition approach available from a variety of tradeoffs included in a best value continuum. A best value continuum exists, featuring many solutions that distinguish relative differences in the importance of cost/price and the effect on the capability to successfully perform the contract. The request for proposal (RFP) should clearly communicate the acquisition approach, relative importance among the factors (for example, stating the factors in descending order of importance), and the specific factors and subfactors.

LPTA Technically Acceptable Acquisition Approach

On the low risk end of the continuum lies the lowest price technically acceptable (LPTA) acquisition approach.[3] Air Force personnel very seldom use the sealed bid acquisition approach now because an LPTA includes the same award decision principle as sealed bids and also offers the opportunity to hold *exchanges* with the offerors.[4] However, LPTAs are suitable for fixed-price contracts. One may consider using the LPTA process when the price and a technical *go/no go* are expected as the only considerations for determining the best value. This is suitable for clearly definable requirements and minimal risk of unsuccessful performance. For example, suppose the installation was purchasing 1,000 queen-sized mattresses for the lodging facilities. As long as the technical proposal suited the requirement (*acceptable*), the award should be given to the lowest price offeror.

LPTAs allow only *acceptable* or *unacceptable* ratings on technical proposals, not degrees of merit and risk. Some offerors may disagree with their unacceptable rating and protest the award decision. However, the contracting officer has the discretion to determine the best method to meet the needs of the user, so an offeror's disagreement with the choice in acquisition method does not necessarily mean the subsequent evaluation was unreasonable.[5]

Past performance evaluations are included on an acceptable/unacceptable basis as well. One special caveat exists when rating the past performance of a small business *unacceptable*. The Small Business Administration (SBA) equates this to determining the small business' responsibility as a contractor. In this case, the SBA may step in to formally evaluate the determination and issue a certificate of competency, which is the SBA *guarantee* that the offeror is a responsible contractor who can perform the work.[6] This requires more time and coordination for the source selection process. Also, one sacrifices the decision authority to determine responsibility.

PPT Acquisition Approach

Beyond LPTA, one may use a tradeoff to award the proposal to a higher rated, higher priced offeror. The Air Force uses performance price tradeoff (PPT) as one such approach.[7] For either fixed-price or cost contracts where the Air Force would like to rate the offeror's past performance rather than simply make it a *go/no-go* responsibility call, the PPT technique may be more suitable. For example, PPT considers the offeror's performance history—in cost/price control, on-time delivery, and other areas. With PPT, one may weigh cost/price considerations against the past performance evaluation for a technically acceptable proposal. For example, while LPTAs were suited for the mattress buy, a PPT would satisfy the installation's custodial contract because of considerations for the offerors' managerial and service delivery performance history.

In PPT, past performance ratings may use a six-category scale as defined in Air Force FAR Supplement 5315.305(a)(2), ranging from *exceptional/high confidence* to *unsatisfactory/no confidence*[8] or some other scale, provided a range of ratings beyond *acceptable* or *not acceptable* is being used to evaluate the performance record. Therefore, one could award the contract to someone other than the lowest priced, technically acceptable offeror if the perceived benefit of superior past performance justifies the additional cost/price. Since the tradeoff exclusively focuses on past performance and price, one will only rate the technical proposal as acceptable/unacceptable with PPT. The PPT acquisition method predominantly suits operational contracting, replenishment spares, some construction, noncomplex supplies or services, nondevelopmental, and *build-to-print* contracts.[9]

The Formal Tradeoff Acquisition Approach

Finally, a formal tradeoff approach exists. Tradeoffs consider a wide range of issues for which a proposal may merit additional costs or price. For example, one may pay more than the lowest price for warranties, maintenance, life cycle, past performance, performance thresholds, management approach, experience in country, environmental and energy conservation solutions, proposal features, and so on. The factors involved in the tradeoff may even feature a performance-based target (for example, response times and percentage of subcontracts to small disadvantaged businesses). A source selection authority (SSA) performs an integrated assessment on every evaluation factor and subfactor and compares these perceived benefits to the past performance and cost/price. In all Air Force source selections, the mandatory factors are mission capability, cost/price, past performance, and proposal risk. The mission capability factor is essentially the technical evaluation of the qualitative aspects of the offeror's proposal. This factor, along with its subfactors (not more than six), are the technical and management aspects of the proposals the team expects to be able to use as discriminators.

Tables 1 through 4 summarize the advantages and disadvantages of each acquisition approach.

Source Selection Procedures

The contracting officer uses discretion in choosing the acquisition approach yet complies with certain procedural requirements. These procedures vary according to the acquisition dollar amount. A basic source selection may only have a contracting officer and a technical representative using simple and minimal procedures and documentation. Median source selections are usually more complex and justify more evaluators, factors, and documentation. Agency source selections are intended for very complex and highly visible acquisitions, which can require even more participants, factors, and subfactors than median acquisitions. Table 5 illustrates when basic, median, and agency source selection procedures apply.

Sealed Bid Acquisition Approach	
Advantages	**Disadvantages**
Fast response due to minimal interaction with offerors.	Exchanges are not permitted.
Suited for standard, fixed-price commodities.	Tradeoffs of any kind are not permitted.
Only the price determines the award, so it minimizes *second-guessing* the award decision.	The competition does not include past performance comparisons among the offerors.
Very simple.	

Table 1. Advantages and Disadvantages of the Sealed Bid Acquisition Approach

PPT Acquisition Approach	
Advantages	**Disadvantages**
Tradeoffs occur on the basis of past performance information and cost/price.	Tradeoffs do not occur on the basis of technical merit (acceptable/ unacceptable instead).
Past performance ratings may range from six available categories (compared to the *acceptable/unacceptable* rating in LPTA).	The SSA may not grant extra value to proposals that exceed threshold or objective performance requirements.
Rating a small business' past performance is not a responsibility determination, so it does not require coordination with the Small Business Administration.	One may have difficulty in establishing a technical *acceptable/unacceptable* standard.
Perhaps easier to decide if the superior past performance outweighs the additional cost/price.	A perception may exist that it takes longer than LPTA.
Less complex as a formal tradeoff.	
Could still award to a lowest price technically acceptable offeror even though the approach is PPT.	
Allows customer contribution in the evaluation.	
Eliminates poor performers.	

Table 3. Advantages and Disadvantages of the PPT Acquisition Approach

Procedure	All Source Selections Other Than Information Technology	All Information Technology Source Selections
Basic	Simplified acquisition threshold (SAT) to $10M.	SAT to $15M for 1 fiscal year or to $30M for the total program.
Median	$10M to $100M.	$15M for 1 fiscal year or $30M for the total program to $120M.
Agency	> $100M.	> $120M.

Table 5. Source Selection Procedures Applicability

LPTA Acquisition Approach	
Advantages	**Disadvantages**
Technical proposals are rated on a pass/fail basis; therefore, less time is required to evaluate the proposal and grade its merits among a variety of factors and subfactors.	Technical proposal evaluations use a pass/fail basis; therefore, tradeoffs do not consider *better* technical proposals.
Exchanges are permitted.	The competition does not include past performance comparisons among the offerors.
Very simple. May include as few as two people (a contracting officer and a technical representative).	If a contracting officer rates a small business' past performance unacceptable, the matter is referred to the Small Business Administration.
	One may have difficulty in establishing a technical *acceptable/unacceptable* standard.

Table 2. Advantages and Disadvantages of the LPTA Acquisition Approach

Formal Tradeoff Acquisition Approach	
Advantages	**Disadvantages**
The technical proposal evaluations include mission capability (a range of four ratings is used, compared to *acceptable/unacceptable*) and proposal risk (high, moderate, or low).	Evaluating proposals usually takes more time than the previous approaches.
The mission capability factor has as many as six subfactors to compare the proposal merits among offerors.	Requires even more clear communication of the evaluation method in the RFP to enhance competition and also to avoid protests.
Past performance ratings may range from six available categories (compared to the *acceptable/unacceptable* rating in LPTA).	Very complex.
Rating a small business' past performance is not a responsibility determination, so it does not require coordination with the Small Business Administration.	
Allows the customer contribution in the evaluation.	
Eliminates poor performers on the basis of proven performance.	

Table 4. Advantages and Disadvantages of the Formal Tradeoff Acquisition Approach

The Tradeoff Elements

In Air Force source selections, a formal tradeoff consists of four main factors: cost/price, past performance, mission capability, and proposal risk.[10] The cost/price analysis addresses the fairness and reasonableness of the price and the realism of the cost. Past performance, often misconstrued as experience, targets a demonstrated track record of contract compliance and successful completion of the effort or ongoing successful contractor performance for existing efforts. It uses recent and relevant past performance information to assign a confidence rating—not a numeric score—of the offeror's ability to perform on the contemplated contract. The evaluation team evaluates the technical proposal in two separate areas: mission capability (the ends) and proposal risk (the means). The team evaluates proposals according to RFP stated factors and subfactors, and they do not evaluate the proposals against each other until they send their report to the source selection authority or to the source selection advisory council (SSAC), if one is used (usually only in agency source selections).

Mission Capability and Proposal Risk

Mission capability focuses on the proposal's strengths and inadequacies, while proposal risk covers the related risks and weaknesses of the approach. Mission capability considerations support key emphasis areas for the source selection decision and meaningful comparisons (a uniform baseline) among the offerors in the competition. Performance thresholds/objectives are encouraged. When writing the RFP, the source selection team may not use more than six subfactors to describe the discriminating characteristics that impact the source selection decision. This gives the SSA more focus on the critical aspects of successful contract performance.

Proposal risk considerations may include cost risk, schedule disruption, potential performance problems, and subsequent Air Force oversight as they correspond with the proposal and validity of the offeror's proposal to mitigate these risks.

Figure 1 illustrates a proposal evaluation matrix for one factor within mission capability. The mission capability has one factor with four subfactors, and they all receive a rating. Each mission capability subfactor also receives a corresponding proposal risk rating. One assesses a performance confidence at the subfactor level but assigns a rating at the factor level. The cost/price is evaluated as an independent factor from the mission capability.

The request for proposal must clearly communicate Air Force requirements, how the evaluation team will evaluate proposals, and how the source selection authority will determine the award.

Mission Capability Factor 1			
Subfactor 1	Subfactor 2	Subfactor 3	Subfactor 4
Proposal Risk 1	Proposal Risk 2	Proposal Risk 3	Proposal Risk 4
Performance Confidence (Assessed at the subfactor level, rated at the factor level.)			
Cost/Price			

Figure 1. Factor Evaluation Matrix[11]

The requirements should include those performance-based factors that deliver the most mission capability. In response to the RFP, a performance-based requirement allows the offeror the latitude to propose a suitable method or solution for meeting the objective. This enhances creativity and maximizes the Air Force's desire to obtain the best commercial practices.

However, just selecting performance-based factors is not good enough. The RFP writers should carefully choose *discriminator* criteria. Discriminators are significant aspects of a program that distinguish one proposal over another. They enhance the ability to choose the best value proposal so the right offeror can satisfy Air Force requirements.

During the evaluation, the team may discover mission capability proposal *inadequacies*, proposal risk *weaknesses*, and *strengths* for both factors. The team may use a host of exchanges to maximize understanding for both the Air Force and the offerors. *Exchange* is a broad word implying a *clarification*, *communication*, or *discussion*, depending on the phase of exchanges.

Clarifications are used if the contracting officer is contemplating an *award without discussions* and needs to resolve minor errors, clarify past performance relevance, or provide the offeror an opportunity to respond to adverse past performance information. Offerors may not, however, revise their proposal in response to a clarification.

Communications help determine the competitive range, which limits the continuing evaluation and eventual in-depth discussions to only those offerors who have the best chance of winning the award. Otherwise, an offeror with no reasonable chance of award participates in the process, and both the offeror and the Air Force will spend a considerable amount of time and money for a marginal return. As with clarifications, communications do not allow offerors a chance to revise their proposal once discussions are opened. In this case, the objective is efficiency, and those offerors still left in the competitive range may later revise their proposal when discussions are conducted. Therefore, if the offeror is *good enough* to make the competitive range, then it is worth the time and money for further revisions.

Issuing an evaluation notice (EN) counts as an exchange, and certain limitations on exchanges exist. For each proposal inadequacy and weakness, if it affects the subfactor rating, then the evaluation team must issue an EN. Finally, discussions are used with those offerors within the competitive range.

Not every formal tradeoff has the same evaluation emphasis. While Air Force FAR Supplement 5315 prescribes the rating categories for evaluating past performance, mission capability, and proposal risk, the requirement drives the tradeoff emphasis. The RFP must state this emphasis. The statement will tell offerors whether all evaluation factors (other than cost/price), when combined, are significantly more important than cost/price, approximately equal to cost/price, or significantly less important than cost/price.[12] The SSA's final decision coincides with this statement yet has broad discretion when it comes to making the tradeoff. For example, suppose technology is significantly more important than price. Does that mean the SSA must direct the award to a highest rated offeror without regard to its price? No. The SSA has the authority to use business judgment in the tradeoff between the benefits of price and technical merits (and its associated additional costs).

Evaluating Cost/Price

A contracting officer determines whether the price is fair (to both the Air Force and the offeror for successful contract performance) and reasonable (the price a prudent and competent buyer would be willing to pay).[13] There are essentially three types of analyses used to make the fair and reasonable price determination: price analysis, cost analysis, and cost realism analysis.

Price analysis is the evaluation of the proposed price without evaluating individual elements of cost and proposed profit.[14] This type of analysis is crucial to determining the fair market value of the requirement. Further, it should be noted the price includes both the total cost of the product or service plus profit. Price analysis will involve some form of comparison with other prices to determine if the price is fair and reasonable. The most preferred method of comparison is through competition. In addition, price analysis could consist of comparing prices to previous prices for the same requirement, published price lists, independent government estimates, prices obtained through market research for the same or similar requirement, or parametric estimations.

If prices are determined to be unreasonable in a competitive situation, a cost analysis can be used to establish reasonableness. A cost analysis addresses the reasonableness of the individual cost elements and profit to determine their accuracy.[15] This analysis provides information to build a probable cost, which the evaluation team will use for its negotiations. It may consider the use of learning curves, allowances for contingencies, cost trends, estimates, audited or negotiated cost rates, labor rates, cost of money, actual cost history, other cost estimates, the independent government estimate, forecasts of planned expenditures, and so on.

For cost reimbursable contracts, one must also analyze cost realism. This review examines the specific cost elements to determine if they:

- Are realistic for the proposed work.
- Reflect a clear understanding of the requirement.
- Are consistent with the unique methods of performance and materials featured in the proposal.[16]

Past Performance Explained

Past performance plays a vital role in PPT and formal tradeoffs. One may even consider it the most important factor. It should be considered at least equal to the most important noncost/price factor.[17] For example, one may emphasize past performance more than any other factor or at least emphasize past performance to the same extent as proposal risk (the most important noncost/price factor in this example).

Using past performance to enhance decision making in government contracts has proved itself over time. In 1986, the Packard Commission identified it as a commercial-style practice suitable for federal procurement agencies.[18] The Federal Acquisition Streamlining Act of 1994 mandated past performance evaluations for all competitively negotiated contracts exceeding $100K.[19] Although its use was contracted back to $1M, past performance, nevertheless, indicates an ability to perform according to recent and relevant contract history.[21] Past performance information may include key personnel and management of quality, cost, timeliness, subcontracts, organization structure, work force, property, inventory, small business subcontracting, technical requirement accomplishments, continuous improvement, and innovation. Including this information in the tradeoff between price and performance may assist in determining the benefits of one offeror over another to successfully comply with a relevant contract.

For relevant contract history, one should match information from similar contracts related to required skills on the new contract. Other factors may affect relevance, such as source of the information (federal, state, local, or commercial), context, contract dollar amount, information time lines, and general trends in the offeror's performance. Some organizations use a rating scale for an aggregate relevance as *very relevant*, *relevant*, *semirelevant*, and *not relevant*.

Past performance information covers a broad range. Requirements are divided among business sectors, such as systems, services, information technology, health care, operations support, fuels, construction and architect engineering, and science and technology. These sectors have unique and similar types of past performance information. The types may include the quality of product or service (or technical), cost control, schedule compliance, business relations, management (key personnel), compliance with labor standards, and compliance with safety standards. Merely having problems on a previous contract does not necessarily equate to a lower confidence assessment if the offeror initiated effective actions to correct those challenges. For this to occur, the contracting officer needs measurable improvements as a result of the corrective change. However, the number and severity of problems may impact the confidence assessment.

The source selection evaluation team (performance risk assessment group, if used) should first find out whether the history is relevant to the new contract. For instance, a recent General Accounting Office protest decision upheld the Navy's decision to award to a higher priced offeror with exceptional past performance on a mess attendant contract over an offeror with exceptional past performance on a food service contract and a satisfactory assessment on a mess attendant contract.[20] The decision was upheld due to the difference in relevancy.

The team also has the challenge of finding the *right* past performance information. Sure enough, offerors will most likely furnish trusted sources of previously *successful* contract history. The team should also find sources the offeror did not provide. If there is no relevant past performance information, which is rare, the rating category for this instance is prescribed in the FAR.[22] The SSA should consider the *neutral/unknown confidence rating* neither favorable nor unfavorable. This implies that a higher priced offeror may receive the award in favor of an offeror with no relevant past performance.[23]

So would a neutral/unknown confidence assessment mean that the offeror could merit a *moderate* or *high* proposal risk rating (for suggesting a method that the offeror theoretically has not performed before)? The proposal risk assessment in Air Force source selections focuses on the offeror's approach with questions such as: Is it sound? Does it demonstrate an understanding of the requirements? Therefore, the offeror's proposal risk rating should not be impacted by a lack of past performance history. However, an offeror will rarely have no relevant past performance

history. If this situation occurs, the evaluation team must inform the SSA. This information will be taken into account in making the final award decision.

The Decision Official

Some jobs in the Air Force deserve the *big bucks*, as the saying goes. The source selection authority has one of them. The SSA takes into account all of the evaluation results provided by the source selection team; then integrates the results for cost/price, past performance, mission capability, and proposal risk; and ultimately determines who will deliver the best overall value to the Air Force. The source selection decision document (SSDD) contains the SSA's decision, and the SSA signs it. The contracting officer is still the only person authorized to obligate the government, yet the SSA has decision authority for competitive negotiations.

Only a trusted senior official bears the SSA's responsibility, a designation to make the source selection decision. The SSA also oversees the source selection process by appointing an SSAC chairperson who presides over a group of senior decision makers.[24] The SSAC members counsel the SSA during the process and prepare a comparative analysis for the SSA.[25] The SSA and the source selection evaluation team have adequate preparation with knowledge of policies and procedures for properly and efficiently conducting the source selection.[26] The SSA ensures there is no conflict of interest (actual or perceived). Also, the SSA approves the source selection plan (SSP), which is the detailed plan of the source selection process, participants, evaluation criteria, and so on.

In the Air Force, the contract dollar amount and the type of requirement designate the SSA. This relationship does not coincide with the basic, median, and agency source selection classifications because of the level of responsibility required for making the decision. Tables 6, 7, and 8 outline the dollar thresholds and the SSA delegation levels.[27]

The Actual Decision

The SSA has the tough challenge of making the award decision. The SSA determines who will deliver the best value to the Air Force. With LPTA, the SSA decides the lowest price proposal and proposal acceptability. In acquisitions other than LPTA, the SSA may determine if a higher priced proposal warrants the additional costs. This takes subjective judgment. While the current policy mandates the rating categories used for past performance, mission capability, and proposal risk, the policy does not mention assigning quantitative weights to those categories. (A previous Air Force FAR Supplement policy prohibited assigning weights. Air Force FAR Supplement 5315.305 lifted the prohibition when it mandated the evaluation categories.) Therefore, some organizations have used a predetermined numerical scoring system, akin to a complex algorithm, to quantify the value of each proposal and thus identify the award winner. In doing so, it reduces or eliminates the SSA's discretion to recognize qualitative benefits of the technical proposal. Also, in some cases (for example, a unique technical approach coupled with average past performance), the SSA may even determine the best value would come from the offeror who had less than the best overall score. Even so, if the SSAs used the scoring mechanism, they would report to the warfighter that the selection was simply given to the offeror with the best score. Would it not be better to report the best offeror was hired because of certain reasons?

Threshold	Delegable SSA (not in AFMC)	Delegable SSA (in AFMC)
Simplified acquisition threshold to $10M.	Not lower than the contracting officer.	Not lower than the contracting officer.
$10M to $50M.	MAJCOM, field operating agency, or direct reporting unit commander.	Single manager or equivalent.
$50M to $500M.	MAJCOM, field operating agency, or direct reporting unit commander.	Program executive officer, designated acquisition commander, or center commander.
> $500M.	MAJCOM, field operating agency, or direct reporting unit commander.[28]	MAJCOM, field operating agency, or direct reporting unit commander.

Table 6. Source Selection Authority Delegation (Non-Information Technology and Non-Major Automated Information System Acquisitions)

Threshold	Delegable SSA (in AFMC)
SAT to $15M or more in any fiscal year or SAT to $30M or more for all program years.	Single manager.
$15M or $30M to $120M and non MAIS.	Program executive officer, designated acquisition commander or center commander.
> $120M or MAIS.	Principal Deputy Assistant Secretary of the Air Force (Acquisition and Management).

Table 7. Source Selection Authority Delegation in AFMC (Major Automated Information System or Information Technology Acquisitions)

Threshold	Delegable SSA (not in AFMC)
SAT to $10M.	Not lower than the contracting officer.
$10M to $120M and non MAIS.	MAJCOM, field operating agency, or DRU commander.
> $120M or MAIS.	Principal Deputy Assistant Secretary of the Air Force (Acquisition and Management).

Table 8. Source Selection Authority Delegation Not in AFMC (Major Automated Information System or Information Technology Acquisitions)

One of two reports, a proposal evaluation report (PER) or proposal analysis report (PAR), is used in Air Force source selections to document the comparative analysis of proposals.[29] For basic source selections, a PER succinctly documents every phase of the process in four sections:

- SSP and acquisition description.
- Evaluation.
- Comparative analysis of offerors and rationale for excluding offerors from the competitive range.
- SSDD and debriefing summary.

A PAR is used for agency source selections to document the evaluation results and provide a comparative analysis (optional for median, which may use the briefing charts presented to the SSA in lieu of the PAR). Unlike the PER, the PAR does not contain the SSP or SSDD, which are separately documented. No debriefing summary is required in the PAR, since each debriefed offeror receives the same briefing charts on its proposal that were presented to the SSA at the final evaluation briefing as well as the ratings of the successful offeror's proposal. A PAR's level of detail compares offerors at the subfactor or element level and usually includes in-depth cost or price analysis as well as detailed past performance evaluation results. For this reason, the PAR is often complex and lengthy, even though it does not include all the phases of the source selection process that are captured in the PER.

Once the SSA renders the decision and signs the SSDD, the source selection evaluation team will hold individual debriefings with the successful and unsuccessful offerors. After all, offerors have spent a significant amount of money on their proposal and competed throughout a long process. The debriefing gives them an opportunity to learn how they can improve on future source selections. Therefore, they may benefit and so will the Air Force. Each offeror will receive a redacted SSDD. This means the team will only debrief the offeror about the successful evaluated cost/price, the successful technical rating, a summary of the award rationale, the make/model of a commercial item (if applicable), and the overall ranking (if used) of the offerors. The evaluation team holds debriefings to give open, frank, and meaningful feedback to the offerors.

Some source selection teams hold debriefings at the offeror's facility. This gives more of the offeror's people the opportunity to engage in the feedback. Also, some SSAs have either attended the debriefing or at least called the offeror's general manager in addition to the team's debriefing. Doing so provides the offeror with more credible feedback because it is from the actual decision maker and senior authority figure.

Lightning Bolt 99-2, Superior Source Selections

Darleen A. Druyun, Principal Deputy Assistant Secretary of the Air Force (Acquisition and Management), initiated an Air Force-wide initiative in 1999 called Lightning Bolt 99-2, Superior Source Selections.[30]

The Lightning Bolt 99-2 initiative created the Air Force Source Selection Expert Advisor (SSEA) Charter. The charter instituted a group of highly qualified, expert professionals who provide assistance in order to "improve consistency, quality, documentation, and debriefings on all Air Force source selections."[31] SSEAs come from each Air Force Materiel Command (AFMC) product center and every major command (MAJCOM) contracting office (LGC). According to the charter, the SSEAs will provide guidance on developing Acquisition Strategy Plans, factors, subfactors, source selection plans, and the SSA briefings. They will also provide training and advise the evaluation team members during the evaluation process. As the SSEAs have hands-on impact for their source selections (mandatory for their inclusion on source selections more than $100M in AFMC and more than $10M for the other MAJCOM LGCs), they can ensure the source selection evaluation teams consistently meet high Air Force standards.

The initiative also resulted in producing the *United States Air Force Source Selection Procedures Guide*, which was revised in March 2000.[32] As the standard guide, it explains policy for all basic, median, and agency source selections. Each set explains the presolicitation, evaluation, and award activities along with the required documentation.

Other topical guides support the Lightning Bolt 99-2 initiative. Some address such topics as conducting market research, participating in a performance risk assessment group, and writing critical documents such as:

- Section L (Instructions, Conditions, and Notices to Offerors).
- Section M (Evaluation Factors for Award).
- Proposal Analysis Report (upcoming).
- Source Selection Decision Document (coming soon).

These guides are available on the Business Solutions Exchange web site: www.bsx.org. In addition to the guides, the site contains an active discussion area open to the general public. The appropriate policy experts have answered many source selection questions from Air Force and industry personnel.

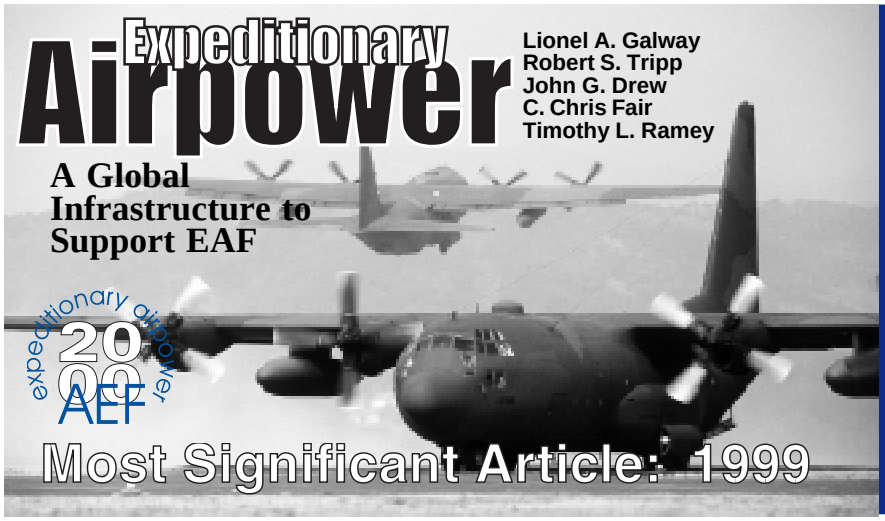
Source selection is a complex process designed to maximize the team's contributions in assisting the SSA in making a decision. It takes commitment to manage this challenge. When talking about selecting the right offeror to augment the total force and thus becoming a force multiplier, one key question needs to be answered: How do you know you selected the right one? Although the answer will not be apparent until the contractor demonstrates performance on the contract, using the tradeoff/best value approach provides a structured way of increasing the Air Force's ability to ensure success.

Notes

1. The Procurement Integrity Act, 41 USC 423, amended by section 814 of PL 101-189, 17 April 2000 [Online] Available: http://www.nara.gov/fedreg/, and the Joint Ethics Regulation, 5 CFR Par 2635, 25 April 2000 [Online] Available: www.access.gpo.gov/nara/cfr/cfr-table-search.html.
2. Government Printing Office, Federal Acquisition Regulation (FAR) 2.101, 20 January 2000 [Online] Available: www.farsite.hill.af.mil.
3. FAR 15.101-2.
4. General Accounting Office, B-284360, 18 April 2000 [Online] Available: www.gao.gov, (18 Apr 00).
5. FAR 15.101-2(b)(4).
6. FAR 15.101-2(b)(1).
7. Air Force Federal Acquisition Regulation Supplement (AFFARS) 5315.101-1(a), 20 January 2000 [Online] Available: www.farsite.hill.af.mil.
8. AFFARS 5315.305(a)(2)(S-92).
9. Air Force Materiel Command, *Performance Price Tradeoff (PPT) Guide*, 9 September 1999.
10. AFFARS 5315.304(c). Proposal risk is optional for basic source selections.
11. Adapted from a presentation conducted by Suzanne Snyder, HQ AFSPC/LGC, "Source Selection," 21 March 2000 [Online] Available: www.bsx.org; also found in *AFFARS Attachment 5315-4*.
12. FAR 15.304(e).
13. FAR 15.404-1(a)(1).
14. FAR 15.404-1(b)(1).
15. FAR 15.404-1(c).
16. FAR 15.404-1(d).

(Continued on page 43)

1999 AFJL Awards



The Editorial Advisory Board selected "A Global Infrastructure to Support EAF" (Volume XXIII, No. 2)—written by Lionel A. Galway, Robert S. Tripp, Chief Master Sergeant John G. Drew, C. Chris Fair, and Timothy L. Ramey—as the most significant article to appear in the *Air Force Journal of Logistics* in 1999.

The Air Force Historical Foundation selected "Contractors on the Battlefield: What Have We Signed Up For?"(Volume XXIII, No. 3)—written by Colonel Steven J. Zamparelli—as the best article containing logistics lessons learned to appear in the *Air Force Journal of Logistics* in 1999.

The Executive Board of the Society of Logistics Engineers, Montgomery Alabama, selected "AEF Munitions Availability" (Volume XXIII, No. 4)—written by Captain John E. Bell and Lieutenant Colonel David K. Underwood—as the best article written by a junior officer to appear in the *Air Force Journal of Logistics* in 1999.

(Force Support for the Expeditionary Air Force continued from page 3)

in flying specialty codes—just under 11 percent of the total force.[4] Our leadership challenge, then, is to ensure the remaining 89 percent of the Air Force fully understand how important they are to the mission. Even more important, we must all understand how we mesh the 11 percent and 89 percent together to accomplish the mission.

Fortunately, we have a ready-made teaching tool in the core competencies as outlined in Air Force Doctrine Document 1 (AFDD-1). With the answers so readily available, it only remains that we must teach our people and change the culture of today's Air Force and continuously demonstrate how vital support (logistics) and other functions are to accomplishing the Air Force mission. This article serves three purposes: (1) emphasize the critical role logistics plays in mission accomplishment, (2) caution all members that taking logistical support for granted (with the view of improving operational capability) may adversely impact readiness and capability, and (3) solicit senior leadership to place emphasis on logistics as an Air and Space Power function.

Air Force Basic Doctrine

For many leaders, especially those who have been around the Air Force since just prior to Desert Storm, mere mention of AFDD-1 brings back chilling memories of the days when Air Force Manual 1-1 (AFM 1-1) came out. General Merrill A. McPeak, then Chief of Staff of the Air Force, decreed that he expected officers and senior enlisted members to know AFM 1-1, Volume I, and at least be conversant with Volume II. It is probably a safe bet that there are thousands of editions still in shrink-wrap or, at best, filling those pesky 2-inch gaps in many professional libraries. Perhaps by realizing that AFM 1-1 was a flight surgeon's best cure for insomnia, Air Force leadership decided something must be done to get people interested in doctrine. Being a problem-solving or image conscious service, we decided to create doctrine documents with pictures, graphs, and bolded items and package them in neat-looking manuals. To further ensure people would accept and read these manuals, they were printed in booklet form perfectly sized for the lower leg pocket on a flight suit or a thigh pocket on a BDU. It was a great start, but what has happened? People still wonder what it is they are doing and how they fit in. Very often the answer to questions on this matter elicits a condescending, "You do not have the big picture." It is quite possible people answering the questions recite this colloquialism because of their own inability to understand the Air Force mission. Why? Perhaps they may not realize that the *big picture* is found in a small document—AFDD-1, *Air Force Basic Doctrine*. More important, we, as leaders, do a poor job outside classroom settings of emphasizing the importance of every Air Force member knowing basic doctrine. With the expeditionary Air Force just over the horizon and uncertain future threats, it becomes more critical that all Air Force people—active, reserve, and civilians—especially support personnel, understand our doctrine or our *raison d'etre.*

Core Competencies Versus Air and Space Power Functions

Perhaps an overarching problem with the seemingly *taken-for-granted* view of force support lies in AFDD-1 itself. The core competencies of Air and Space Superiority, Precision Engagement, Information Superiority, Global Attack, and Rapid Global Mobility[5] are readily supported—or further refined—by 1 or more of the 17 Air and Space Power functions. These functions are counterair, counterspace, counterland, countersea, strategic attack, counterinformation, command and control, airlift, air refueling, spacelift, special operations employment, intelligence, surveillance, reconnaissance, combat search and rescue, navigation and positioning, and weather services.[6] To a casual observer, nothing may seem to be missing. After all, is not the Air Force only about airplanes, bombs, and satellites? These functions represent an *end product* for the Air Force. If you know your doctrine, you should have noticed that in the above list of core competencies, Agile Combat Support was omitted. The omission was made because in AFDD-1 there is no further refinement or support for this competency in the list of Air and Space Power functions. Is logistics not included as an Air and Space Power function because it is too broad a topic to grasp? Or could it be that it does not necessarily involve aircraft and, therefore, does not require *winged* operators; hence, it should not be an Air and Space Power function? Or is Agile Combat Support listed as a core competency merely to throw a *bone* and placate the support fields? All of these are true. For this reason, our Air Force leaders must facilitate increased understanding of logistics and institutionalize logistics (Agile Combat Support) as a warfighting skill, especially in this era of the Expeditionary Aerospace Force.

Logistics Defined and Understood in Context of Joint Publication 4-0

When Paul G. Kaminski, Under Secretary of Defense for Acquisition and Technology, addressed the 12th National Logistics Symposium and Exhibition in October of 1995, he stated, "[he] found the subject of logistics is of growing interest to our warfighters."[7] What did he mean by *warfighters*? Is the logistician any less a warfighter than the pilot, infantryman, or tanker? Do logisticians just punch the clock and work *normal* office hours? Hardly! Had Mr Kaminski read the definition of logistics in AFDD-1, he might have reconsidered his term *warfighter* and perhaps recognized the fact logistics *is* an *operational* (warfighting) art. The definition in AFDD-1 (taken from Joint Publication 1-02) follows:

> The science of planning and carrying out the movement and maintenance of forces. In its most comprehensive sense, those aspects of *military operations* that deal with: a. design and development, acquisition, storage, movement, distribution, maintenance, evacuation, and disposition of material; b. movement, evacuation, and hospitalization of personnel; c. acquisition or construction, maintenance, *operation*, and disposition of facilities; and d. acquisition or furnishing of services.[8] [Emphasis added.]

Mr Kaminski came close to calling logisticians *warfighters* when he spoke of the logistics role of Desert Shield/Desert Storm. He quoted John Chancellor of NBC news as saying, "This was a logistician's war. Logistics, the movement of troops and supplies, made all the difference."[9] Mr Chancellor's comments should not have come as a surprise. In the executive summary of Joint Publication 4-0, the notes of emphasis (in the margin) state, "Logistics is the foundation of combat power."[10] The supporting text states, "Logistics is the bridge connecting a nation's economy to a nation's warfighting forces."[11] How important was logistics to our success in the Gulf War? Some interesting statistics help paint the picture.

> The Air Force alone used fifteen million gallons of jet fuel *a day* [Emphasis in original] at the height of the war . . . . Storing, transporting, and issuing this fuel remained a significant obstacle that was surmounted by a combination of new pipelines and the Air Force's supply of fuel bladders, hydrant systems, refueling vehicles, and trained personnel gathered from all over the United States, Europe, and the Pacific. To meet this requirement, however, the Air Force deployed *92 percent of its entire refueling assets to the theater*. [Emphasis added] . . . . [They] had also deployed to the gulf 85 percent of all . . . equipment for operating from bare bases—tents, dining facilities, and so forth . . . [52 percent of the Air Force's HARMs (high-speed antiradiation missile), 63 percent of its LGBs (laser-guided bomb), 63 percent of its Mavericks, and 43 percent of its CBUs (cluster bomb unit) were deployed into theater.][12]

This equipment movement was planned, coordinated, and executed by logisticians. Whether or not people in the logistics functions of supply, maintenance, transportation, general engineering, and health services[13] are seen as warfighters, it should be readily evident that without the logistics capability they provide, our Air Force will be unable to fulfill its role in joint operations. Our task, then, is to marry the concept of logistics as outlined in Joint Publication 4-0 with the Agile Combat Support competency found in AFDD-1. In order to do so, we should understand some of the historical *lessons learned* concerning logistics and realize there are a myriad of challenges in our future. These challenges can be overcome if we ensure all logisticians know and understand their roles and responsibilities as set forth in doctrine.

Logistics Lessons Learned

The maxim that *failing to learn history dooms one to repeat the same mistakes* is probably the most overused, yet underpracticed, statement in the military. Many leaders, when pontificating or postulating on a given subject, will spout those words and then set policy based almost solely on current information and political restrictions. The Department of Defense (DoD) civilian leadership and elected officials are supposedly taking the advice and counsel of our general officers, who should be getting well-researched advice from their staffs. It is quite probable this is happening, but these same people are also being inundated with information and requests from special interest groups who are looking out for their pocketbooks rather than our national security. In the area of logistics, history has proven time and again that we continue to make costly mistakes when we fail to learn from history.

In his article "Logistics: The Past is Prologue," Deputy Assistant Secretary of the Army for Logistics Eric A. Orsini says:

> In the plethora of initiatives on efficiencies, some favorite buzzwords are two-level maintenance, outsourcing to original manufacturers, and just-in-time inventory. The judgment is that the infrastructure is bloated, systems are archaic and we are living in the past. These charges are not coming from battle-hardened commanders but from industry representatives, think tanks, and academia.[14]

He cites as historical precedence the case of the German military in the 1940s. Panzer divisions operated under the concept of two-level maintenance and just-in-time inventory. Damaged tanks that could not be repaired in the field were sent back to the factory. The logistics concept worked well in the campaign in Poland in 1939 and subsequent campaign in France in 1940, but both were fairly short campaigns. The Germans declared the two-level concept a success and implemented the plan. Unfortunately, this concept was to work against them in Russia. Poor planning (possibly by taking their capability for granted), increased losses due to mines and attack, high attrition rates due to distance and extreme climatic conditions, and a poor logistics infrastructure made the two-level system impractical. The fix did not come until 1942, and then it did little good because of other blunders. The Tiger tank failed because of rushed production and employment without adequate supplies of spare parts. The same thing happened with mass production of the Panther tank. The Germans sent 325 Panther tanks into battle and then found defects in the steering and control mechanisms. They all had to go back to the factory. To make matters worse, once the initial problem was fixed, the engines were found to be inadequate.[15] Lesson learned: you cannot shortchange any part of the logistics chain and hope to be successful in battle. But has senior leadership learned this lesson?

To answer this question, consider the following excerpt from *Focused Logistics* concerning the concept of agile infrastructure.[16]

> [Agile infrastructure] will result in the *right sizing* of the logistics footprint through reductions in logistics forces, facilities, equipment and supplies. These reductions will be enabled through significant enhancements to joint logistics policies, structures and processes in inventory management, engineering, maintenance, and infrastructure improvements.

It is difficult to put much stock in a logistics system whose success has been promised without testing in the worst possible cases or scenarios. Are we making changes to our future logistics capability based on relatively short campaigns, as the Germans did earlier this century? The Gulf War may have been won in 6 weeks, but we had nearly 6 months to prepare. The recent Kosovo air campaign was, perhaps, easier logistically but lasted even longer—78 days. Granted, there were gross inefficiencies in the way we handled the logistics chain in both scenarios. However, much of that was due to our own dealings with the *fog* and *friction* of war—better to have too much of what you do not need than to have none of what you must have. Is this only true in modern warfare? Not at all!

In *For Want of a Nail*,[17] Kenneth Macksey cites Benjamin Franklin's maxim:

> For want of a nail—
> The shoe was lost—
> For want of a shoe the horse was lost—
> For want of a horse the rider was lost—
> For want of a rider the battle was lost.

This, along with 13 chapters of text replete with examples of the effects of logistics on war from the early 1800s to 1975, serves as warning that we must not "overlook the workings of what may

be termed the *logistic equaliser*."[18] He cites Britain's failure to maintain her logistical capabilities gained during the Napoleonic wars as an example of allowing economic policies to subjugate military power. "Whenever military organisations come under financial constraints, they tend to make disproportionate economies in the logistic services compared to the combat arms."[19]

The case is easily made that we are following historical precedence and putting money into force modernization at the expense of logistical capability. Outsourcing and privatization is an example. "The Commission on Roles and Missions of the Armed Forces in 1995 encouraged the DoD to pursue outsourcing and privatization to generate savings that could be applied to force modernization."[20] The operative word in that quote is *could*. Hardly a contractual statement to make the logisticians of the world sleep better at night.

Given that the historical lessons and current policies regarding infrastructure paint a less than perfect picture for the logistics community, how will we motivate our people to meet the challenge? It all goes back to understanding our role in doctrine.

Maintaining Doctrinal Focus in the Expeditionary Air Force

"Logistics is traditionally an unglamorous and unappreciated activity. To generalize, when the battle is going well, the strategist and tactician are lionized; it is only when the tanks run out of gas that people go head-hunting for the logistician."[21] Regardless of historical lessons, the fact remains that we are in a changing military environment for economic, political, tactical, and strategic reasons. We can and will make changes to our doctrine documents as the need arises. What we must not do is make arbitrary decisions to disassociate ourselves from our role in doctrine simply because we gain more attention for ourselves—or our particular career fields—through association with other career fields that may be in the limelight. A firm understanding and complete acceptance of our role in doctrine will go far in making every member proud to be associated with the Air Force, regardless of career field. Teaching and demonstrating the importance of doctrine to our newest members may help turn the tide in this era of individualism or association with only those seen as *heroes* or *winners*.

A Leadership Opportunity

General Patton's speech to the Third Army, as depicted in the movie, was cited earlier. The emphasis is on our natural tendency to associate ourselves with *winners*. Many who have watched the movie may have perceived the *winners* as only those front-line troops who fought for General Patton. He did not see it that way. In the movie, an important part of his actual speech was omitted, probably since it lacked glamour.

> All of the real heroes are not storybook combat fighters, either. Every single man in this Army plays a vital role. Don't ever let up. Don't ever think that your job is unimportant. Every man has a job to do, and he must do it. Every man is a vital link in the great chain . . . every man does his job. Every man serves the whole. Every department, every unit, is important in this vast scheme of war . . . . Each man must not only think of himself, but also of his buddy beside him.[22]

With the expeditionary Air Force becoming a reality, we have a golden opportunity to heed General Patton's words concerning people's importance. Recognizing logistics as a warfighting skill by including it as an Air and Space Power function and educating the entire Air Force about each other's role in doctrine will go far toward ensuring our natural tendency for association remains healthy and focused on our warfighting capability.

Notes

1. Lt Col James C. Rainey, et al, *Logistics on the Move,* Maxwell AFB, Gunter Annex, Alabama: Air Force Logistics Management Agency, April 1999, 3.
2. *Patton,* 20th Century Fox, 1970, Directed by Franklin J. Schaffner.
3. *The Famous Patton Speech,* Phil Buckley's G.I. JOE Bar & Grill [Online] Available: http://www.1918.com/phil/patton.shtml.
4. "Career Field Breakdown," *Airman Magazine,* January 1999, 47.
5. Air Force Doctrine Document 1, *Air Force Basic Doctrine,* September 1997, 29-35.
6. *Air Force Basic Doctrine,* 45-60.
7. Paul G. Kaminski, Undersecretary of Defense for Acquisition and Technology, "The Revolution in Defense Logistics," *Defense Issues,* Vol 10, No. 107, 31 October 1995 [Online] Available: http://www.defenselink.mil/speeches/1995/index.html.
8. *Air Force Basic Doctrine,* 83.
9. Kaminski.
10. Joint Publication 4-0, *Doctrine for Logistics Support of Joint Operations,* January 1995.
11. *Ibid.*
12. Thomas A. Keaney and Eliot A. Cohen, *Revolution in Warfare? Airpower in the Persian Gulf,* Naval Institute Press, Annapolis, Maryland: Naval Institute Press, 1995, 176-177.
13. *Doctrine for Logistics Support of Joint Operations,* 10.
14. "Insight," *Military Review,* Army Command and General Staff College, November-December 1997, No. 6, Professional Bulletin 100-97-7/8, 63 [Online] Available: http://www-cgsc.army.mil/milrev/english/novdec97/insights.htm.
15. *Ibid.*
16. *Focused Logistics, Joint Vision 2010: A Joint Logistics Roadmap,* GPO, undated, 34.
17. Kenneth Macksey, *For Want of a Nail: The Impact on War of Logistics and Communication,* Brassey's (UK), original date unknown, School of Advanced Aerospace Studies reprint, Academic Year 1997-1998, xiii.
18. *Ibid.*
19. Macksey, 10.
20. *Focused Logistics, Joint Vision 2010,* 35.
21. Lt Gen William G. Pagonis, USA, *Moving Mountains: Lessons in Leadership and Logistics from the Gulf War,* Boston, Massachusetts: Harvard Business School Press, Boston, 1992, 8.
22. *The Famous Patton Speech.*

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(Big Week—Eighth Air Force Bombing 20-25 February 1944 continued from page 15)

constraints associated with humpback bridges, narrow winding roads with reverse camber, and bridge clearances.

103. "Materiel Behind the 'Big Week'," 2-3.
104. Knerr, "Knerr Correspondence."
105. "Notes for Supply and Maintenance Chapter," 6. Although it is not clear from the historical account if VIII Air Force Service Command sought to replace British personnel at Burtonwood depot with Americans because the British were not productive or if the decline

in British employee productivity was caused by the agreement, it is clearly documented that productivity increased.

106. *Ibid*.
107. "Materiel Behind the 'Big Week'," 3-4.
108. "Notes for Supply and Maintenance Chapter," 5. The shortage of station overhead personnel also necessitated the use of skilled service personnel for overhead functions.
109. "Materiel Behind the 'Big Week'," 4.
110. "Materiel Behind the 'Big Week'," 6. Despite initial USAAF reservations regarding Lockheed's control of depot personnel at Langford Lodge, which occurred due to an error made by the government in writing the contract, it appears the contractor managed the personnel satisfactorily.
111. "Materiel Behind the 'Big Week'," 4.
112. *Ibid*.
113. Maj Gen Hugh J. Knerr, "Letter from USSTAF in Europe Deputy Commanding General, Administration to Commanding General," USAF, HRA 519.8671-3, 1 April 1945.
114. Knerr, "Knerr Correspondence."
115. Knerr, "Air Force Logistics," 7.
116. "Notes for Supply and Maintenance Chapter," 12.
117. Knerr, "Air Force Logistics," 7.
118. Knerr, "Knerr Correspondence."
119. Stockfisch, 19.
120. "Notes for Supply and Maintenance Chapter," 12.
121. Craven and Cate, *Vol. 2, Europe: Torch to Pointblank—August 1942 to December 1943*, 742.
122. Cook, 6.
123. "Materiel Behind the 'Big Week'," 4.
124. Richard G. Davis, *Carl A. Spaatz and the Air War in Europe*, Washington, DC: US Government Printing Office, 1993, 327.
125. Knerr, "Strategic, Tactical, and Logistical Evaluation of World War II," 7.
126. Knerr, "Air Force Logistics," 1.
127. Stockfisch, 52.
128. *Ibid*.
129. Knerr, "Air Force Logistics," 6-7.

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(Alternate Munitions Prepositioning—Strategy 2000 continued from page 21)

in the Mediterranean to Spain and then to Nordenham, Germany, to be offloaded. At this point, about 2 weeks had elapsed since the initial request was sent out by USAFE. The deep-water port is only one constraint for an APS. Host nation restrictions, as well as availability of equipment and experienced personnel for munitions offloading, also play major roles in the selection of the port. The offloaded munitions from the *Bennett* were then sent to three different locations. A portion was sent on barges to the United Kingdom, and the rest were sent to Italy and Germany. These locations required selected munitions that were spread throughout the entire ship. As a result, all the containers had to be offloaded, opened, and sorted and then either shipped forward or repacked and put back on the ship (Figure 4).

It took about 2 weeks to complete the offload and delivery to Germany and the United Kingdom and upwards of a month to complete the delivery to Italy. Some of this delay may be attributed to the hazardous nature of munitions and the rules and regulations governing its transportation.

Could smaller, faster ships alleviate some of the problems outlined above? For example, EAF peacekeeping scenarios, as well as many other smaller conflicts, may not require as many munitions as an MTW, and yet the requirement for munitions in a multiple-conflict scenario across large distances can overwhelm two or three large APS.

The Air Force should start examining the smaller, faster sealift capability. One particularly attractive option includes the high-speed sealifts (HSS)—such as the 91-meter wave-piercing ferry INCAT 046 and Revolution 120, a 120-meter wave-piercing RO/Pax Catamaran—both built by the International Catamaran (INCAT) Australia Shipyard. These boats combine three attributes: light weight, high performance, and large payload. The INCAT 046 *Devil Cat*, Figure 5, with a surface-piercing catamaran hull 91 meters long and beam of 23 meters, is capable of carrying 500 metric tons and reaching speeds of up to 43 knots. In fact, the Army, as part of the Center for the Commercial Deployment of Transportation Technologies High-Speed Sealift program and in cooperation with the US Transportation Command and Maritime Administration, has sponsored an evaluation of the 91-meter INCAT 04614. The newest INCAT design, Revolution 120, with turbine-powered jets, is 120 meters long with a beam of 30 meters. It can achieve speeds of more than 60 knots lightship (400 metric tons) and 50 knots fully loaded (1,200 metric tons). In fact, the Australian Navy used an INCAT-built catamaran, the *HMAS Jervis Bay*, to carry troops and vehicles to and from East Timor.

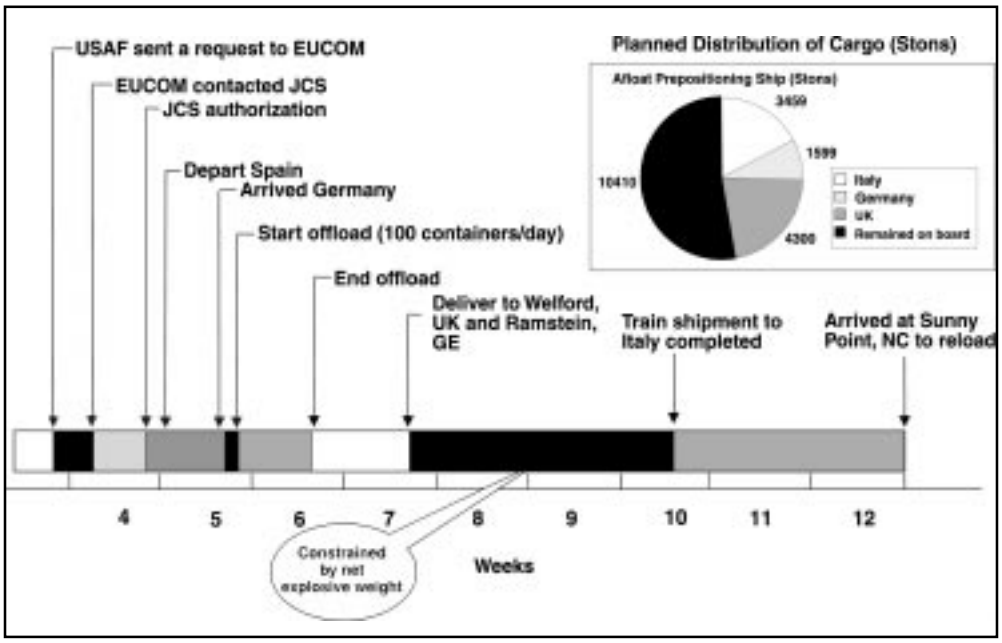

Figure 4. Time Line of Munitions Delivery by *MV Stephen L. Bennett*

Figure 5. Bow View of 91-Meter Wave-Piercing Ferry INCAT-046 Running at 43 Knots

There is no doubt that an afloat prepositioned fleet (APF) of larger ships can meet the need for sustainment or, when time lines allow, for longer transportation delay. Moreover, HSS ships do not obviate the need to preposition munitions at some FOLs that require a very short time line. Although the transit time for sealift can be substantially decreased, ground transportation can still add delays to the delivery of munitions to FOLs. For example, one can imagine a hypothetical situation where HSS ships would be deployed to ports in the three countries where the *S. L. Bennett's* cargo was sent. It would have taken eight HSS ships to do the job, but substantial savings might have been achieved in terms of sealift transit time, loading and offloading, and surface transportation.

Conclusions and Recommendations

The initiatives evaluated—reducing WRM munitions on the ground in Southwest Asia, increasing the size of the afloat prepositioned fleet, and changing its composition—have the potential to improve the Air Force's ability to respond to crises worldwide. However, the deep-water nature of the ships presents some problems in finding suitable ports. During the ONA, considerable time was taken to unload and transport the munitions to their final destinations. These initiatives do provide benefits for meeting operational requirements in contingencies with relatively long warning times and substantial uncertainty. These results suggest both specific and general policies for the Air Force to consider in increasing operational robustness.

Specifically, the Air Force may want to pursue positioning a mix of WRM on fast, smaller HSS, such as the 91-meter INCAT 046 *Devil Cat* or Revolution 120 and other larger ROROs. The Catamarans can travel up to 50 knots and carry 500 to 1,200 tons of equipment and personnel. In comparison, the larger ships can carry about 20,000 tons of cargo at a speed of 18 to 22 knots. If the Air Force needs to meet very rapid employment time lines, prepositioning munitions at selected FOLs may still be necessary. Difficult tradeoffs need to be made. More generally, the Air Force should undertake further exploratory modeling of the type used in this analysis. Such modeling is ideal for developing the dynamic and responsive system needed to support expeditionary operations.

Uncertainty dominates planning for war. It affects virtually every decision related to war reserve policy, requirements, investment levels, prepositioning, transportation capacity and priorities, and campaign planning. In the face of so many variables, for which there is so much uncertainty, it is no surprise that planners may wish to rely on canonical scenarios. A canonical scenario can be a constructive approach to the problem of matching logistics resource investment levels with budgetary constraints, but it is less useful for determining resource mixes or specific military capabilities needed for operations. Rather than a canonical scenario, what is needed is a methodical approach for:

- Evaluating alternative strategies under a variety of scenario assumptions.
- Exploring a large number of alternative resources.
- Choosing among strategies in a way that yields a robust mix of resources positioned to be most responsive to the widest possible variety of scenarios.

Planning processes should focus more explicitly on the levels of flexibility, adaptability, and robustness needed in resource investments, asset postures, and prepositioning strategies. Planners for EAF operations may need to think outside conventional bounds and canonical scenarios.

The RAND analysis of only a few variables for WRM prepositioning, for example, shows the key question is not where on land WRM ought to be positioned but how its positioning can become more flexible for greater support responsiveness. There are likely other areas of EAF planning where the key questions are not how best to use existing materiel, technology, and support structures but how to design a support system that stretches the current boundaries posed by existing materiel, technology, and support structures. Exploratory modeling can contribute significantly to identifying and answering such questions.

Notes

1. See the following *Air Force Journal of Logistics* articles: Lionel Galway et al., "Expeditionary Airpower: A Global Infrastructure to Support EAF," Vol 23, No. 2; Robert S. Tripp et al., "Expeditionary Airpower, Part 2: EAF Strategic Planning," Vol 23, No. 3; Eric Peltz et al., "Evaluation of F-15 Avionics Intermediate Maintenance Concepts for Meeting Expeditionary Aerospace Force Support Challenges," Vol 23, No. 4; Robert S. Tripp et al., "A Vision for an Evolving Agile Combat Support System," Vol 24, No. 1; and Amatzia Feinberg et al., "Evaluation of LANTIRN Intermediate Maintenance Concepts for Meeting Expeditionary Aerospace Force Support Challenges," Vol 24, No. 1.
2. Bruce W. Bennett, A. Bullock, D. Fox, C. Jones, J. Schrader, R. Weissler, and B. Wilson, *JICM 1.0 Summary*, Santa Monica, California: RAND, MR-383-NA, 1994.
3. Steven C. Bankes, "Exploratory Modeling for Policy Analysis," *Operations Research*, Vol 41, No. 3, May-June 1993.
4. DataView was implemented by James Gillogly, formerly of RAND.
5. According to current doctrine, munitions needs for a two-MTW scenario are determined by the Nonnuclear Consumable Annual Analysis process. Munitions allocated amongst the theater munitions stocks (USAFE, Pacific Air Forces, and Central Air Force), and swingstock. The latter includes the CONUS munitions stocks, Standard Air Munitions Packages, and the afloat prepositioned fleet; the Air Force presently has three ships as part of the APF program: the *MV Buffalo Soldier*, *MV Major Bernard F. Fisher*, and *MV Captain Stephen L. Bennett*. *Buffalo Soldier* is a break bulk and the other two are container ships. At the time this analysis was done, there were two break bulk ships and one LASH.
6. Scenarios were analyzed in which there are no, one, or two surprises. In scenarios in which there are two surprises, it is assumed, with one exception, that the same surprise cannot occur twice. That exception is for sabotage, which can occur twice.

7. In cases where both *ship sunk* and *ship late* surprises occurred, the first ship expected to arrive in theater was the one assumed lost.
8. If sabotage was simulated to occur twice, it was assumed that 10,000 tons of munitions were lost.
9. It was assumed that one shipload of munitions would always be kept in SWA. For other scenarios, if more than one shipload was in Southwest Asia, it was assumed that one shipload could be airlifted directly from SWA to the theater. If three shiploads were in Southwest Asia, the second load would be moved by sea.
10. White squares indicate cases not run. Off-diagonal squares are for combinations of surprises, but sabotage of munitions on the ground is the only surprise that can happen twice. The *Hormuz* surprise only affects the SWA scenario. Except for the first position, the bottom row is empty because it would be just like the first column.
11. The exception is that performance is worse in the North African scenario when there is an enemy attack on the port (the port surprise). Understanding this requires an analysis of the interaction between the ship arrival schedule, what we assumed about unloading processes, and our model of the effects of an attack on a port.
12. Using CTEM, for example, we estimated munitions requirements for scenarios in Southwest Asia and Korea, finding the optimal mixes of munitions required for these two theaters to be quite different.
13. Courtesy of INCAT Australia.
14. Martin J. Dipper, Jr., "91-meter Wave-Piercing Ferry INCAT 046 Transit from Hobart, Tasmania, Australia, to Yarmouth, Nova Scotia, Canada, Naval Surface Warfare Center Carderock Division, West Bethesda, Maryland, 20817, CRDKNSWC/HD-1479-01, 1998.

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(Global Access—Strategy 2000 continued from page 27)

Developing and acquiring aircraft with longer operating ranges would help the Air Force avoid future access difficulties. Aircraft able to operate over a range of 2,000 nautical miles without refueling, for example, could support contingency operations in most of the world while operating exclusively from the five forward support locations preciously identified. Small, *smart* munitions could improve the rates at which aircraft could deliver ordnance, in turn, permitting the Air Force to consider a wider variety of options for access and basing. By adopting processes or technologies that expand its options for access and basing, the Air Force will hedge against risks of future *access lockout*. By identifying and implementing process and technology innovations that improve expeditionary operating range, logisticians will also overcome many of the political constraints on their options.

Exploiting new opportunities. There are two types of opportunities for access and basing that may be exploited for future operations. The first is extraterritorial access. We cannot identify a future host country, but the United States possibly could work now to develop such opportunities. The Air Force should survey one or more key areas of interest, starting in the western Pacific, to identify potential sites for such access. If some are found, then logisticians can consider the cost, feasibility, and development of facilities there. This preparation will help should theoretical possibilities become actual opportunities.

A second area of opportunity for access and basing is in the currently rapid pace of geopolitical change. The changes of the last decade may have created new opportunities for access and basing that have not yet been realized. Many nations of Central Asia have demonstrated an interest in closer ties with the United States. Their help could be crucial in access and basing for responses to crises involving China or Iran. Several Southeast Asian nations have also expressed interest in expanding ties with the United States; their help could be crucial for US responses to crises there.

Addressing immediate concerns. In both Southwest Asia and the Pacific Rim, current access arrangements are insufficient, and the risk of contingencies is high. Both these regions should command the most attention in managing and developing access and basing options.

In Southwest Asia, flexible planning will be critical to maintaining Air Force capabilities to respond to contingencies. Such planning should focus on how to maintain current capabilities if basing options are not optimal. This might include planning to base aircraft at one regional location and support processes at another in order to minimize risks and create more basing options. The United States may wish to develop more strategic partners in the region. Israel is a prime candidate for such a role should a broad peace accord permit its *normalization* in the region.

The Asian Pacific Rim outside Korea presents daunting access and basing problems to the United States. Particularly problematic is the lack of bases available near the Taiwan Strait. Facilities in the northern Philippines would solve this problem if they could be used in a Taiwan crisis. Identifying and developing extraterritorial access would also help. In Southeast Asia, the United States would improve its options by expanding its presence in Singapore, continuing to build its relations with Thailand, and possibly, developing Malaysia as a site for access and basing.

In both Southwest Asia and the Pacific Rim, the development of new, longer range combat aircraft could ameliorate access and basing concerns.

Future Access and Basing Needs

Continuing changes in military technology may eliminate many access and basing problems. Space-based surveillance and attack systems may someday enable the Air Force to strike any target in the world without deploying aircraft or personnel. Still, it is unlikely that such changes will completely eliminate expeditionary operations in general and the need for access and basing in particular. Peacekeeping and humanitarian operations will continue to require local access and basing.

There is no single solution that the United States can apply for its access and basing needs now or in the future. Traditional problems for access and basing will persist, and new ones, including new threats posed to US forces based regionally, may develop, further complicating a global access strategy. Nevertheless, a global access strategy that includes maintenance of core assets and development of new political and technological opportunities can help the United States manage and develop access and basing options both now and in future years.

Notes

1. *Tactical* forces are those not committed primarily to the nuclear retaliatory mission performed until the early 1990s by Strategic Air Command.
2. For more information on the resources that must be prepositioned to meet a 48-hour deployment and operation time line, see Lionel Galway et al., "Expeditionary Airpower: A Global Infrastructure to Support EAF," *Air Force Journal of Logistics*, Vol 23, No. 2, 4-9, 40-41.
3. The next planned generation of tactical aircraft, including the F-22 and the joint strike fighter, will have similar operating ranges.
4. In 1973, the Air Force fleet of C-141A transport aircraft was not fitted for aerial refueling and could not have flown nonstop from the United States to Israel. The C-5A, which was equipped for refueling but was prohibited from doing so because of difficulties with its wing structure, could have made the trip without refueling, but its maximum payload would have been reduced to 33 tons. By stopping at Lajes, the C-5s were able to carry an average of 68 tons per sortie. See J. Lund, 1990, "The Airlift to Israel Revisited," unpublished manuscript, and US General Accounting Office, 1975, *Airlift Operations of the Military Airlift Command During the 1973 Middle East War*, LCD-75-204, 10, 30.
5. Israel might be said to have a special relationship with the United States, but it currently cannot help the United States solve its access and basing problems in the Mideast. Using Israel for access and basing in an operation against another state in the region—for example, against an Arab state—is, at best, problematic. This could change if the position of Israel in the region continues to improve. For more on the political dynamics and military implications of improving Arab-Israeli relations, see Zalmay Khalilzad, David Shlapak, and Daniel Byman, 1997, *The Implications of the Possible End of the Arab-Israeli Conflict for Gulf Security*, MR-822-AF, RAND: Santa Monica, California. We also recognize that Australia shares many of the cultural bonds that the United States has with the United Kingdom. There are, however, several reasons why these bonds will not yield a special relationship with the United States. London and Washington share many of the same perspectives on regional and global issues, but Canberra and Washington do not. A significant number of Australians would likely oppose greatly expanded ties with the United States. Even if a special relationship were possible, Australia still would not be ideally located for supporting operations away from the far southeastern portion of Asia.
6. For an overview of the role of FSLs in EAF logistic processes, see Lionel Galway et al., "Expeditionary Airpower: A Global Infrastructure to Support EAF," *Air Force Journal of Logistics*, Vol 23, No.2 For a discussion of how FSLs can improve EAF logistics processes, see, inter alia, Eric Peltz et al, 1999, "Exploring F-15 Avionics Intermediate Maintenance Concepts to Meet AEF Challenges," *Air Force Journal of Logistics*, Vol 23, No. 4, 3-5, 36-37.

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(Best Value in Source Selections continued from page 35)

17. AFFARS 5315.305(a)(2).
18. President's Blue Ribbon Commission on Defense Management, *A Formula for Action, A Report to the President on Defense Acquisition*, Washington DC, April 1986, 62-63.
19. The Federal Acquisition Streamlining Act of 1994, PL 103-355, 17 April 2000 [Online] Available: http://www.nara.gov/fedreg.
20. FAR 15.304—DAR Tracking Number 99-00002 and 15.305(a)(2).
21. General Accounting Office, B-284360, 18 April 2000 [Online] Available: www.gao.gov.
22. FAR 15.305(a)(2)(iv) and AFFARS 5315.305(a)(2)(S-92).
23. General Accounting Office. B-280645, [Online], Available: www.gao.gov (19 Apr 00).
24. AFFARS 5315.303(b)(1)(i).
25. AFFARS 5315.301-90(i).
26. AFFARS 5315.303(b)(1)(ii).
27. AFFARS Attachment 5315-3.
28. However, the Assistant Secretary of the Air Force (Acquisition) is the delegable SSA for new ACAT ID programs entering the engineering and manufacturing development phase.
29. AFFARS 5315.308-90(b), (c), and (d).
30. "Lightning Bolt 99-2, Superior Source Selections," 14 April 2000 [Online] Available: www.safaq.hq.af.mil/acq_ref/bolts99/factsheets/lb2.htm.
31. Memo, Darleen A. Druyun, Principal Deputy Assistant Secretary of the Air Force (Acquisition and Management), "Lightning Bolt 99-2 Air Force Source Selection Expert Advisors (SSEAs) Charter," 1 February 2000.
32. *United States Air Force Source Selection Procedures Guide*, March 2000 version, 21 March 2000 [Online] Available: www.bsx.org.

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The Editorial Advisory Board selected "Air Force Deployments and Support Services Contractors: Running Out of Gas?"—written by Matthew F. Pausch—as the most significant article to appear in the *Air Force Journal of Logistics*, Vol XXIV, No. 1.