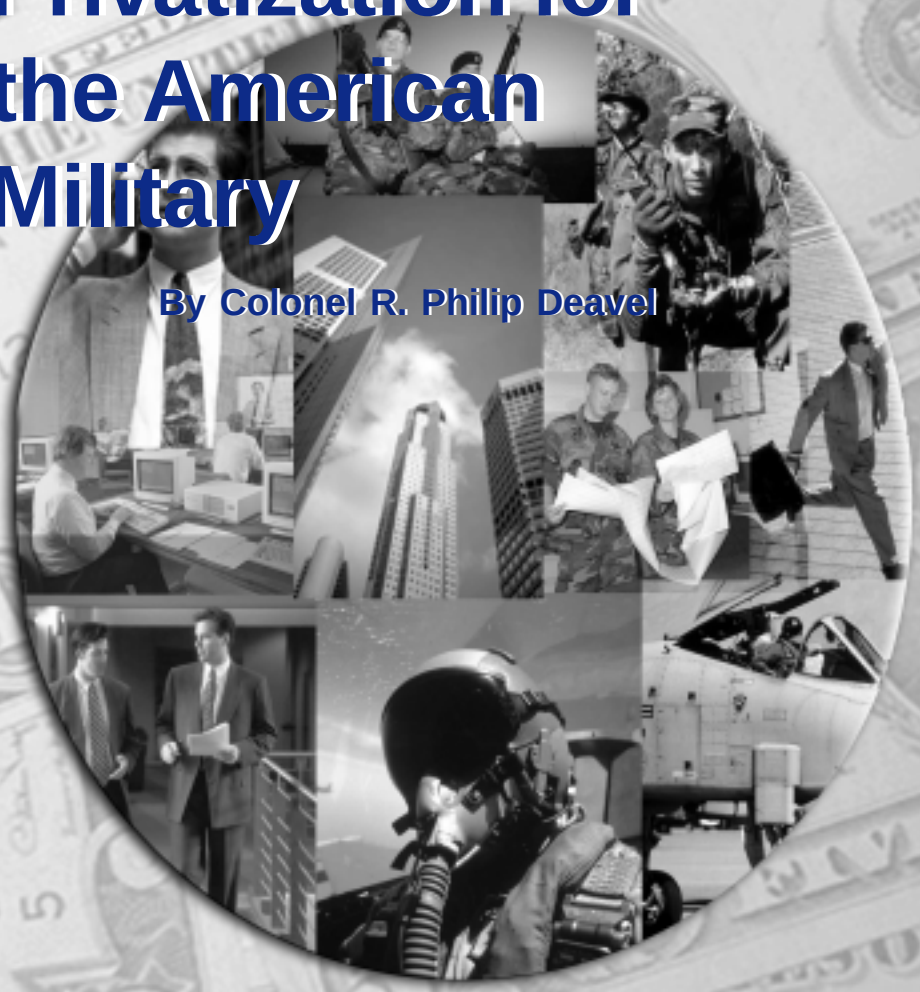
The Challenge of Sustaining Older Aircraft

By Lieutenant General William P. Hallin

The Political Economy of Privatization for the American Military

By Colonel R. Philip Deavel



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The Challenge of Sustaining Older Aircraft

Lieutenant General William P. Hallin, USAF

We face challenges every day, and one of them is managing the costs associated with keeping an aging fleet of aircraft flying longer and longer. Sustaining a fleet of aircraft that soon will average over 20 years of age requires a commitment to balancing available resources and a focus on "Total Ownership Cost" (TOC) to ensure we continue to meet our most stringent operational taskings. Balancing increasing support costs against declining or flat future budgets presents a challenge that must be attacked from several aspects. Air Force maintainers and "loggies," across the board, are stepping up to that challenge. Innovative process changes, new maintenance concepts and emerging technologies will all help contain sustainment costs while maintaining the readiness of an aging fleet.

We have expanded the focus beyond operations and support (O&S) costs to *Total Ownership Cost*, which is defined as:

> The sum of all financial resources necessary to organize, equip, sustain and operate military forces sufficient to meet national goals in compliance with all laws; all policies applicable to the DoD; all standards in effect for readiness, safety, quality of life; and all other official measures of performance for the DoD and its components. It is comprised of costs to research, develop, acquire, own, operate and dispose of defense systems, other equipment and real property; the costs to recruit, retain, separate and otherwise support military and civilian personnel; and all other costs of business operations of the DoD.

While this definition expands the horizon and correctly sets our direction for the future, we must continue to bore in on O&S costs which directly correlate to aircraft age. Figure 1 captures the essence of our challenge: the fleet will continue to age and exert upward pressure on O&S costs.[1]

Today, the average age of all of our aircraft is almost 20 years and it will continue to grow over the next several years, even with the addition of new systems like the C-17, F-22, Joint Primary Aircraft Training System (JPATS) and the Joint Strike Fighter (JSF). Figure 1 shows that even though the age of fighters levels off, the fleet age continues to trend upward. Reducing costs becomes even harder with an aging fleet, whose increasing O&S costs are driven by parts obsolescence, fatigue and airframe and engine challenges. Figure 2 shows that our oldest aircraft are the B-52, C-135 (C-135 and KC-135), C-130, T-37 and T-38, with the average age of some of these exceeding 50 years by Fiscal Year 15.[2]

The most significant problems with the oldest aircraft are airframe related, such as KC-135 skin corrosion, bulkhead cracks and beam corrosion. To put the problem in perspective, the KC-135 programmed depot maintenance costs increased $650K per visit in Fiscal Year 98, largely due to corrosion and rewiring. We have seen even relatively "young" aircraft like the F-16 (average age 9 years) affected by age: skin corrosion, bulkhead cracks and landing gear wear are common. The F-16 Service Life Extension Program (SLEP) extends the F-16A/B service life to 8,000 hours

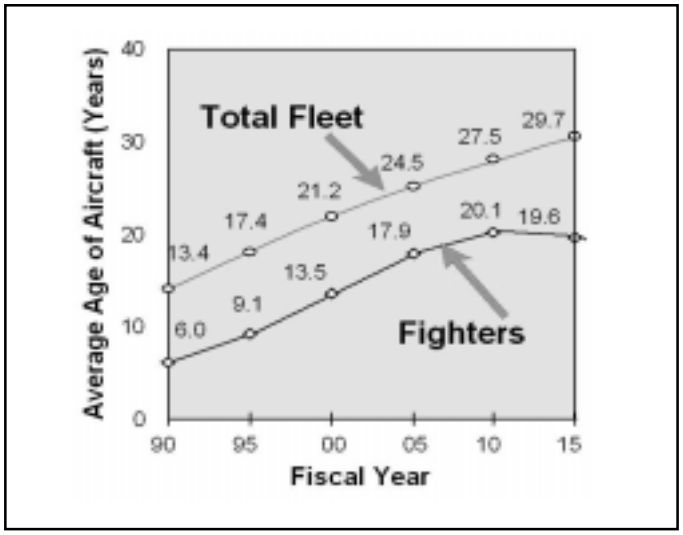

Figure 1. Aging Aircraft

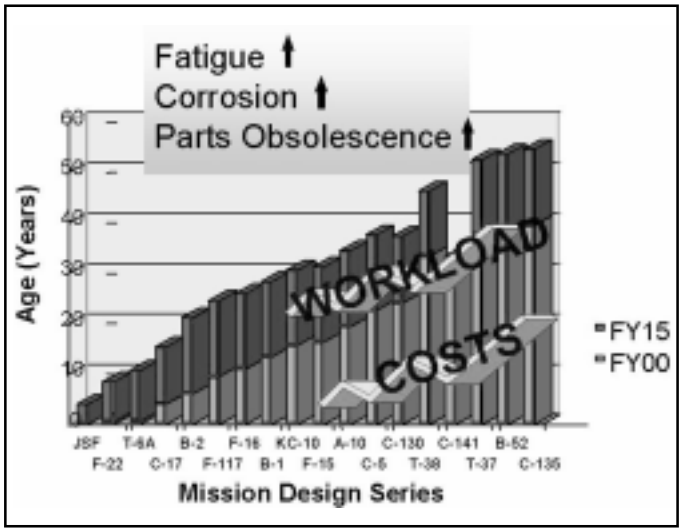

Figure 2. Challenges With the Aging Fleet

at a cost of $703K per aircraft in Fiscal Year 98. To offset these "bills" we need to make the right investments in programs that allow us to attack the O&S cost "bow wave" and perhaps turn the tide.

Savings from programs and efforts such as: sustaining engineering; reliability and maintainability modifications; depot maintenance capital improvements; two-level maintenance (2LM); Agile Logistics;[3] weapon system cost reduction (WSCR) initiatives; engine component improvement program (CIP); and productivity, reliability, availability and maintainability (PRAM) have helped slow the rate of increase. WSCR resulted in over 70 product/process improvements, which netted over $780M in

savings from Fiscal Years 96-01; 2LM brought over $260M to the table; and Agile Logistics reduced both inventory and manpower for a savings of $800M over a three year period (Fiscal Years 97-99).

While these savings are invaluable, we are at best holding the line or slowing the rate of O&S cost growth. Given the challenge of balancing readiness and modernization needs, today's reality dictates planned upgrades of systems and subsystems and not wholesale replacement. However, upgrades and modifications for readiness, reliability or maintainability (which could have lowered O&S costs) have not competed well against other funding requirements. This places a real premium on our ability to predict the effects of aging, to predict the associated cost and to make smart decisions.

Sustaining a fleet of aircraft that soon will average over 20 years of age requires a commitment to balancing available resources and a focus on "Total Ownership Cost" (TOC) to ensure we continue to meet our most stringent operational taskings.

The recently established Aging Aircraft Program Office at Wright-Patterson AFB, Ohio, is developing technologies to help predict aging aircraft impacts. This office helps to transfer emerging technologies that will extend aircraft lives and/or reduce support costs from the laboratories into operational use. They focus on seeking common solutions for multiple aircraft systems, not solving problems specific to individual aircraft. Currently, projects are underway that will make it possible to determine the corrosion impact on structural integrity and the associated impact on service life. Other tools are being developed to predict widespread fatigue damage. These tools will greatly enhance the confidence in the structural integrity of older aircraft by increasing the probability of detecting hidden corrosion and multi-layer cracks within aircraft structures and, ultimately, they will reduce O&S costs. Reducing costs, especially for our aging fleet, will depend on the successful integration of these new technologies so we can better predict the impacts of age and allow our oldest aircraft to operate well into the next century.

In addition to cost, another consequence of aging aircraft is readiness. If systems fail more frequently or take longer to repair, aircraft remain out of commission longer for maintenance, and this reduces aircraft availability for peacetime training and contingency operations. The Air Force aggregate Total Not Mission Capable Maintenance (TNMCM) rate for all aircraft has increased from 14.0 percent in Fiscal Year 94 to 18.2 percent in the third quarter of Fiscal Year 98. Much of this negative trend can be attributed to less reliable systems creating a greater maintenance burden.

The bottom line is the Air Force clearly recognizes the aging aircraft problem, and the O&S cost bow wave that it creates, and is making significant efforts across several fronts to minimize its effects.

Notes

1. Data was prepared by HQ USAF/ILM, August 1998.
2. *Ibid*.
3. Agile Logistics maximizes "operational capability by using high velocity and time definite processes to manage mission and logistics uncertainty in lieu of large inventory levels—resulting in shorter cycle times, reduced inventories and cost and a smaller mobility footprint." *See*: Agile Logistics Homepage, [Online], Available: http://www.hq.af.mil/AFLG/LGM/leanlog.shtml on the World Wide Web [20 Aug 98].

Lieutenant General Hallin is presently the Deputy Chief of Staff, Installations and Logistics, at Headquarters United States Air Force, Washington, DC.

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Most Significant Article Award of 1997

The Editorial Advisory Board selected "Quickness Versus Quantity: Transportation and Inventory Decisions in Military Reparable-Item Inventory Systems" written by Major Christopher J. Burke, USAF, PhD, and Vincent A. Mabert, PhD, as the most significant article published in the *Air Force Journal of Logistics* during 1997.

Most Significant Article Award

The Editorial Advisory Board selected "Past Performance: What's Preventing Us Now From Picking Winners?" written by Captain Jonathan L. Wright, USAF, Major Cindy L. Fossum, USAF, and Richard A. Andrews as the most significant article in the Volume XXII, Number 1 issue of the *Air Force Journal of Logistics*.

The Political Economy of Privatization for the American Military

Colonel R. Philip Deavel, USAF

Editor's Note: The paper on which this article is based was selected by the Society of Logistics Engineers (SOLE) for their annual award given for the best Air War College (AWC) research project in the field of logistics, AWC Class of 1998. It was also selected as a finalist in the Chairman of the Joint Chiefs of Staff Senior Service School Strategy Essay Contest.

Introduction

The concept of privatization has become a catchword for modernization and efficiency in the American military, but the Department of Defense (DoD) is certainly not at the cutting edge of the privatization movement. It is in fact at the tail end of the world's march to privatization; somewhere in the parade ahead of Fidel Castro but, ironically, well behind the formerly Leninist leaders of the Russian Federation. This situation is not inherently bad: there are major differences between the needs of military and civilian societies that often make brilliantly sensible policies for the private sector inapplicable to the armed forces. Nevertheless, the current debate on privatization in the DoD needs to be analyzed in the context of the global movement away from socialism and through the prism of American military culture to be truly understood.

As used in the current lexicon of the American military, *privatization* is an all-encompassing word for moving responsibility for functions and processes from the public sector to the private sector. It encompasses both the narrower form of privatization, "outsourcing" (now termed "competitive sourcing") and "absolute privatization." For clarity of communication, I will adopt the definitions of outsourcing and privatization as set forth by the Defense Science Board. The Board defines *outsourcing* as the "transfer of a support function traditionally performed by an in-house organization to an outside service provider, with the government continuing to provide appropriate oversight."[1] The Board defines *privatization* as "involving not only the contracting out of support functions, but also the transfer of facilities, equipment and other government assets to the private vendor."[2]

The Global Picture of Privatization

Most forms of public (that is, governmental) ownership of industrial production, social services and utilities were created on a socialist ideological underpinning of what constitutes the common good. This holds true if one reviews the Leninist economic model of the former Soviet Union, the economic philosophy of the 1930s Fascist regimes of Italy and Germany, the Fabian socialist (Fabian Society) ideology which gave birth to the British Labor Party, or the liberal, democratic model of President Roosevelt's New Deal.

The collectivists of the 1930s showed great ideological diversity, and some, especially in the United States, went to great lengths to advocate socialist economic models while scrupulously avoiding the use of the socialist cant common to European labor parties. However, they all shared a common collectivist belief in the basic goodness of government economic intervention and governmental ownership of key parts of the national economy.

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The relentless unraveling of socialist economics which has occurred during the last 50 years is beyond the scope of this article. Suffice to say, perhaps no ideological movement has promised so much wealth and prosperity for mankind, only to deliver such a bitter harvest of economic stagnation and poverty as modern socialism.

Those governments that embarked on the socialist economic equivalent of complete-immersion baptism, the absolute ownership of vertically-integrated industries from the production of raw materials to the creation of the final manufactured products, found their ultimate economic pain absolutely magnified. As the correlation between socialism and poverty became ever stronger, the daunting challenge faced by governments around the world has been to withdraw from commercial enterprises.

Those regimes which have deduced that an open repudiation of socialism would undermine their own historical legitimacy have retained a shell of collectivist jargon while filling their policy core with aggressive privatization practices built upon capitalist ideals. The best example is the Chinese government's disingenuous explanation of their capitalist policies as "socialism with Chinese characteristics."[3]

While government-owned commercial enterprises often poorly serve the general public, that does not mean no one profits from their existence. Management and labor in government-owned industries can be counted on to man the ideological barricades in unison to oppose privatization and are passionately

supported by their allies in the public-sector trade unions. These groups are supported in turn at the national level by government ministries whose reason for existence is the supervision of state-owned enterprises and/or operation of economic regulatory programs.

The Fruits of Privatization in the Civilian Sector

While the short-term political pain governments must endure to privatize industries is often intense, the long-term benefits make the effort worthwhile. The tidal wave of global privatization began to form in Britain with the election of Margaret Thatcher in 1979. A generation of industrial nationalizations by successive Labor governments had left the country suffering from what was known around the world as "the British disease."[4] Far from enhancing the standard of living for the nation, Britain's nationalized industries were extracting the equivalent of $600 *annually* from each tax payer in subsidies in order to keep them from collectively going bankrupt.[5] Over vociferous public-sector trade union opposition, the Thatcher government undertook a comprehensive program of denationalization. By 1996 these same companies, now privatized, not only were off the corporate welfare roles (that is, receiving no further cash infusions from the government), *they paid to the British Treasury* the equivalent of $200 in taxes for each taxpayer in the nation.[6] Indeed, British Steel, which required perennial infusions of cash while owned by the government, now represents a global benchmark for the efficient production of steel.[7]

The experience of the British government is consistent with the results of privatization around the world. In 1992 the World Bank conducted a global study of the net effect of privatization in four nations: Britain, Chile, Malaysia and Mexico. In the aggregate, the Bank found that privatizations produced a net gain of 26 percent in economic output for the denationalized industries.[8] The Bank found the biggest efficiencies flowed from one factor alone: the new-found freedom of privatized companies to hire and fire employees and to craft compensation packages that reflected the true value of individual productive output.[9]

While privatization did in fact create "losers" (the state employees who now faced the more demanding requirements of market economics), the Bank found the nations as a whole gained prosperity from the enhanced economic performance those countries reaped from privatization.[10] Whether one views the equation in utopian terms of the "greatest good for the greatest number" or makes a cold-eyed calculation of what best enhances a nation's economic status, the evidence is overwhelming that privatization works.

Cultural Impediments to Privatization

While the concept of privatization is the same around the world, the impediments are not. Few political leaders have the luxury of analyzing privatization in bare economic terms. As an example, Margaret Thatcher's first privatization venture was the sale of British Telecom (a government-owned monopoly provider of telephone service) in 1984. Viewed as a pure economic transaction, it would have been in the best interests of the British government to seek the highest possible sale price for the telephone company. Simple economics would have dictated that individuals and corporations from around the world be allowed to purchase as much stock as they desired. This would expand the pool of bidders and insure the highest possible sale price. Furthermore, the Goliaths of the world equity markets—investment banks and pension fund managers—should have been allowed to bid for large blocks of the stock to ensure the initial public offering (IPO) price for the shares truly reflected global demand.

However, Thatcher's administration took the very opposite approach.[11] Her government set the IPO for the shares artificially low, all but guaranteeing the stock could be quickly resold on the secondary market at a tidy profit. The government then offered to sell a large percentage of the stock directly to small British investors at this predetermined (and artificially low) price. While not publicly acknowledged, strategic political considerations, rather than short-term economic goals, drove the terms of the privatization. The government's strategy was aimed at two primarily political objectives. First, to neutralize the opponents of privatization who had argued that the denationalization of British Telecom would generate unjust profits for wealthy individuals and foreign corporations. Second, Prime Minister Thatcher wanted to build an appetite for further denationalizations in the British electorate. By "guaranteeing" that citizens who participated in the privatization by purchasing stock directly from the government would turn an instant profit, the benefits of denationalization became immediate and tangible to a wide swath of voters who cared little about the abstract economic debate.

Unfortunately, analysts of privatization in the American military, especially those in favor of greater privatization, tend to approach the issue using naked economic calculations unclothed with considerations of the cultural framework.

This strategy was spectacularly successful. Over two million small investors applied to purchase British Telecom shares directly from the government.[12] These small investors were extremely well rewarded for placing their savings into the British Telecom privatization. On the first day British Telecom stock began trading on the international exchanges the share price rose a stunning 90 percent over the price these small investors had paid the government.[13]

From the beginning, the Thatcher government quite cleverly co-opted the British public into becoming its ally in privatization by allowing small investors to act as arbitrageurs between the government and the global equity markets. In pure economic terms, allowing the British public to profit as the middleman in denationalization did not add value to the process. It was,

however, immensely valuable in achieving the government's overarching strategic objective of moving Britain from a statist to a free-market society. The manner in which British Telecom was privatized created an irresistible momentum in support of widespread privatization for every sector of the economy. Prime Minister Thatcher understood the *social dynamics* of privatization were every bit as important as its mathematics.

Unfortunately, analysts of privatization in the American military, especially those in favor of greater privatization, tend to approach the issue using naked economic calculations unclothed with considerations of the cultural framework they attempt to change. These proponents view the DoD as being inherently values-neutral in its use of economic models, or in the alternative, as a bureaucratic robot with neither the right nor ability to oppose the changes thrust upon it. This economically sophisticated, but politically naive, approach has caused needless turmoil within the uniformed services and exasperation for the privatization advocates when their objectives are repeatedly stymied.

Military Culture and Privatization

Military professionals analyzing defense privatization must realize this policy issue will not be addressed solely in martial terms. Similarly, civilian leaders must make concessions to the exigencies of forward deployments, labor on demand, and ultimately, combat. It is unpersuasive for military leaders to resist specific privatization initiatives essentially on the grounds that the proposal would be inconsistent with traditional military practice, and equally unpersuasive for civilians to ignore the noncommercial realities of the profession of arms.

The Defense Science Board defined one of the primary impediments to privatization in the military as the "resistance of the DoD culture to fundamental change."[14] The Board attributed the military's hostility to privatization as flowing from its orientation on readiness rather than efficiency. While no doubt technically accurate, the Board's analysis skims the ideological surface and does not address why the "culture" of the DoD is hostile to private sector solutions, nor why military officers assume organic (government-owned) support services better enhance readiness.

The American Military as a *New Deal* Society

Military culture and its system of personnel benefits, with a general preference for State ownership of economic assets, is solidly rooted in the paternalistic and socialist ideals of President Franklin Delano Roosevelt's *New Deal*. While this assertion might strike many career military members (who in recent years have been collectively accused of what might be termed "excessive Republicanism" by liberal critics) as counter-intuitive, the points of commonality between socialism and the military are in fact striking.[15]

First, on a personal level, the military controls an omnipresent social service system on which the average service member is deeply dependent. Rather than provide income which individuals are free to allocate as their needs and desires dictate, military compensation is predicated upon providing modest salaries supplemented with government controlled services. Ergo, military optometry care might be basic and provide only black frame glasses of little aesthetic appeal, but the service is free and available to all. Indeed, for many military members every facet of life is provided for and controlled by the State. The house where they live, the school their children attend, the clinic where they receive medical care and the stores where they shop, are all owned and controlled by the State. The State provides these benefits for "free" or at reduced cost.

Almost alone among major organizations in America, the military clings to a defined-benefit rather than a defined-contribution pension system. Defined contribution plans, commonly referred to as 401(k)s or 403(b)s from the sections of the tax code which authorize them, utilize tax-deferred retirement accounts into which the employee and/or his employer make monthly contributions. The employee owns the assets immediately or vests for ownership in relatively brief periods of time. Customarily, employees have great freedom to select specific investment vehicles and may roll the assets over to a new deferred account if they elect to change employers (total portability).

The modern 401(k)/403(b) is the essence of the free market ethos: it places great responsibility on the employees to plan for their retirement; in turn, it empowers them to control their own destiny. The defined-benefit plan utilized by the military is at the other end of the spectrum; it is a classically socialist system: military members never contribute a penny of their own money to the system and, in turn, have no voice in how the system is funded. There is normally no vesting (the right to draw benefits) until 20 years of service, and the system has no portability. That is, barring unusual force reduction measures, a service member voluntarily departing with 19 years of service has no accrued assets and leaves with nothing.

In its totality, the military compensation system would be viewed as strange by the typical American employee at Microsoft, while his counterpart in a socialist collective farm would immediately recognize it as strikingly similar to his own world. Is it really so surprising that individuals nurtured and raised in such a system tend to cast a jaundiced and distrustful eye at the freewheeling private sector?

This military orientation toward rigid command and control production and compensation systems over decentralized market models is certainly not unique to the United States. William H. McNeill catalogues the widespread appeal command economics has for military elites in *The Pursuit of Power*.[16] This sweeping review of the relationship between civilian society and military forces over the last thousand years chronicles how both the 19th Century Prussian and British armies, distrustful of private industrialists, attempted to contract for armaments exclusively through government-owned arsenals. Only after it became painfully obvious that weapons from government arsenals were consistently inferior in design and overall quality did conservative British and German officers turn in frustration to the private sector. Indeed, it has been popular at times in the Anglo-American view of history to paint the Prussian General Staff and Krupp's industrial combine as locked in an unholy alliance of conquest and profits. McNeill shows how in reality the Prussian Army stubbornly attempted to keep armaments production inside army-owned plants. The General Staff finally turned to Krupp, resentfully, only out of fear that inefficient and technologically inferior government arsenals would imperil German security.[17]

Whether one analyzes 19th Century European armies or the modern American military, the cultural bias against the private

sector remains constant. The power and security which command economies provide are as compelling for military leaders as they are for Marxist ruling elites. However, exactly like Marxist rulers, military leaders fettered to the government-controlled production of goods and services are ultimately faced with the spiraling inefficiency and continual resistance to change that are part and parcel of command economies. It makes no difference in this equation if the government-owned and directed plants are used for the production of automobiles or tanks. Likewise, the fact that the commands are given by military officers rather than civilian government bureaucrats will not inject creativity and incentives for efficiency into stodgy government monopolies. Only when the price to be paid (in subsidies and shoddy products) for the security of control becomes unacceptably high do command bureaucracies relax their grip and look to the private sector in desperation.

The social dynamic that motivated the Prussian General Staff and British Army to resist privatization—the security of control—is as relevant today for the United States military as it was in 19th Century Europe. The rather exasperated statements of the Defense Science Board that military culture is needlessly hostile to the private sector and wedded to inefficient support systems might be true, but they are not particularly helpful in understanding why those policy biases exist or in ameliorating the legitimate concerns of commanders.

The Ghost of McNamara

The DoD has a long collective memory. The privatization debate has a hauntingly familiar ring to career military officers. It resonates with the policy initiatives of an arrogant Robert McNamara and his civilian "Whiz Kids." Even the buzz words used then and now are similar. McNamara was, after all, determined to bring private sector business efficiency to the armed forces.

In perhaps his most famous quote on the subject, McNamara stated "Running any large organization is the same, whether it is the Ford Motor Company, the Catholic Church, or the Department of Defense. Once you get to a certain scale, they're all the same."[18] By such a sweeping assertion, McNamara dismissed any suggestion that the military had unique organizational needs because of its mission.

Not only was McNamara determined to force private sector business practices on the military, but ever distrustful of career officers, he used his civilian systems analysts as shock troops to force and implement "reform." His roughshod efforts to impose efficiency on the DoD, and his subsequent disastrous attempts to apply systems analysis to the war in Vietnam (for example, comparing friendly and enemy body counts as a quantifiable measure of success), all worked to reinforce the military's impression that private-sector business practices are grossly inapplicable to armed forces.

While one might soundly discredit a concept in military circles by merely attributing it to McNamara, that does not hold true with Congress, Presidents or the elite of the American business world. McNamara's reorganization of the Ford Motor Company, his efforts to rationalize defense procurement systems as Secretary of Defense and his subsequent stewardship of the World Bank all won him many influential admirers in American society.[19]

If the most conservative members of the military and the most vociferous and left wing critics of the Vietnam War agree on one thing, it is that Robert McNamara was a disaster as Secretary of Defense. Despite the irony, the wheels of history grind on and the military cultural deficiency that allowed McNamara to so thoroughly dominate the debate over the proper organization of the DoD shows itself again in the debate over privatization. The deficiency I refer to is the fact that the senior military leadership and the staffs which served them were ill prepared to do intellectual battle on the terms McNamara set for the debate.

Privatization initiatives should be managed in the introductory phase, not to maximize financial savings, but to build a consensus inside the military that "de-nationalization" of support services leaves the armed forces better cared for than the status quo.

McNamara's disdain for the officer corps, based upon his perception of their ignorance about professional (that is, private sector) organizational management, cost accounting methods and other quantifiable measures of merit, should not be dismissed solely as personal intransigence, or the prejudice of a leader who favored the private sector. In reality, the management of the DoD, in particular the always-vexatious defense procurement process, left much to be desired.

Thirty years after its introduction by McNamara, the "planning, programming and budgeting process" remains the benchmark for the coherent financial integration of research and development, weapons production and operations. Furthermore, the Office of Systems Analysis (a.k.a. the Whiz Kids) created by McNamara in 1961, and subjected to withering criticism from the moment of its birth by both military officers and Congressional budget chieftains, is still alive and well. However, it now travels under the moniker of the Secretary of Defense's "Office of Program Analysis and Evaluation," and is an accepted (if at times grudgingly) part of the DoD landscape.

The dominance of systems analysis in the early 1960s flowed not from the intellectual brilliance of McNamara and the Whiz Kids, though in their hubris they believed so. Their ideas only appeared to shine brightly when compared with the utter inability of the military services to quantify their own objectives, or credibly dissect the methodology of the Whiz Kids. As one of McNamara's analysts succinctly explained their ideological dominance, "Other people had objectives, we had arithmetic."[20]

Rather than deal effectively with McNamara on his own terms, the uniformed military tended to dismiss all systems analysts and their civilian advocates, as the proverbial "pencil-necked geeks" who knew nothing of the equally proverbial "real world." This is aptly reflected in the condescending remarks made by Air

Force Chief of Staff General Thomas White in 1963 when he stated: "I am profoundly apprehensive of the pipe-smoking, tree-full-of-owls type of so-called professional defense intellectuals who have been brought into this nation's capital."[21] While this posturing might have done much for the military's collective sense of professional superiority, it did nothing substantively to answer the challenge posed by McNamara's organizational and budgetary expertise, or respond to the relentless mathematics of his Whiz Kids.

The McNamara juggernaut was never really stopped as much as it was first tamed and then exploited by the military services to enhance their own organizational and procurement objectives. By the late 1960s all of the Services had sent military officers to learn systems analysis as it was used in the corporate world, and then used this institutionally loyal talent to establish their own versions of DoD's Office of Systems Analysis.[22]

Beyond McNamara: The Current Experience With Privatization

There are numerous policy roads that steer the military toward privatization. A modified version of the "Thatcher approach" has the potential not only to diffuse the current consternation over privatization, but also to turn the uniformed military into enthusiastic supporters.

Early privatization initiatives should be selected and managed to provide quantifiable and palpable improvements in the status of the military, particularly in the quality of life provided for the rank and file. Privatization initiatives should be managed in the introductory phase, not to maximize financial savings, but to build a consensus inside the military that "denationalization" of support services leaves the armed forces better cared for than the status quo.

While the political leadership has asserted that it is pursing this objective, the reality on the ground has fallen short. First, the rewards of privatization have often been defined in promises of abstract future benefits that will accrue years from now. Even a rudimentary understanding of the Congressional appropriations process does not inspire confidence that savings generated now will be reliably returned to the Air Force in the form of additional F-22 aircraft or improved barracks in future years. For military members, the generalized benefits of privatization are tenuous and intangible promises of a distant nature. Furthermore, there is the gnawing (and well-placed) fear that promises of reinvesting savings from privatization made by today's political appointees and Congressional leaders are will-of-the-wisp and unenforceable; promises are easily swept aside and forgotten by new political leaders with far different budgetary priorities. In essence, the uniformed military is thus encouraged to surrender tangible manpower authorizations and organically owned property today, based upon unenforceable assurances that this virtuousness will be rewarded in future budgetary decisions. This is not a formula to inspire confidence among astute military leaders in the wisdom of voluntary privatization.

Second, the comprehensive privatization initiatives that have been undertaken to date have been the antithesis of the Thatcher strategy. Far from producing an immediate and tangible benefit for the uniformed military which will build support for future privatizations, they have tended to produce an immediate and tangible *decrease* (both perceived and real) in the level of support services. The leading count in this indictment is the outsourcing of medical care for dependents through the TRICARE program. For the vast majority of military members, their personal experience with privatization has nothing to do with depots or base closings. The decision to outsource medical care and the impact of this action on their families forms their template for judging privatization.

TRICARE has been castigated by a former Surgeon General of the Army as a breach of faith with military families that produced a "six year set back" in Army medicine.[23] It has been subjected to scathing, widespread criticisms by its intended beneficiaries,[24] and often found to be inferior to the former government-owned and operated military medical care facilities that were outsourced.[25] A recent General Accounting Office report warned that civilian physicians were becoming disillusioned with TRICARE because of its low compensation rates and unresponsive bureaucracy.[26] While a sound case can be made that these problems are attributable to the halfhearted and incomplete outsourcing of medical care that TRICARE represents, the argument is lost on the recipients of the program. The fundamental fact is that TRICARE remains the overarching personal experience most military members have with privatization. With this hard reality on the ground, is it any wonder that a broad cross-section of military society views privatization as a code word for decreased levels of support and inferior services?

The successful outsourcing of medical care could have been a fulcrum that enthusiastically levered military society away from its embrace of *New Deal* models of support services. Indeed, it could have been the Secretary of Defense's equivalent of what the British Telecom sale was for Thatcher: a successful watershed that created a ground swell of support for privatization. Instead, the dismal TRICARE experiment has served to reinforce the traditional view that only government-owned and operated support services are reliable.

Recommendations

The situation military leaders face today in the struggle over the scope of privatization is highly analogous to the one faced with McNamara. Indeed, it is essentially the same struggle, only fought over different objectives. Spearheading the drive for privatization are again political appointees guided by advisors with strong roots in the private sector.

The Defense Science Board Task Force that created the landmark study on military privatization was guided and led by masters of the private sector. The Chairman of the Task Force was Phil Odeen, President and Chief Executive Officer of BDM International. The Vice-Chairman was Mort Meyerson, President and Chief Executive Officer of Perot Systems Corporation. Once again, civilians from the private sector are defining the terms of the debate. Once again, the military operates at a double disadvantage. First, the senior political leadership who ultimately mold the DoD have found the gist of the arguments put forward by this new group of private-sector Whiz Kids very credible. Second, the military is at an institutional disadvantage in raising concerns or objections that are *credible within the framework of the debate*.

When presidents of major industrial and service corporations, people of immense business competence and unquestioned

patriotism, confidently state that specific parts of the military mission can be performed better, and for less cost, by private sector contractors and support their arguments with professional quantitative analysis, those arguments do (and in fairness should) carry great weight.

Senior military officers who have spent their lives focused on the art of operations, but have no experience at the executive level in the corporate world, are at an immediate disadvantage in this debate. Furthermore, counter-arguments that are not put in quantifiable terms, that are based on generalized philosophical premises of what parts of the support structure need to remain organic to ensure "reliability," tend to be viewed skeptically as smoke screens for the maintenance of bureaucratic empires and the emotional security of the status quo.

If a deployment tasking calls for 30 civil engineering troops, does the sole hapless installation commander who elected not to privatize this operation have his squadron deployed en masse to meet the tasking for the numbered Air Force?

The time has come for military officers to stop rowing against the tide and plunge into the world of privatization. The current ad hoc approach to privatization is largely predicated upon the Byzantine (and purely economic) requirements of the Office of Management and Budget (OMB) Circular A-76 cost comparisons. They are conducted by local commanders ill prepared to conduct the *quantitative analysis* this outsourcing requires, let alone determine how their installation-level privatizations impact the overall fabric of military support services. Ergo, if five of the six bases in a numbered Air Force elect to totally privatize their civil engineering squadrons based upon local budgetary determinations, how does this impact the deployment decisions of the numbered Air Force?

If a deployment tasking calls for 30 civil engineering troops, does the sole hapless installation commander who elected not to privatize this operation have his squadron deployed en masse to meet the tasking for the numbered Air Force? Do the five installations that privatized their civil engineering roll happily along during the contingency, secure in the knowledge their engineering support staff is "undeployable?" Ad hoc privatization conducted under OMB Circular A-76 rules for outsourcing does not provide a forum for even addressing such issues, let alone resolving them.

The uniformed military needs a vastly expanded pool of well-trained professionals dedicated to understanding and analyzing the world of privatization issues. To be effective, these military brain trusts *must* have true expertise in "real world" military operations, public sector privatization lessons learned, federal law and policy issues, as well as a thorough knowledge of commercial capabilities in the private sector. To the degree the officer corps studies and understands the corporate world, its knowledge and attention tends to focus on the massive, vertically integrated industries of a bygone age. This is understandable since those industrial behemoths most resemble the current structure of the DoD and have traditionally served as the most important suppliers; they are thus comfortably familiar. However, they are of marginal usefulness in understanding the challenges of privatization.

Rather than sending the best and brightest of the officer corps to intermediate and senior service schools, a more useful tack might be for a far greater percentage to attend institutions such as the Wharton School of Business, followed by internships with the "Wal-Marts" of the corporate world.

By Wal-Marts, I mean cutting-edge businesses whose success hinges on information management, outsourcing and a complex web of suppliers. When those officers returned to the military they would be far better prepared to utilize privatization where appropriate. Educating military/corporate interns would also give the military leadership the institutional firepower to answer credibly the challenge of today's civilian Pentagon Whiz Kids. Developing a robust institutional expertise in privatization would allow the military to coherently graft a new economic paradigm into its culture, while intelligently opposing conversion in areas where a thoughtful analysis establishes it would weaken the military.

The marching orders for this privatization corps should be to analyze each initiative on its *merits* for enhancing the quality of life and operational robustness of the military. Also crucial, senior leadership should cease the public commentary that we must privatize to find the money for new weapons. The unstated message in this justification is privatization does produce inferior support services, but we have no choice because of budgetary constraints. The implication here is senior leadership has placed hardware over people.[27] Defining the motivation for outsourcing as financing weapons poisons the social dynamics of privatization.

Conclusion

The struggle between McNamara and the officer corps, which has evolved to the current debate on privatization, is often cast as a contest between military and civilian values. While superficially true, this analysis misses the mark. A long historical view indicates the partisans of both groups represent two separate but equally honorable military philosophies.

McNamara and his proteges are the modern disciples of Jomini. Like this great Napoleonic strategist, they view warfare as a cold and precise science. To McNamara, and to Jomini, success goes to the leader with the greatest organizational skill in building and wielding a massed military force. It is warfare as the science of physics; the ability to concentrate energy and unleash it on an opponent.

The precise calculation of economic and logistical efficiencies are also integral to the Jominian model. During the Napoleonic era, as during the Cold War, the size of the military force a nation could raise and keep mobilized for years on end was critical in pursuing national objectives. When the maintenance and supply of large military formations are a permanent part of the environment, rather than a transitory situation, pursuing economic efficiency in a comprehensive and quantifiable manner becomes a national security imperative.

If the old adage that "war is too important to be left to the generals" holds a nugget of truth, it is also true that military privatization is too important to be left to civilian accountants.

The situational dynamics of the Cold War that motivated McNamara and his Whiz Kids were very Jominian, as were the solutions they attempted. While the international situation today is less foreboding for the United States, the relentlessly increasing budgetary restraints placed on the military drive the civilian leadership of the DoD into a new set of quantitative cost-versus-benefit analyses for every aspect of the military establishment. Indeed, the budgetary pressures for economic rationalization over robust operational readiness are, if anything, more intense now than they were in McNamara's time. With no hostile totalitarian super power menacing the interests of the US, the arguments of those who make their policy recommendations based upon cold mathematics are harder to resist.

At the other end of the philosophical spectrum, the American officer corps are, in the aggregate, disciples of Clausewitz. As such, they view warfare as ultimately a human attribute, an art that can never be completely quantified in a mathematical equation. The firm political support of the nation, flowing through the iron will of the commander energizes the force and cuts through the fog and friction of war. It is a philosophy that gives little credibility to those who would predict success or failure based upon the laws of physics or calculations of economic efficiency.

This is not a philosophical orientation that needs to be hedged or apologized for when articulated. How privatization affects the morale and self-confidence of the military is a profoundly germane issue, even if it is difficult to quantify. Members of the DoD who believe their service has little intrinsic value, that their quality of life, if not their very careers, hinge on the non-military economic calculations of endless A-76 outsourcing competitions, are unlikely to have the devotion to duty and willingness to sacrifice needed by a professional military with global responsibilities.

If support personnel, from flight surgeons to mechanics, are effectively told their services are needed only if they "cost out" at less than private sector equivalents, is it realistic to expect they will place "service before self" in assessing the loyalty they owe the DoD? Is it ethical to criticize them for making year-by-year calculations of the value of continued military service based purely upon economic considerations, rather than patriotic loyalty, when they know their employer judges them solely by an economic yardstick? If senior military leaders do not raise these considerations in the debate over privatization, rest assured that no one else will.

Truly great leaders borrow freely from both Jomini and Clausewitz, melding social sophistication with dispassionate science. The American military operates best when there is a balance between these two schools. During the periods when either camp gains absolute ideological dominance, as happened with Secretary McNamara in the 1960s, the military becomes a less balanced and, ultimately, a less effective force. This historical and cultural prism provides both the officer corps and the civilian political leadership the best focus for the unfolding debate on privatization. If the old adage that "war is too important to be left to the generals" holds a nugget of truth, it is also true that military privatization is too important to be left to civilian accountants.

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6. *Ibid*.
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8. "Escaping the Heavy Hand of the State," *The Economist*, 13 Jun 92, 73-74.
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18. Shapley, Deborah, *Promise and Power, the Life and Times of Robert McNamara*, Boston: Little, Brown & Company, 1993, 236-237.
19. For a laudatory review of Robert McNamara, his drive and energy to excel and the success of the systems analysis he utilized at the World Bank, *see*: Louis Galambos and David Milobosky, "Organizing and Reorganizing the World Bank, 1946-1972: A Comparative Perspective," *Harvard College Business History Review*, Vol. 69, 22 Jun 95, 156-229.
20. "Whiz Kids Rebound?" *The National Journal*, Vol. 21, No. 21, 11 Nov 89, 2741.
21. *Ibid*., 2742.
22. *Ibid*., 2741.
23. Willis, G. E., "Top Doc Hands off Troubled System," *Army Times*, 9 Sep 96, 4. (Interview with retiring Army Surgeon General Alcide LaNoue.)
24. Nesmith, Jeff, "Complaints Haunt Pentagon's Health Care Repair; Where are the Savings? And Where is the Service? Doctors, Patients and Politicians Slam Program," *Atlanta Constitution*, 1 Jan 98, 7A.
25. "Congress Told of Problems with Military's TRICARE Health Plan," Cox News Service, 1 May 98.
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28. It is not just the uniformed military who draw this inference, or question whether privatization really produces better services for personnel. Congressman Steve Buyer, Chairman of the House National Security Committee, recently stated "I find the DoD preoccupation with cost to be somewhat disingenuous. DoD witnesses have told us that TRICARE is saving billions of dollars in health care costs, yet apparently, none of those

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CAREER AND PERSO

The Air Force Assignment System

The Air Force is changing the current officer assignment system. The new system, known as the Air Force Assignment System (AFAS), debuts in early 1999. AFAS is designed to: (1) be more responsive to commanders in the field; and (2) retain necessary considerations for both career development and personal desires. The move to AFAS culminates the work of the Officer Assignment System (OAS) Review Group.

In December 1997, Air Force Chief of Staff Michael E. Ryan tasked a 17-member OAS Review Group, led by General John A. Shaud, USAF, Retired, to review the current officer assignment system in order to determine if its principles and processes were valid for today's Air Force. They concluded their work in February, and after a month of review, General Ryan announced the move to AFAS on 30 March 1998.

Under AFAS, changes will be seen in the following areas:

1. Commander Involvement. Under today's assignment process, a commander's involvement is only encouraged. With the move to AFAS, commanders at all levels will be guaranteed input into the assignment process. This will happen in two ways. The first avenue is via the Preference Worksheet (PW). A commander's review is mandatory and the PW cannot be submitted to the Air Force Personnel Center (AFPC) without it. The second avenue is through direct contact with the appropriate assignment team at AFPC. Assignment officers will continue to work closely with commanders in order to maintain a healthy balance between Air Force needs and individual preferences and development opportunities.

2. Personal Requirements Display (PRD). The PRD will no longer be used to advertise job openings or to volunteer for jobs. It becomes an information system displaying all potential job openings (including special duty) and those job requirements AFPC is working to fill in the next six to nine months. In order to ensure easy and widespread access, the PRD will be available via the World Wide Web (WWW).

3. Preference Worksheet. With AFAS, the PW is a key information tool. Submitted electronically, it tells the assignment teams at AFPC what an officer would like to do next and provides the current commander's views concerning future assignments. When the PW is filed, "checking the board" for new "assignments to pop up" becomes a thing of the past. AFPC will automatically consider assignment-eligible officers and the on-file PWs as requirements open up. Specific PW form details remain to be finalized; however, the form will allow listing multiple duty titles and assignment locations. It will also contain narrative blocks for both the people submitting the form and the current commander.

4. Role of the Officer Assignment Team (OAT). The gaining commander is no longer the sole "hiring" authority in the assignment process. Under AFAS, the OAT assumes a much greater role and is responsible and accountable for the assignment process. A career-field expert charged with educating and advising officers and commanders leads each OAT. The OAT is responsible for updating the PRD and is required to use an officer's PW in making future assignments. However, the information contained in the PW will not always guarantee a future assignment. Remote tours and other "hard to fill" assignments must still be satisfied.

AFAS retains the positive aspects of the current system and makes needed improvements. If you have any questions, a listing of logistics (including contracting) assignment officers is provided in the table below.

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Assignment Officer	AFSC	Area of Responsibility
Maj Michele Smith	21A	Joint and Air Staff
Maj Marc Novak	21A/M	AMC, USAFE and AFSPC Missil
Capt Ray Roessler	21A	AFMC, PACAF and AFSOC
Capt Dave Belz	21A	ACC and AETC
Maj Rick Sullivan	21G	Air Staff, ACC, AFMC, AFSOC a
Capt Ken Moore	21G	AETC, AMC, PACAF and AFSP
Capt James McClellan	21S	AETC, AFSPC, AFMC and AFS
Capt Ken Sampels	21S	ACC, USAFE, AMC, PACAF and
Capt Lilly Holt	21T	Company Grade Transportation O
Capt Ken Backes	21T	Field Grade Transportation Office
Capt Will Lorey	64P	All Contracting Officers

Learning From the ArmyLogistics Officer Training System

Captain Scott A. Vaughan, USAF

Benchmarking is a key quality term that has been around for years. However, it has only recently been used in Quality Air Force programs. It seems as if everyone keeps looking to other bases for ideas on how to do things better, smarter or faster. A few units have even gone so far as to look at what private industry is doing and use this as a benchmark, but what about the other Services? One would think they have certain concepts, ideas, processes or doctrine the Air Force could adopt to improve its own way of doing things. After all, we're all in business for the same reason.

This article discusses the Army's approach to training and developing company grade logistics officers. As an Air Force officer recently assigned to an Army post, I was surprised to find that while all "loggies" have the same overall goal—to sustain and support the full spectrum of military operations—the means by which logistics officers are prepared to meet this is quite different. The Army has a good system and there are some things the Air Force can learn from it.

Air Force Logistics Education

The Air Force instituted changes to logistics career paths so that all logistics officers start with a core Air Force Specialty Code (AFSC) as a lieutenant, become qualified in a second AFSC as a captain and become a fully qualified logistics officer as a major.[1] This means an officer with less than four years time in service (TIS) will have one AFSC and no official education in the other four logistics disciplines. An officer with four to ten years TIS will have two AFSCs, with formal education in both, but no formal education or training in the other three. It is not until the tenth or eleventh year of service the officer receives formal Air Force education in the remaining three disciplines and learns how all five interrelate by taking the Advanced Logistics Officer Course (ALOC), the logistics officer qualifying course. The officer will have gained some knowledge during his or her career, but there is no required education until the officer reaches the field grade level. Since the officer will have taken the qualification course for his core AFSC shortly after commissioning, the only required logistics education at the captain level is a bridge course for a second AFSC.[2]

The LOG X99 series of courses offered by the Air Force Institute of Technology does provide logistics education, but the courses are not mandatory professional military education requirements.[3] Additionally, LOG 399 and LOG 499 are not available until after the officer has been promoted to major. So, once again, little formal logistics education is available during the six years an officer spends as a captain.

The Army Way

The Army places a much greater emphasis on the early education of its logisticians. Newly commissioned officers are sent to an officer basic course (OBC) where they are trained in their Military Occupational Specialty (MOS, which equates to our AFSC). This basic course is similar to the initial Air Force courses in that it provides the basic technical and managerial knowledge the new officer will need in the field. After completing the OBC, an officer is sent to his or her first assignment. As a junior captain, the officer is sent back to school to attend an officer advanced course (OAC). In the past, each OAC was branch (infantry, armor, etc.) specific and gave the officer more in-depth knowledge, prepared him or her for company command and started the officer on the path to be a staff officer. However, the Army decided there is a better way.

Infantry-Armor Combined Advanced Course

Several years ago, an idea was formulated to combine the Infantry and Armor advanced courses. This allowed both branches to learn the tactics and concepts of the other, and it made sense because they operate and fight in the field together. The proposal sounds similar to the concepts of cross-functional training and "training how we fight." Although an Infantry-Armor Advanced Course never came to pass, the idea was picked up by personnel at the Combined Arms Support Command (CASCOM), the Army command responsible for retail logistics support issues. The leadership at CASCOM thought the idea could be applied to logistics, and in 1991, a task force was established to develop a combined advanced course.

The result of this developmental task force was a new course called the Combined Logistics Officer Advanced Course (CLOAC). CLOAC is a single course designed to give all Army logistics officers formal education in multifunctional logistics. The overall course is quite lengthy (20 weeks) and is divided into three phases. Additionally, at the end of CLOAC, all officers attend another six-week course called the Combined Arms and Services Staff School (CAS^3, pronounced "Cass-cubed"). Both of these courses are required for advancement beyond the company grade level.

CLOAC Phase I[4]

Phase I of CLOAC is conducted at the Army Logistics Management College, Fort Lee, Virginia. It is seven weeks long and is similar to the Air Force Squadron Officer School (SOS). The students are divided into groups of 12 to 16 students, and instruction is accomplished in both small groups and with the class as a whole. During this phase, the students are given blocks of instruction on leadership, command team training,[5] training management, military justice, unit logistics functions, military history, Army operations doctrine and communication skills. All of this training and instruction prepares the officer for eventual company command.

CLOAC Phase II[6]

At the end of Phase I, the students are separated by their MOS and they return to their branch school for advanced education in their core specialty. Quartermaster (supply) officers stay at Fort Lee; ordnance (maintenance) officers go to the Aberdeen Proving Ground, Maryland; ordnance (munitions) officers go to the Redstone Arsenal, Alabama; and transportation officers go to Fort Eustis, Virginia. Phase II lasts five weeks and the officers learn advanced concepts about their core specialty not taught at OBC. This phase gives them the opportunity to interact with contemporaries in their own MOS as well as gain "face time" with the senior leaders in their core specialty.

CLOAC Phase III[7]

For Phase III, the students return to Fort Lee for an additional eight weeks of instruction. Phase III is where the actual multifunctional logistics education takes place. During this phase, initial blocks of instruction include battlefield tactics, support of combat units and challenges of combat support. Students are then given formal instruction in all areas of logistics, to include: (1) fueling, fixing, moving and sustaining equipment and weapon systems; and (2) moving and sustaining soldiers. They are expected to work in teams, and the phase culminates in a staff exercise. During this exercise, the students prepare a logistics estimate and support plan for a brigade-sized force in Southwest Asia. The plan is presented to senior logisticians who have commanded an equivalent sized force.

The Combined Arms and Services Staff School

CAS^3 is actually a separate course from CLOAC[8]. Immediately after graduating from Phase III of CLOAC, students attend CAS^3. Since CAS^3 is taught at Fort Leavenworth, Kansas, the students attend the course in temporary duty status (TDY, Fort Lee to Fort Leavenworth). CAS^3 is the entry-level staff officer course where all officers (not just logisticians) improve their ability to analyze and solve problems, improve communication skills, learn to interact as staff members and expand their understanding of Army organizations and procedures in a combined arms environment. After completing CAS^3, the students are assigned to their next duty station.

When and How

Due to the length of the entire program (26 weeks), students receive permanent change of station (PCS) orders to Fort Lee. This increases the initial cost of training, but overall, it is more cost effective than other alternatives. Some savings result from less lost work time. Previously, the students would PCS for a 20-week OAC and later go TDY for nine weeks to CAS^3. During the nine-week TDY, units in the field were forced to have an officer assigned on paper, but he or she would be away at training. By incorporating CAS^3 at the end of CLOAC, officers return to a unit present for duty, without any further personal training requirements, for the length of their assignment.

Additional savings are generated in reduced infrastructure costs. The old OACs were 20 weeks long, so the schools at Fort Lee, Aberdeen Proving Ground, Redstone Arsenal and Fort Eustis were required to support the students while they were there. Now, since the students are assigned permanently to Fort Lee, the administrative functions, along with manning authorizations required at Aberdeen, Redstone and Fort Eustis, have decreased.[9] While authorizations at Fort Lee increased because of the additional workload, and a five-week TDY cost was incurred for CLOAC Phase II, the net result is a small cost savings to the system as a whole.[10]

Junior captains are the target audience of the course. However, in many cases, after an officer is commissioned, attends an OBC and completes a typical three-year assignment, he or she is promotable but has not yet pinned on captain. In this situation, the Army could either send the first lieutenant to CLOAC or to another operational assignment. If the officer is sent to a second assignment, he or she would most likely become a company commander and would not attend CLOAC until two or three years later. Since CLOAC is designed as a primer for company command, the Army opted to open the course to promotable first lieutenants.

Why a Single Course?

Before establishing CLOAC, the Army experimented with allowing each branch to teach multifunctional logistics in its OAC. Unfortunately, problems arose because the instructors at each OAC did not necessarily have the expertise to teach the other disciplines. Because of this, the decision was made to incorporate all of the OACs into a single course.

Since the four OACs were located at different bases, the natural choice was for one of those four to take charge of CLOAC. The problem, of course, was one of branch rivalry with no branch willing to hand over control of their officers to another branch. Fort Lee was chosen because it is the home of the Army Logistics Management College (ALMC), the Army Training and Doctine Command's multifunctional logistics school. Thus, CLOAC could be located at one of the four OAC bases, but none of the branches would have total control over it. To maintain political neutrality and impartiality in course development the course came under the control of ALMC; however, each branch still maintains functional control over the course content during the five weeks of Phase II.

Results

The results of this program have been outstanding.[11] Some of the first graduates of CLOAC are just now returning to ALMC to serve as instructors. These officers have nothing but good things to say about the knowledge they gained about multifunctional logistics. They already understood how things were supposed to be done in their specialty areas, but CLOAC gave them a perspective on why things needed to be done that way. More importantly, the course opened their eyes to the bigger picture of logistics and where their functional area fits in the support and sustainment equation.

The crux of the course is to get the students to understand the goal of logistics in general, and of logisticians in particular, is to sustain military operations (fuel, fix, move and sustain equipment and weapon systems; and move and sustain troops). They come away with the understanding that they as logisticians, rather than as supply, ordnance, or transportation specialists, must work together to provide the support which is needed to perform the mission.

What do the field commanders like about this course? With CAS^3 as a direct follow-on, their officers will not be away for school. A junior captain will have completed his or her education and can focus on the job when reporting to the second (or possibly third) duty assignment. The most important benefit of CLOAC is that the commander gets a company grade officer who is ready

for company command and understands multifunctional logistics much earlier than his or her predecessors.

Future of CLOAC

Fiscal Year 1999 brings some changes to the CLOAC program. First, the course will be renamed the Combined Logistics Captains Career Course (CLCCC). A second, and much more significant, change is the length of Phase I. It will be reduced from seven weeks to five, shortening the overall course length to 24 weeks. Finally, CAS^3 will cease to exist and will be known as CLCCC Phase IV.

Air Force Application

The Army's method facilitates an understanding of logistics as a whole much earlier in an Army officer's career than a comparable Air Force officer's career. They are thus probably better equipped to deal with support and sustainment issues. This may indicate a need for change in the formal education system for Air Force logistics officers. However, what is the best way to accomplish the change? A course such as CLOAC is probably out of the question. Air Force leaders are not likely to allow logistics officers to attend an Air Force version of CLOAC instead of Squadron Officer School (SOS). Funding for a PCS to attend a logistics school, in light of flat or declining budgets, also seems unlikely.

Given that all Air Force officers attend SOS (either in residence or by correspondence), Phase I of CLOAC and CAS^3 really aren't needed. The knowledge gained in them is important, but Air Force logistics officers will get the same knowledge from SOS. Having a separate "loggie only" school to teach them again would be a waste. If we have learned one thing from Quality Air Force, we should be eliminating duplication of effort, not creating it.

Phase II brings up some interesting considerations. Right now, only one career field, supply, has an advanced course, but it is like the Army advanced course in name only. The Air Force course focuses on student interactions with each other in order to increase knowledge of various systems and changes that are ahead. The Army course is much more structured and focused. For example, the students in the Quartermaster OAC are taught about wholesale logistics, including several blocks of instruction on depot distribution and item management. Further, the Army course is mandatory, the Air Force course is not. This is not to say that one or the other is better, only different.

The Army's experience could lead one to conclude the Air Force should implement required advanced schools for all logistics disciplines. But is that the right way for the Air Force? Phase II of the Army's advanced course is designed to increase the depth of their officers' core knowledge. However, the Air Force does not have the same goal for its company grade logistics officers (captains). They are expected to increase the breadth of their knowledge by cross-flowing to another logistics specialty. Implementing required advanced courses for all logistics disciplines may not be the way to go.

Phase III of CLOAC is roughly equivalent to the Air Force ALOC, but it is taught about seven years earlier in an officer's career. Perhaps this is the key to how we can benchmark from the Army and improve our own logistics education system. We could expand our multifunctional course, ALOC, and make it mandatory earlier in an officer's career.

The New ALOC

Air Force logistics officers are already expected to cross-flow into a second logistics discipline as captains and attend a bridge course in order to become qualified in this second area. This should be the point at which an expanded ALOC is taken. For example, once an officer is selected for cross-flow, he or she would attend the bridge course and also ALOC. To facilitate officers taking both, the courses could be called ALOC Phase I and II. Phase I would be the bridge course as it stands today, and it would still be taught by the instructors from the gaining AFSC at its current location. ALOC could still be taught at Lackland Air Force Base, Texas. The key difference would be that officers, upon completion of the bridge course, would transfer immediately into Phase II, the new ALOC. This new course would include all of the course content currently seen in the ALOC but would be expanded to include many of the same areas that are included in Phase III of the Army CLOAC. A logistics support exercise for the deployment of a provisional wing or Expeditionary Aerospace Force would be essential.

The requirements for award of the 21LX AFSC would remain the same: full qualification in two logistics AFSCs, completion of ALOC and promotion to major. Even though the ALOC would be completed earlier, we could wait until the officer is promoted to major before he or she is awarded the 21LX AFSC. This is similar to airmen who complete their career development courses but must wait for the appropriate grade before they are awarded the next skill level.

The Army has an effective system for training their logisticians and we need to learn from it. When we benchmark, we cannot overlook the obvious. We look at other Air Force bases because they operate like we do. We also look at civilian logisticians because they do similar things. But let's not forget our sister Services. The Army supports ground forces and the Navy supports sea forces, but their logisticians have the same goal that we have—sustaining and supporting the full spectrum of military operations.

Notes

1. Logistics specialty areas include logistics plans, supply, maintenance, transportation and contracting. The logistics officer career track which includes cross-flowing into a second specialty area applies to logistics plans, supply, maintenance and transportation officers. Contracting officers are not required to earn a second AFSC although they may if they desire.
2. Bridge courses are abbreviated courses which are required in order to cross-flow into a second logistics specialty area. An example is the Supply Operations Officer Crossflow Course, L30LR21S1000, offered at Lackland AFB, Texas. This course is approximately four weeks long (as opposed to the 14-week Supply Operations Officer Course) and an officer will earn the Supply AFSC upon completion.
3. The Professional Continuing Education program at the School of Systems and Logistics, Air Force Institute of Technology, Wright-Patterson AFB, Ohio, offers: LOG 199, Introduction to Logistics; LOG 299, Combat Logistics; LOG 399, Strategic Logistics Management; and LOG 499, Logistics Executive Development Course. These courses are open to all Services.
4. Numerous sources describe the three phases of CLOAC and CAS^3. Phases I and III: US Army Logistics Management College, *FY 98 Course Catalog*, 28. *DA PAM 351-4, US Army Formal Schools Catalog*. Johnson, LouAnne L., Captain, USA, "Preparing for CLOAC," *Army Logistician*, May-Jun 95, 36-37. "ALOG Digest—CLOAC Replaces Branch Courses," *Army Logistician*, Nov-Dec 93, 42. Personal interview with Paula McDonough, CLOAC Director of Operations.

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The War in the Persian Gulf

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Editor's Note: The following article is an edited version of the first part of Chapter 3 of The Logistics of Waging War, Volume 2, US Military Logistics, 1982-1993, The End of "Brute Force" Logistics, which was recently published by the Air Force Logistics Management Agency. This monograph chronicles logistics efforts and operations from 1982-1993 and examines the final chapters of what has been aptly called the era of "brute force" logistics. Volume 2 is available in hard copy through the Air Force Journal of Logistics or via the World Wide Web (http://www.il.hq.af.mil/aflma/lgj/lww2.html).

Overview

On 2 August 1990, Iraqi forces under the command of Iraqi president Saddam Hussein launched an all-out invasion of the neighboring country of Kuwait. At 0100 hours local time, divisions of the Iraqi Republican Guards crossed the Iraq-Kuwait border on two separate axes, moving rapidly southward toward Kuwait City in a classic blitzkrieg operation. The initial assault was coordinated with direct special forces attacks on Kuwait City, and helicopter and amphibious assaults against key points of tactical significance. The war in the Persian Gulf had begun.

When US forces were ordered to deploy to the Persian Gulf in August 1990, the challenges confronting logisticians were unparalleled since those experienced in World War II. A force exceeding that deployed in either Korea or Vietnam would be deployed half a world away during an exceedingly short span of time. The logistics pipeline (air segment) supporting the theater would span more than 8,500 nautical miles over an indirect, 17-hour flight from the US to the Middle East via Europe.[1]

Operations DESERT SHIELD and DESERT STORM would involve the largest contingency deployment of troops, supplies, and equipment ever undertaken by the United States military. Commencing on 7 August 1990, Operation DESERT SHIELD set in motion the opening deployment of US forces with elements of the 1st Tactical Fighter Wing from Langley AFB, Virginia, flying F-15Cs, initiating the US's forward presence in the crisis area. The primary intention of DESERT SHIELD was to protect Saudi Arabia and US vital interests in the area from the threat of expansion of Iraqi offensive operations beyond the borders of occupied Kuwait. Operation DESERT STORM would subsequently commence on 17 January 1991, with the unleashing of a massive, unparalleled air campaign, assaulting key Iraqi forces and installations with the eventual aim of forcing the complete withdrawal of Iraqi forces from Kuwaiti territory. The ground phase of operations began on 24 February 1991 and ended exactly 100 hours later in an Iraqi rout.

The scope of the logistics effort necessary to accomplish a Coalition victory in the Gulf War was massive. The US military moved a previously unprecedented volume of personnel and materiel across great distances to a geographically remote theater of operations and successfully employed these forces in the execution of a major military campaign. For the US military and, indeed, US foreign policy in general, there were many lessons and implications stemming from the many logistics successes. Recognition of shortcomings and obstacles encountered during both defensive and offensive operations also provides critical insight towards the conduct of future theater-specific crisis military actions. The massive effort necessary to equip, transport, receive, employ and sustain a force in excess of 500,000 US military personnel in the face of the geographic distance of the combat theater, the extraordinarily harsh environment in which

US troops board a military transport aircraft for deployment to Southwest Asia. Most troops would deploy via Civil Reserve Air Fleet (CRAF) aircraft vice military aircraft. (Official US Air Force photo)

personnel and equipment were required to operate and the absence of any major pre-existing US military forward presence or basing agreement, contributed significantly to the creation of a logistics challenge of phenomenal proportions.

Unique Challenges

Operations DESERT SHIELD and DESERT STORM would confront the US military with many unique, complex and wholly unexpected logistics challenges. For example, US Marines found themselves operating well inland with a line of supply stretching from the port of Al Jubail in Saudi Arabia, 250 miles across the desert, to Kuwait City. Army units also faced a long line of supply that resulted in a shortage of transportation equipment—trucks, trailers, vans, buses, forklifts and other special purpose vehicles. This situation was exacerbated by the continual arrival of additional units. Eventually shortfalls were alleviated through contracting for commercial support from the host nation(s), the arrival of additional transportation assets from the US, support from Coalition nations and donations from nations such as Japan. This heavy demand for vehicles and transportation capability, coupled with the extremely harsh climatic conditions in which equipment was operated, led to a higher than expected load on the forward supply system. Air Force units similarly discovered their demand for consumable items such as oil filters, tires and batteries was much higher than levels planned prior to deployment.

During the 43 days encompassing Operation DESERT STORM, Air Force fighter aircraft logged 34,038 sorties and in excess of 118,000 aggregate flying hours. There were 45,666 sorties flown transporting personnel, supplies and equipment within the theater of operations, and 17,331 strategic airlift missions were flown. Such high utilization levels generated a commensurate demand for reparable items and consumables.

Another unique aspect of Operations DESERT SHIELD and DESERT STORM that had a significant effect on logistics operations was the employment of certain equipment and weapons systems in roles and missions different from those for which the systems were originally designed. One of the more famous systems participating in the conflict and employed by the Army, the Patriot missile system, was designed to accommodate the threat of high performance aircraft and certain missile systems with non-ballistic trajectories. The system gained fame in its exclusive use against Iraqi SCUD missiles.

The Patriot system was also involved in the first deployment of US ground forces on Israeli soil as a part of Patriot batteries set up outside Tel Aviv. Similarly, the A-10 found itself servicing an expanded role beyond close air support by providing active battlefield air interdiction prior to the commencement of the US ground assault.

Still another unusual aspect of DESERT SHIELD and DESERT STORM operations stemmed from the unique social and cultural environment existing in Saudi Arabia and into which US personnel were deployed. For the Department of Defense (DoD), the challenge was not only to keep the troops in the field equipped and supplied, a daunting task in and of itself, but to do so within a framework of strict local customs stemming from the traditions and tenets of the Islamic faith. Some items, such as alcohol and non-Islamic religious items were banned outright by the Saudi Arabian government. Strict mores regarding materials

Patriot missile just after launch. This weapon system was successfully used to intercept SCUD missiles launched from Iraq. (Official US Air Force

US personnel discussing support with Saudi military commanders. (Official US Air Force

which Saudi censors deemed pornographic kept items such as *Sports Illustrated*'s annual swimsuit issue, sent to servicemen by the thousands by a well-meaning American public, out of the hands of US troops. In a similar vein, Saudi Arabian social beliefs regarding the role and place of women in society created a somewhat unique and challenging environment for the thousands of US servicewomen deployed in defense of a country that does not itself allow women to serve in its military in any capacity. These issues impacted the choices made in the execution of plans for the region. It also forced logisticians in general to be very flexible in adapting to unforeseen restrictions imposed by local custom.

Volume of Requirements

By the end of the ground war in late March 1991, US transportation forces accomplished the equivalent of moving all the people, vehicles and household goods of Oklahoma City halfway around the world to the Persian Gulf. That included approximately 547,000 passengers, approximately 2.9 million tons of equipment, 6.5 million tons of refined petroleum products and nearly a million tons of supplies.[2] This population was fed, housed, clothed, protected and entertained. There were 400,000 personnel eating three meals a day, seven days a week, amounting to 1.2 million meals per day, or 8.4 million meals per week.

Trucks and tanks assembled at a US port prior to being loaded onto transport ships. (Official US Air Force photo)

While the Saudi government supplied vast quantities of soft drinks, fresh fruit and potable water, the requirements on the US logistics system were immense from the start.[3]

During the first ten days after Operation DESERT SHIELD was announced, the Naval Supply Center at Norfolk, Virginia, requisitioned almost five million pounds of subsistence for deploying ships from the Defense Depot, Richmond, Virginia (DDRV). More than 120 truckloads were required to support the requisitions from DDRV, and this represented only the percentage of the Naval Supply Center's total requisitioned requirement supported by the Richmond Depot. [4] This surge in depot activity was representative of the massive total logistics effort required.

During a five-day period, 250 18-wheel tractor trailers full of equipment for deploying US Army units inundated Fort Stewart, Georgia. Another 128 truckloads of ammunition were also delivered. The port of Savannah, Georgia, was likewise deluged with an influx of armored, support and other vehicle types as units prepared for their deployment.[5]

In the first 30 days of Operation DESERT SHIELD, New Cumberland Army Depot, Pennsylvania, shipped more than 3,000 tons of repair parts, tool sets, and construction materials to Saudi Arabia via the port facilities in Baltimore, Maryland, and at Dover Air Force Base, Delaware. In contrast to the traditional European war scenario, where basic stockage items are already prepositioned in the theater, DESERT SHIELD involved sending troops to a theater with minimal in-place stocks and infrastructure.[6] The Army's Military Traffic Management Command (MTMC) routed over 83,000 passengers, 27,360 trucks, and 15,827 rail cars to US ports.[7]

During the first 30 days of DESERT SHIELD, Army depots throughout the US shipped more than 45,000 tons of support materiel to the Middle East. Another 6,000 tons of supplies were prepared for shipment and awaiting transport. According to Army Materiel Command officials, the initial loads included more than 30,000 tons of ammunition and explosives, 6,000 tons of major end items such as tanks and howitzers, and another 6,000 tons of repair parts. Another 3,000 tons consisted of clothing, construction and barrier materials and medical supplies.[8]

To comprehend the need for such a significant level of depot-type supply activity, one must realize that a modern military force operating in an austere theater generates a significant logistics "tail" in the form of its ongoing sustainment requirements. A typical armored division, with some 350 tanks, 200 Bradley Fighting Vehicles and 16,000 soldiers, may consume on a daily basis 5,000 tons of ammunition, 555,000 gallons of fuel, 300,000 gallons of water and 80,000 meals. In addition to the division's

fighting vehicles, nearly 1,000 cargo, fuel and ammunition trucks are required. Typically, the M1A1 main battle tank consumes between six and seven gallons of fuel per mile. An armored division can go about three to five days without external resupply; about 3,500 of its troops, or about one-quarter of the division, will have logistics responsibilities of some kind.[9]

Desert Environment

The climates of Iraq and Saudi Arabia are controlled by two of the great "weather engines" of Asia—the Great Indian Heat low pressure system year-round, and fast-moving Arctic cold fronts from the north in the winter.

From May through November, climatic conditions in the theater of operations were typified by high temperatures and a dust haze of varying intensity up to an altitude of several thousand feet. While the ever-present dust created problems for personnel and equipment alike, the chief hazards to military operations in the region during the summer months were towering mile-and-a-half high sandstorms—great rolling walls of red sand and dust propelled by gale force winds.[10] Average noonday temperatures above 110 degrees took a significant toll on personnel and equipment.[11]

US military aircraft were forced to operate under harsh climatic conditions during the Gulf War. A constant problem was the effect of sand on all major weapon systems. In this photo a C-130 kicks up a dust cloud while landing. (Official

December marked the start of the rainy season in the theater. Rain was present intermittently until approximately April, when summertime conditions again began to emerge. The rainy season is dominated by the presence of fast-moving Arctic fronts that cause considerable wind shear and extremely variable weather conditions. Coalition air operations throughout northern Saudi Arabia and Iraq were hampered by extended periods of fog, low ceilings, clouds and rain during this period. When conditions at friendly airfields were sufficient to support aircraft sorties, conditions at the target often obscured objectives and limited or eliminated both combat and reconnaissance opportunities.[12]

The desert environment with its fine, blowing sand and harsh temperatures was hard on both man and machines. The demand for air filters for vehicles and aircraft surpassed all expectations, as did the need for more frequent maintenance. Orders for oil filters and the variety of lubricants required to maintain a substantial mechanized force also exceeded expected demand. One newspaper quoted Army officials:

> The harsh environment and accelerated training pace is wearing out our parts much more quickly than expected. For example, most filters fail eight times faster; tires, five times. In general, the Army, based on past testing in desert conditions, has been buying parts three and a half times its normal rate for systems deployed in the region and it's proven to be pretty accurate.[13]

The time between overhauls of some Chinook helicopters fell from an average of 300 or more flying hours to about 50 due to dust. The combination of more sorties and fewer maintenance opportunities caused the asphalt-like paving surfaces on several of the flight decks of US aircraft carriers stationed in the region to wear thin prematurely.[14] Hoses and pumps were found to have an equally limited life in the desert environment. Also, high temperatures rapidly drained batteries and blew electric circuits. Resupplying less glamorous, but absolutely essential items, made up a substantial portion of the demand on defense depots and often necessitated emergency shipments to get these critical items to the field. As temperatures in the desert began to drop with the passage of the seasons, demands for other items such as long underwear, sleeping bags, field jackets and night desert camouflage coats soon materialized.[15]

US Army airborne troops wearing some of the equipment issued to US forces to protect them from the climatic conditions found in Southwest Asia. Note the goggles and cloth used for eye and face protection. (Official US Air Force photo)

Personnel were also exposed to the effects of the desert environment. Health hazards associated with the desert environment vary. Hazards which particularly worried military health officials were onchocerciasis ("river blindness"), bilharzia (schistosomiasis), malaria and strangely enough, rabies. River blindness was common in this theater and is caused when an individual is bitten by the black fly—an insect smaller than a common housefly that injects its larva into the bloodstream after which they migrate to the optic nerve and cause irreversible damage. Bilharzia, a form of schistosomiasis, is a liver parasite that annually kills tens of thousands. The flukes of this organism are found in surface waters and are known to penetrate the skin of the feet, legs, and hands and then migrate to the liver where they cause their damage. Two types of malaria, vivax and falciparum, increase in occurrence during the rainy season. Incidents of rabies also tend to become more prevalent with the

change of seasons with wild dogs and native fennec foxes serving as carriers.[16]

Under the desert climatic conditions of Southwest Asia, water, sanitation and food preparation techniques differed greatly from those practiced under a more often exercised defense-of-Europe warfighting scenario. Medical supplies and care were geared to hot weather and desert peculiar illnesses. The arid climate dictated a supply of specialized equipment: desert camouflage clothing, nets and flameless ration heaters. Equipment must be tuned and modified to operate more efficiently in the desert.

The threat of chemical and biological warfare by Iraq compelled another set of unique requirements: specialized equipment, chemical agent-resistant paint, mission oriented, protective posture (MOPP) gear and chemical agent detectors. Because crucial oil stocks were subject to attack, it was necessary to deploy equipment to build and repair pipelines.[17]

The troops in this photo are wearing standard protective chemical/biological equipment. This "gear" would be donned when the threat of chemical/ biological weapons use was present. (Official US Air

Overseas Deployment Requirements

In addition to the logistics requirements peculiar to a desert setting, there were also those requirements necessarry for any overseas deployment: equipment and services for port and airfield operations, personnel and equipment to plan and construct support facilities and depots, and second-destination transportation assets.[18] Because only limited stocks for the Army were prepositioned in the Middle East, most supply support items had to be shipped through channels originating in the United States and Europe.[19]

A Complete Team

While the military personnel involved in prosecuting the Gulf War received the bulk of public and media attention, they were a portion of the total force that made a successful US conclusion to the Gulf War possible. Civilian personnel almost exclusively staff defense depots, and the dedication of the work force was a critical factor in the successful deployment and sustainment of US troops. Another civilian force, the civilian transportation industry, played a key role in the deployment effort.[20] Industry executives estimated there were about 1,000 contractor personnel at air bases, on aircraft carriers and at other military facilities throughout the Gulf region. The primary role of these personnel was to assist military technicians in diagnosing and solving problems with weapons systems and in assessing and repairing battle damage.[21] Without significant contributions by government civilians, contractors and the hundreds and thousands of people working at plants and factories supplying everything from bottled water and desert camouflage uniforms to spare parts for the Abrahms main battle tank, the US's ability to successfully support a major military campaign in the Gulf region would have been jeopardized.

Host Nation Support

Saudi Arabian Support Critical

Regardless of the presence of culturally based restrictions on the activities of deployed US service personnel, Saudi Arabian support for its allies was generally superb and unqualified. As the host for the allied coalition arrayed against Saddam Hussein and his armies, Saudi Arabia provided extensive logistics support in the form of basic supplies such as food, water and fuel. In addition, many US personnel were billeted in quarters or commercial hotel space provided by the Saudi Arabian government. Such support was usually provided free of charge to the United States government. In addition to support provided by Saudi government organizations, many US units actively contracted for commercially available supplies such as tires, batteries and fuel pumps when these and similar items were not available through available DoD supply channels in a timely manner. Additional services such as transportation, sanitation and food service were also often contracted from host nation vendors.

Host Nation Facilities

While many US personnel found themselves bedding down in unimproved remote sites, and ultimately, large tent cities erected by deployed US personnel, troops billeted near large Saudi metropolitan areas were often housed in modern commercial military or civilian apartment complexes located nearby or on existing Saudi air bases. Such was the case for many US personnel deployed near Riyadh and King Kalid Military City. Other housing facilities supplied by the government of Saudi Arabia were often in the form of residential camps built to house foreign nationals employed in support of the Saudi Arabian petrochemical industry. Such facilities generally not only improved the quality of life for the personnel housed therein, but provided a ready means to rapidly billet incoming personnel while arrangements were made for their eventual beddown at forward operating locations.

Modern port facilities such as those at Al Jubail, which served as the primary debarkation point and theater supply depot for US Marine Corps forces in theater, provided adequate mooring capacity, warehousing, staging, and aggregation areas. Saudi ports were generally well served by modern highways and were usually only hampered by limitations in the number of large cranes and derricks available for unloading bulk and containerized cargo.

Units of the US Air Force were stationed at several Saudi air bases, many of which were built for contingency purposes, and

had never been used. Such facilities varied from installations complete with hangars, water and sanitation systems, living quarters and messing facilities, to more austere locations providing only a serviceable runway and little else.

For the forces deployed in support of Operations DESERT SHIELD and DESERT STORM, the range of conditions experienced varied from the austere to the luxurious. Logisticians were forced to account for the realities of desert warfare and the possibility of sustained operations in a chemical or biological environment. This meant many unique challenges had to be overcome to ensure protection of US personnel and equipment and ultimately provide the Coalition victory in the campaign to oust entrenched Iraqi forces from occupied Kuwaiti territory.

Local Saudi nationals were employed or supplied by Saudi Arabia to support US forces in a variety of ways. In this photo, Saudi dock laborers are helping berth a US aircraft carrier. They would also be used to unload and load US and Coalition ships. (Official US Air

Host Nation Contractors

To bolster the small contingent of dedicated logisticians and support personnel initially deployed to the theater, the military turned to local vendors, contracting for billions of dollars worth of rentals, services and equipment. Because of the urgent need to supply the daily throng of arriving troops, the military initially bypassed normal bidding procedures to purchase items as diverse as rice, Bedouin-style tents and lumber.[22]

During DESERT SHIELD, US military forces were initially poised for defensive military operations. Once President Bush directed US commanders to prepare their forces for possible offensive operations, logistics elements in the theater had to be rapidly expanded to accommodate the influx of up to another 200,000 military personnel. Military construction units expanded aircraft ramps and parking aprons, built maintenance hangars at airfields and ports and laid roads across the otherwise trekless desert. Clearing and preparing huge staging areas to hold arriving vehicles, containers, equipment and supplies effectively doubled port capacities. Traditionally, the "tooth-to-tail" ratio of combat troops to support troops has been roughly 1-to-3. For DESERT STORM, the ratio changed to something more like 1-to-5 due to the distances involved and the duration of the operation.[23]

Military support personnel were fortunate that the legacy of the oil boom left huge amounts of construction equipment and trucks that could be rented. Many locations needed alteration to accommodate the number and type of aircraft brought by Coalition forces. Additionally, the rental of fuel trucks and drivers was instrumental in the sweeping maneuver used by Coalition forces in the ground attack against Iraq.[24]

Multinational Force and Logistics Requirements

The largely multinational force deployed in the theater presented numerous logistics challenges in the areas of interoperability, identification of enemy combat equipment, food, maintenance, transportation and medical services. Additional concerns included: development and testing of equipment for desert warfare, stress-protective measures, desalination, host nation support, mobile power generation, chemical defense and decontamination and communications for command and control.[25]

Heavy construction equipment of the type was used by US forces in Southwest Asia. Military construction units performed a variety of construction tasks. (Official US Air Force photo)

Sealift

Dedicated airlift and fast sealift efforts indicate that the US military has some formidable capabilities in meeting its quick mobility needs. However, it took the full-time commitment of 90 percent of the C-5 fleet and 80 percent of the C-141 fleet to transport just 15 percent of the dry cargo moved during this effort. Eighty-five percent of the dry cargo was moved by sealift. Sealift picked up the burden of moving heavy equipment and materiel to the Gulf, but for the most part, it was too slow. Fast sealift was the exception. These oversized, roll-on/roll-off vessels were able to get heavy weapons and equipment to the Gulf in half the time (two versus four weeks) that it took conventional vessels. In fact, when the first two fast sealift ships arrived in Saudi Arabia, they carried more tonnage than the entire airlift up to that point.[26]

Other than airlift and fast sealift, moving war supplies by ships was a long and tedious process requiring at least a month or more to complete. Only 12 of the 44 Ready Reserve ships could be activated in the specified five-day period.[27] In fact, many of the ships used to accomplish this function were so old that it was hard to find crews to operate their steam turbines. In one case, an 80-year-old seaman came out of retirement to help.[28]

Although the US force projection strategy calls for the ability to move out quickly, DESERT SHIELD clearly showed just how many weaknesses the US military has in this area. As General

Military vehicles are driven directly into the hull of a transport ship. Sealift is critical to the movement of the heavy equipment which supports all major US ground force elements. (Official US Air Force photo)

Gray noted, "Our forces must have the ability to get to areas of crisis quickly and by multiple means of deployment."[29] The Gulf War demonstrated that the United States currently does not have enough airlift and fast sealift forces to, as Confederate Army General Nathan Bedford Forrest said, "get there the 'firstust' with the 'mostest,'" unless it has considerable time to assemble forces, equipment and supplies.[30]

US Navy ships during the Gulf War were pressed into service to perform tasks for which they were not designed. In this photo a Navy "gray bottom" is being used to ferry trucks to the Gulf. This type of ship is normally used as a helicopter carrier. (Official US Air Force photo)

One of the clearest lessons of the Gulf War is that the US cannot rely on airlift and fast sealift alone to support its mobility plans. Even though the US staged the largest airlift of troops and equipment in history, it was still too slow. "If the situation had been slightly different and Iraq had attacked the 82nd Airborne soon after deployment, these light rapid deployment forces would have served as little more than a "speed bump" for the then-massed Iraqi Army."[31]

Despite their superior numbers and armor, the Iraqi forces chose not to attack. Instead, the US had six months to build-up and prepare to take the offensive. It is unclear how the US logistics community would have responded if combat operations had started in August instead of six months later. General Schwarzkopf noted later that in the event of an attack, the only option US forces would have had was to "pull back to an enclave on the coast and hope we could either reinforce them or get them out."[32]

The comprehensive mobilization, build-up, and sustainment of this conflict showed that the US military has tremendous capabilities—once it gets them in place. However, it lacks the strategic lift resources to mobilize and deploy at the speed that it would like. It is also unlikely the DoD will get considerably more strategic lift resources to make up for this shortfall. So the

question becomes what can be done to reduce our reliance on strategic lift resources.[33]

Various sources chronicled three major ways the strain on the overburdened lift system was reduced. Prepositioned supplies, highly accurate and reliable weapon systems and contracts let within the theater all took some strain off strategic airlift and fast sealift.

Airlift

Over the course of the first five weeks of DESERT SHIELD, the tactical air power assembled in the Gulf region, comprised of USAF, USN and USMC squadrons, would exceed more than 400 combat and 250 support aircraft, a force roughly equivalent to the force deployed in Europe during the Cold War. Each 24-plane fighter squadron that deployed required the equivalent of 20 C-141 airlift cargo loads of over 70,000 pounds each to support their initial deployment and operating capability.[34]

During the first 12 days of the deployment, Military Airlift Command (MAC) delivered 19,000 tons of cargo to the theater of operations, including three tactical fighter wings and most of the 82nd Airborne Division. When DESERT STORM ended on 28 February 1991, strategic airlift had conducted approximately 15,800 missions and transported over 501,000 passengers and 544,000 tons of cargo to the Middle East.[35] As the network news so aptly illustrated, air assets were extremely limited throughout the deployment. In what became a somewhat routine camera shot of a busy Saudi Arabian flight line, Federal Express and Burlington Air Express aircraft were shown side by side with Air Force C-5s and C-141s.[36]

C-5s from the Military Airlift Command (MAC) were used to transport outsized and oversized cargo to the Gulf. While most heavy unit equipment was moved via sealift, MAC airlift moved heavy equipment to support early deploying units such as the 82nd Airborne Division. (Official US Air Force photo)

Desert Express

For the majority of items requisitioned by forces deployed in the theater, at least ten days was required for the order to make its way through the supply system from the United States to the end user in Saudi Arabia. Because of the congestion at the aerial ports and the fact that ten days was too long to wait for mission critical items, a daily Desert Express cargo service was initiated. With C-141s operating between Charleston AFB, South Carolina, and eastern Saudi Arabia, Desert Express reduced the time from the moment an order was placed to the time the needed item arrived in Saudi Arabia to as little as 72 hours.[37] Once the cargo was uploaded, the Desert Express service could put a package or pallet of high priority materiel in Saudi Arabia in as little as 16 hours and 15 minutes after takeoff from the US.[38] However, the daily flight did not carry a great deal of tonnage, less than 40,000 pounds per flight. The biggest users of Desert Express were Air Force and Army aviation units.[39]

Operating from 30 October 1990 to 31 May 1991, Desert Express flew more than 200 missions to the theater of operations.[40] In addition to Desert Express, on 7 December 1990, US Transportation Command (US TRANSCOM) established a European Desert Express. This daily flight, like its US-based counterpart, provided express service for high priority cargo from Europe to the Gulf. The European Desert Express flew 92 missions before it ended operations on 31 March 1991.[41]

Figure 1. Major DESERT SHIELD and DESERT STORM Aerial Ports of Debarkation (APOD)

Each Desert Express shipment was carefully monitored to prevent abuse of the priority system. Items being shipped had to meet the criteria for priority treatment, otherwise they were diverted to the regular airlift stream.[42] Once airborne, there was only a single, 1¼-hour stop at a staging base in Southern Europe. Upon arrival, it was not uncommon to see crews scurrying to the parking apron and begin stripping plastic wrap off pallets and sorting dozens of IBBs and GBBs—Itty Bitty Boxes and Great Big Boxes, in the parlance of the unloading teams.[43] Desert Express aircraft went to the head of the service queue while the aircraft's crew was swapped out with fresh personnel. A second aircrew and a backup aircraft were kept standing by in the event of a problem that would otherwise delay the mission. As few as 15 minutes were required to shift palletized loads from one aircraft to another when the need arose.[44]

Reliability of military airlifters averaged about 85 percent for the C-5 and 91 percent for the C-141 through November 1990. The only chronic problems peculiar to DESERT SHIELD were excessive stress on main landing gear struts associated with the

heavy loads and sand working its way into seals. Sand abrasion on pistons caused the seals to wear out prematurely, requiring repacking at staging bases on an accelerated schedule.[45]

Intratheater Airlift

Once in the theater, cargo was quickly transferred to the seven C-130s designated to fly short-haul Camel Express (cargo) or Star Route (personnel) flights to the various bases in the Persian Gulf Region.[46]

Cargo arriving in theater was broken down and distributed to holding areas maintained by each of the Services. Incoming personnel were likewise directed to one of three "circus tents" for processing and transportation to their units.[47]

Although several thousand C-141 sortie equivalent loads were transported to the area of operations, much of the equipment was centrally stored, and not efficiently distributed to its final destination.[48]

APOEs

The demand for air shipment direct to Saudi Arabia grew as more units arrived in the theater. Aerial Ports of Embarkation (APOE) such as Dover AFB, Delaware; McGuire AFB, New Jersey; and Charleston AFB, South Carolina, soon approached gridlock. Each Service operated an Airlift Clearance Authority (ACA) to control its allocation of theater-bound military airlift. Shipments from the depots were forwarded to the designated APOE for entry into the airlift allocation and prioritization system. Because of the overwhelming volume of air-eligible shipments, TRANSCOM established a fixed set of prioritization criteria to expedite the decision process. These criteria automatically downgraded a large volume of shipments to surface (sealift) mode.[49]

Figure 2. Major DESERT SHIELD and DESERT STORM En Route Locations

Figure 3. Intratheater C-130 Camel Routes

By October, the situation at the APOEs, while somewhat improved, still found the APOEs overwhelmed by more tonnage than they possibly could move quickly on available aircraft. Critical repair parts were not getting shipped quickly enough. Desert Express helped bypass the regular APOE backlogs. With Desert Express, each Service was allocated space for "the highest priority, not-mission-capable supply (NMCS)" items. Desert Express freight was restricted to repair parts and medical items only.[50]

Constraints

Several factors which adversely affected airlift operations were identified in a General Accounting Office study published in the aftermath of the Gulf War. These factors included the limited number of locations initially available in the theater of operations for strategic airlifters to unload cargo, the general failure on the part of the Services to regulate their requisitions for high priority airlift, insufficient cargo airlift capability to meet Central Command's requirements for sustainment cargo and Central Command's constant and rapid shifts in airlift priorities.[51]

During DESERT SHIELD and DESERT STORM there was a high incidence of poor discipline in the assignment of priority codes to non-priority cargo. Cargo coded "999" is recognized as the highest movement priority and is intended to consist of items such as medical supplies, critical spare parts or other items which may seriously degrade the mission if not delivered quickly. However, on numerous occasions the triple-9 code was assigned to large numbers of inappropriate items. As a result, the volume of high-priority items being placed in the airlift system overstressed the system's ability to accommodate the number of requests. As more and more priority-coded cargo jammed the system, items not coded as priority in many cases ceased moving. As units awaiting requisitioned items in Saudi Arabia grew

frustrated with the long delays experienced in receiving their orders, they exacerbated the situation by submitting new requisitions with a higher priority in an attempt to "game the system." The result was even more congestion at the ports. The priority system rapidly collapsed until, in essence, no priority system existed. Cargo was simply moved in a first-in, first-out procedure that left real priority shipments on an even par with less crucial items.[52] Many units failed to realize that not only is airlift a scarce asset, but it is tremendously expensive.[53]

Backlogs of cargo at the APOEs grew to staggering proportions. Military Airlift Command's (MAC's) ability to move cargo out of these bases did not exceed 1,300 tons per day during either DESERT SHIELD or DESERT STORM. Backlogs were at their worst in January 1991, when the APOEs found themselves saturated with over five times the amount of cargo MAC could accommodate.[54] As sustainment cargo backlogs began to swell significantly in January 1991, MAC's cargo airlift capability was insufficient to meet the movement requirements for sustainment cargo being levied on it by US Central Command. One factor in this shortfall worth noting is that even in a time of crisis such as the Gulf War, MAC still had to devote some organic airlift missions to support other critical operations. In addition, DoD was hesitant to activate additional Civil Reserve Air Fleet (CRAF) aircraft due to the potential adverse economic impact of such an action on US carriers.[55]

and good surfaces, the majority of these airfields lacked the necessary infrastructure such as refueling capabilities and the facilities required to support maintenance and aerial port personnel.[57]

Airlift Shortfalls

The rapidly changing nature of Central Command's requirements, in part as a result of the lack of a developed operational plan for conflict in the region, caused MAC to operate in a reactive mode to users' widely ranging airlift priorities. Instead of being able to anticipate its taskings, MAC found that any efforts to schedule its airflow more than a few days in advance were largely a waste of time and effort. These abrupt changes in airlift priorities and requirements also played havoc with the users. On more than one occasion, MAC was tasked to have C-141s at an aerial port to pick up a unit only to discover upon arrival of the aircraft that some or all of the scheduled unit's cargo was outsize and would require C-5s rather than C-141s to move. On occasion, airlift arrived at a base, but the unit for which the airlift was designated had not received orders to deploy. Under such circumstances, aircraft either moved what cargo was available or were diverted to other bases which had cargo ready to move.[58]

To alleviate the congestion at the aerial ports and the abuse of the priority system, Military Airlift Command initiated a

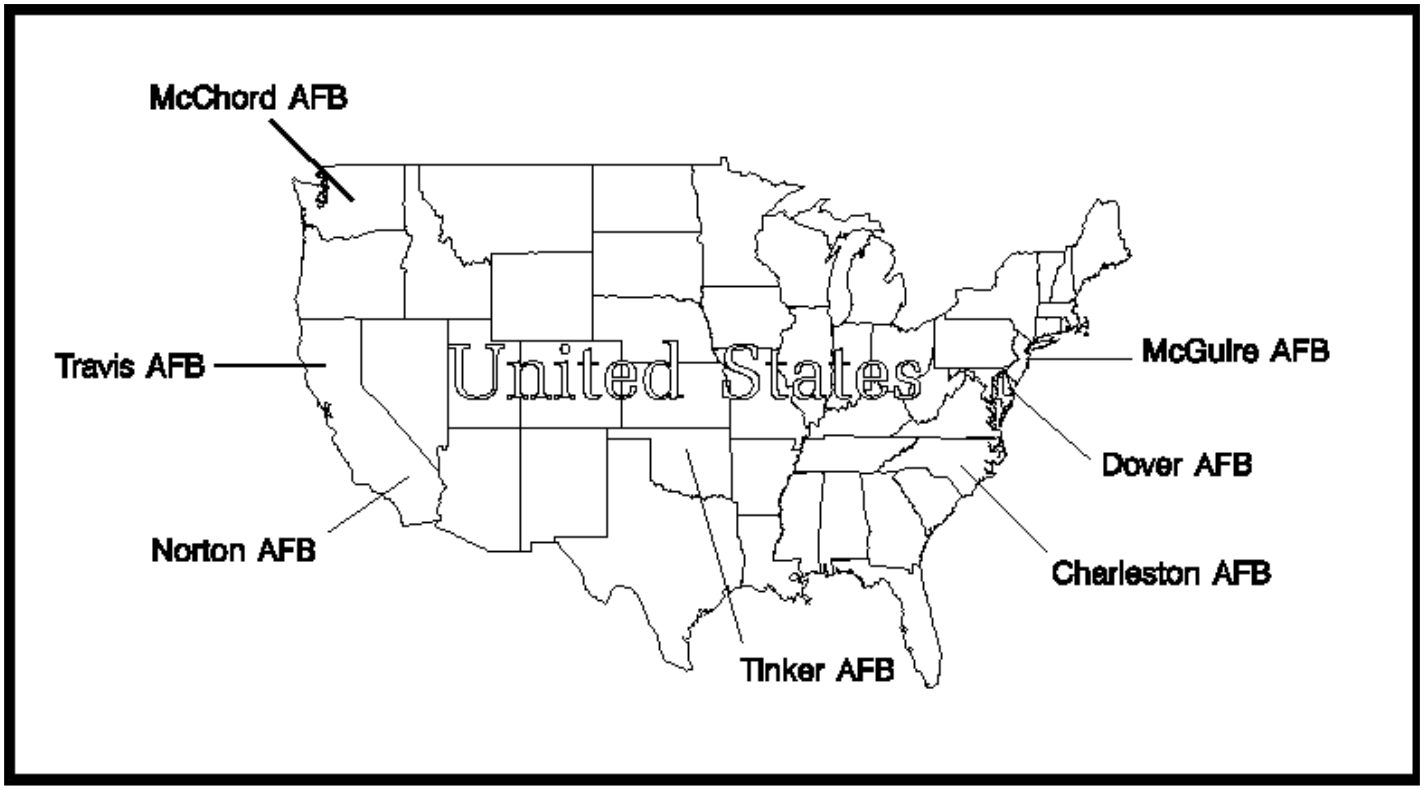

Figure 4. Major DESERT SHIELD/DESERT STORM Aerial Ports of Embarkation

Advanced planning for the region called for the utilization of at least 34 off-load locations in a DESERT SHIELD/DESERT STORM type of scenario. However, due to the physical and political restrictions that existed in the theater at the time, MAC was limited to no more than ten locations throughout the entire Gulf deployment.[56] While US airlift planners were pleased to recognize that Saudi Arabia has several sites with large runways

number of practices. Cargo teams were established at the two major APOEs, Dover AFB, Delaware, and Tinker AFB, Oklahoma, to prioritize cargo and divert non-priority items to sealift as appropriate. Each Service was given, and was limited to, a fixed airlift allocation for its sustainment cargo requirements. In addition, requests for airlift support were made to members of the North Atlantic Treaty Organization (NATO). As stated

Trucks and trailers are loaded onto transport aircraft. (Official US Air Force photo)

previously, the daily express cargo service Desert Express moved the highest priority cargo from the US to the theater of operations in minimum time.[59]

Initial allocations totaled 1,250 short tons per day. Later, this amount was raised to 1,600 short tons as the number of initial unit moves diminished and more airlift became available for sustainment operations.[60]

This system, while generally effective, was not without its problems. The Services' actual requirements for sustainment airlift still exceeded available capacity. The Army's allocation, for example, was usually fully allocated within the first three hours of the day. Once the allocation limit was reached, the Services' ACA could designate no additional cargo for air movement on that day. Units and shippers, frustrated by their inability to have their cargo scheduled for airlift, bypassed the established control procedures and forwarded their cargo directly to the aerial ports. Once cargo was at the ports, handling personnel and MAC had no way of actually determining whether cargo being prepared for airlift exceeded a given Service's allocation for a specific day. Thus, while the system helped somewhat, it was relatively easy for units and shippers to bypass the controls if they desired.[61]

User	Initial Allocation	Revised Allocation
Army	425	655
Air Force	190	240
Navy	105	175
Marine Corps	40	110
Defense Logistics Agency	40	5
European Command	150	215
Mail	300	200
Total	**1,250**	**1,600**

Table 1. Daily Cargo Allocations in Short

Civil Reserve Air Fleet (CRAF)

Operation DESERT SHIELD saw the first ever implementation of the CRAF. Commercial aircraft in CRAF Stage I and Stage II transported about 60 percent of the troops and 27 percent of the cargo airlifted to the Middle East.[62] Stage I of CRAF was activated on 17 August 1990. The primary airlift requirement at the time was to support the movement of troops. The activation made a total of 21 cargo and 17 passenger aircraft available to MAC.[63] This provided strategic lift capability that would not otherwise have been available and without which the US would have been unable to complete its force buildup in time to meet the United Nations' imposed deadline for Iraq to withdraw from Kuwait.

Stage III CRAF activation was briefly considered for a time in January 1991. However, it was believed that full activation of all of the reserve air fleet would severely disrupt the

commercial airline industry. As a result, Stage III of CRAF was never implemented.[64] The chief concern of airline managers was the loss of market share because of the diversion of aircraft to the military, particularly among cargo carriers as the holiday season approached.[65]

While, for the most part, implementation of CRAF was a success, several concerns about the fleet's use and role in future US crises arose. For example, a shortage of ground support equipment delayed delivery and unnecessarily lengthened aircraft utilization times at many locations.[66] In addition, many carriers were forced to operate for a time with no insurance for either their aircraft or their crews. Aircraft called up for use sometimes sat idle for days before they were utilized, but the carriers were only reimbursed for the time the aircraft was in flight, not the time it sat idle. Problems of this nature and others led to calls for an overhaul of the CRAF concept. No one is overly critical of the success of the system, but adjustments aimed at fairness and better flexibility are being implemented.

In the first phase, CRAF-activated civil transports operated 1,237 flights through 26 November 1990, at a total cost of $267.4M. These aircraft moved 126,451 passengers, approximately 60 percent of the total deployment, and 25,226 tons of cargo, about 20 percent of the total. Another 36 missions were flown as passenger and cargo mixed flights.[67] Through 26 November, 717 cargo missions and 432 passenger missions had been flown. Passenger missions averaged 292 passengers per flight, reflecting the heavy use of wide-body transports. Aircraft use ranged from as few as 10 per day to a high of 50 during Stage I of the activation.[68]

Approximately 1.67 billion ton miles were flown as of 27 November, far exceeding the 697.5 million ton miles accumulated during the Berlin Airlift. Stage II of the CRAF call-up involved 17 percent of the passenger capacity of the US fleet and 30 percent of its long-range cargo capacity.[69]

A Change of Plans

Military Airlift Command war plans at the time assumed that an in-theater crew recovery base would be available soon after the onset of operations. In fact, no such base was ever established, and this significantly impacted strategic airlift operations throughout Operations DESERT SHIELD and DESERT STORM. Such a base was deemed to be required because of the extreme distance of the theater from US and European recovery bases. Space and facility limitations at the debarkation aerial ports did not allow transiting strategic airlifters or their crews to remain overnight. As such, crews were forced to complete an extended Europe-theater-Europe flight during a single extended duty day of more than 16 hours. To accomplish this, more crewmembers and modified flight rules were required. In particular, the lack of an in-theater recovery base forced MAC to rely heavily on volunteer aircrews during the initial phases of DESERT SHIELD and to require an official Reserve call-up much sooner than anticipated.

US troops board a Civil Reserve Air Fleet (CRAF) aircraft for deployment to the Gulf. Operation DESERT SHIELD/DESERT STORM marked the first activation of the CRAF in history. CRAF aircraft played a major role in the deployment of US forces to the Gulf. (Official US Air Force photo)

An in-theater recovery base was a mainstay of MAC planning. Such a base would require adequate facilities for crews including sleeping quarters and meal service, and a substantial aircraft refueling capability of at least 1.5 million gallons per day. US Central Command decided not to provide a recovery base due to physical space limitations at facilities in the theater and the desire to use the available bases for fighter, bomber and tanker forces.[70]

In order to meet the overwhelming logistics requirements, MAC was forced to make changes to standard operations. Not only did MAC have to augment aircrews to a greater extent than planned, but certain flight rules had to be modified or relaxed as well. Flying hour limits were increased from 120 to 150 flying hours per 30 days. Crew duty hour limits of 16 hours for a basic crew and 24 hours for an augmented crew were raised to 20 and 29 hours respectively.[71] MAC was also forced to request similar waivers on behalf of the civilian aircrews and airlines supporting DESERT SHIELD and DESERT STORM under the auspices of the CRAF program and charter air operations.

During DESERT SHIELD, Air Force Reserve volunteers augmented regular Military Airlift Command crews from the onset of the operation, more than three weeks before the President formally initiated the call-up of reserve forces. Without these volunteers, MAC simply would not have had enough aircrews to perform the required missions during the first weeks of DESERT SHIELD. During the first few weeks, reservist volunteers flew 42 percent of all strategic airlift missions. Once formally activated, approximately 50 percent of MAC's aircrews and aerial port personnel were reservists.[72]

In-Country Distribution

Distributing supplies once they arrived in theater was a major logistics challenge. The road network in the region was never designed to handle the extensive volume of traffic generated by the force buildup and rail lines were virtually nonexistent. One Army source described the destribution problem as:

> The main reason that distribution is such a problem in the Gulf is that the dense infrastructure of roads, railways, airfields, ports, buildings and other structures do not, by and large, exist among the Gulf States. In large part, because their populations are fairly small in relation to the land area they cover, these countries have not developed many of these things.[73]

Fuel was one of the major resources requiring in theater distribution. The US Army estimates that one division of 350 M1 tanks consumes more than 600,000 gallons of fuel a day, nearly twice the consumption of General George S. Patton's entire 3rd Army in its 1944 drive across France. Transporting supplies to an armored division by truck required 98 5000-gallon tankers and 210 five-ton cargo trucks daily.[74] Thus, movement of materiel within the theater was in itself a major logistics effort. Ironically, advances in technology also increased the strain on logistics efforts because advanced night vision equipment enabled combat to continue around-the-clock. This meant distribution channels had to operate at full capacity 24 hours a day.[75]

The remainder of Chapter 3 will be printed in the Fall 1998 edition of the AFJL.

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Managing Transportation Priority 4 Shipments: A Success Story

Captain Carnell Cunningham, USAF

Transportation personnel assigned to the United Kingdom developed an aggressive program to manage excess space on Air Mobility Command (AMC) aircraft destined for the Continental United States (CONUS).[1] The Airlift Clearance Authority (ACA) allowed the Traffic Management Office (TMO) to flow all eligible cargo into the aerial port that would normally depart from the United Kingdom via a surface mode. Due to the large amount of opportune airlift that passes through RAF Mildenhall, this cargo didn't fully use all of the available pallet positions, so the personal property Central Booking Agency was asked to make up the difference with household goods shipments.

However, at the beginning of the year, Headquarters AMC rescinded a customer guarantee on shipment rates which caused us to take another really good look at how we managed Transportation Priority 4 (TP-4, routine) household goods shipments (HHG), commonly known as Code T. Up until the review, our program management was rather informal. Today, the process for movement of TP-4 shipments from RAF Mildenhall has been streamlined. During the review, we also identified more opportunities for cost avoidance, as well as the challenges associated with managing the program.

The problems associated with managing the flow starts with determining just how much airlift will be available to handle movement of household goods shipments. The height of a standard household goods container (87 inches) limits loading to specific airframes (for example, C-17, C-141, C-130, C-5 and B-747). The Tender of Service with the international household goods carriers limits the DoD to using Dover AFB as our east coast port of debarkation for HHG deliveries destined for the CONUS. The next step in the process is determining just how many pallet positions will be available for use. The aerial port commander determines this in collaboration with the ACA based on projected lift and cargo generation. There is a large amount of opportune lift passing through RAF Mildenhall. On average, from May through October 1997, 72 positions per week have been available to Dover AFB for all types of cargo. Actual positions available ranged from a high of 165 to a low of eight.

Gaining member satisfaction and ensuring a positive experience when moving household goods during a permanent change of station (PCS) is a tough challenge. The entire process starts with the time and care packers take assembling, packing, loading and delivering the household good crates to the aerial port. After a shipment arrives at the aerial port, it is palletized and stored outside in a cargo grid area until it can be airlifted to Dover AFB. AMC's policy requires covering unaccompanied baggage and TP-4 shipments with two plastic pallet covers and netting. Since England often has inclement weather, it is even more important for aerial port personnel to ensure the crates are properly protected from the elements. At RAF Mildenhall, TP-4 shipments are prepared with two new pallet covers underneath the nets and an additional pallet cover over the cargo nets during transshipment/storage. The additional pallet cover is removed just prior to loading the pallet on the aircraft.

A structured TP-4 program and method for forecasting tonnage allocation was developed over a four-month period. We compared the actual and forecasted flow of household goods versus the number of pallets in the backlog and the actual space utilized on departing missions. As a result of this data, a weekly tonnage allocation was provided to the property Central Booking Agency. The weekly TP-4 allocation was pre-cleared for airlift movement during the booking process, eliminating the need to send the details of each shipment to the ACA for individual approval.[2] From May through October 1997, the TP-4 allocation changed three times, ranging from a low of 25 short tons to a high of 50 short tons. The decision to change the allocation was based upon scheduled lift (if any), expected flow of other TP-4 cargo (which historically peaks in the summer time), actual space utilization and the number of pallets in the backlog. The goal was to achieve and maintain 100 percent pallet space utilization while minimizing the time household goods pallets have to sit awaiting airlift movement. To achieve this, a 50-pallet backlog was established.

Results

Between May through October 1997, we shipped 2.5 million pounds of household goods via the TP-4 method. Over the same period we utilized 93.7 percent of all available pallet positions that could accommodate household goods. If we had not used TP-4 shipments, we would have only utilized 47.5 percent of all available pallet positions. During the entire six-month period, only three out of 825 TP-4 pallets did not move within the 20-day standard established by AMC. All of these numbers sound very good, but the bottom line is we kept $625K within the DoD by paying AMC to move these shipments across the Atlantic rather than paying international personal property carriers to move the same cargo via ship. We did this by simply increasing our involvement in a valuable program that would have otherwise been taken for granted.

A full scale TP-4 program similar to the Mildenhall program might not be for everyone, considering current costs. During the May through October time span, cost avoidance was calculated at $25 per hundredweight which is the average amount the carriers charge to complete a TP-4 shipment. AMC has charged as much as $36.67 per hundredweight.[3] For this reason, we limited our shipment selection principally to Air Force sponsored

shipments and only selected shipments from the other Services when a true cost avoidance could be realized. Ideally, this happened when the delivery location is in the vicinity of the aerial port of debarkation.

All of these benefits would be for naught if the members' property arrived with water damage. The packers' care and the aerial port's efforts, as discussed earlier, paid off. The Central Booking Agency reviewed all the damage reports filed by the property owners and not a single one indicated any water damage.

Managing TP-4 shipments produced other dollar savings and some perceived benefits. Shipments moved on AMC aircraft received less damage (attributable to less handling and better preparation), and this resulted in fewer claims. There is also a customer perception (positive perception) that shipments move faster by air. Although in reality, transit times vary little between AMC and international personal property carriers.[4]

Because of these successes, we are currently expanding our TP-4 shipments to include property destined for Germany. We are being very careful not to include final destinations that require more than one flight within the AMC system. This is a restriction associated with all TP-4 shipments because we don't have oversight on cargo backlogs at other down-line en-route stations that could affect continued movement of the shipment. Having the shipment pulled and diverted back to surface mode due to high-priority, must-move-cargo, at a down-line station, would negate everyone's efforts and slow down the shipment.

A successful TP-4 program requires a lot of patience and thorough planning. However, once established, it can produce both a cost avoidance and dollar savings for the DoD by utilizing the unused space on AMC aircraft.

Notes

1. Department of Defense, 4500.32-R, *Vol I, MILSTAMP*, 15 Mar 87, and Department of Air Force, AFI 24-201, *Cargo Movement*, 1 Aug 96.
2. Department of Air Force, *Joint Travel Regulations Vol 1 and Joint Travel Regulations Vol 2*, Air Force Supplement, May 97.
3. AMC charged $36.67 per hundredweight to move these shipments from RAF Mildenhall to Dover AFB—the difference being the cost of new pallet covers. This is based on International Through Government Bill of Lading rates for the United Kingdom area.
4. Up to 1 January 1997, AMC would upgrade a TP-4 shipment to TP-2 status at no increased cost if it had not departed an aerial port 20 days after arrival. Current policies dictate that a TP-4 shipment that has sat for 20 days will be upgraded to TP-2 to move at the TP-2 rates or it will be diverted to another mode for movement. *See*: Air Mobility Command, AMCI 24-101, Vol 11, *Military Airlift – Cargo and Mail 29*, Mar 96. To upgrade the shipment to TP-2 and pay the TP-2 rates, Joint Personal Property Shipping Office – San Antonio's approval must be received for Air Force sponsored shipments. *See*: Department of Defense, 4500.34-R, *Personal Property Traffic Management Regulation*, Oct 91. AF/ILTT approval must be obtained to divert the shipment for surface movement. *See*: Department of Defense, *Airlift Rates for Passenger and Cargo/Mail*, FY 97. Other DoD components have different approval levels.

At the time of writing this article, Captain Cunningham was the Commander of the 100 Materiel Flight, RAF Mildenhall, England. He is an Aircraft and Munitions Maintenance Officer cross-flowed into transportation. *The author would like to thank Technical Sergeant Wilson, Chief United Kingdom Airlift Clearance Authority, and Staff Sergeant Ruff, Chief United Kingdom Central Booking Agency.*

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Have You Thought About—

The plan of embarking mules and men in the same ships, was in the first instance objected to on the ground that some ships were better able to carry mules than others, and that the comfort of the troops would be greater if all animals were placed in separate vessels; but this objection was overruled by the Commander-in-Chief, who stated that he was convinced by history, that the governing principle in preparing such expeditions, was so to embark the force that every portion of it should be able to disembark, completely equipped from the ship or ships conveying it. This, he stated, was absolutely necessary if the landing was likely to be opposed, and was the best means of preventing confusion and delay even if there were no opposition.

British Egyption Expedition, 1882.

To prepare for war in time of peace is impracticable to commercial representative nations, because the people in general will not give sufficient heed to military necessities, or to international problems to feel the pressure which induces readiness.

Mahan

In all war situations, the actions and decisions of command, whatever the level, are based on a blend of strategical, logistical and tactical plans.

Rear Admiral Henry E. Eccles

Commercial Travel Office Contract Policy

The revised Commercial Travel Office (CTO) Performance Work Statement (PWS) was released to the field on 30 June 1998 and will be used for all new CTO official and leisure travel solicitations. The PWS has been revised to account for problems identified in a contract bid protest. The revision actually resulted in two separate PWSs: one for official travel and one for leisure travel. The revised PWSs:

- Make a cleaner break between the official and leisure travel services.
- Describe a revised method of handling leisure travel in conjunction with official travel (the leisure contractor will handle this type of travel if the leisure and official contracts are awarded to different contractors).
- Mandate a new method for computing the Government discount that will tie the discount to the CTO's commission rate, instead of gross sales, and provide for automatic adjustments in the event of future CTO commission reductions.

These changes answer problems raised by the bid protest and should greatly reduce the likelihood of future protests. They also ensure concession fees paid by the leisure contractor can be deposited in the Morale, Welfare and Recreation Account.

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AFIT The D

Thesis Topics Needed

The Graduate School of Logistics and Acquisition Management (AFIT/LA) invites suggestions and topics for thesis research for the 1999 and 2000 Master of Science degree programs. Send your proposals to the Assistant Dean for Research and Consulting, Dr. David K. Vaughan, AFIT/LAC, 2950 P Street, Wright-Patterson AFB, Ohio 45433-7765, or by e-mail to dvaughan@afit.af.mil. Agencies that wish to sponsor a student's research are especially welcome.

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AFIT Welcomes New Students

In May 1998, 46 new students arrived at AFIT's Graduate School of Logistics and Acquisition Management (AFIT/LA). These students will graduate with masters degrees in their respective programs in September or December 1999, depending on the length of their program.

Program	*Students*
Acquisition Logistics Management	1
Contracting Management	7
Cost Analysis	8
Information Resource Management	11
Information Systems Management	1
Logistics Management	10
Software Systems	1
Supply Management	3
Systems Management	0
Transportation Management	4

AFIT and Latin American Allies

AFIT has a long tradition of hosting international students studying for a degree in logistics management, and as a result, the faculty is often invited to lecture in these countries on logistics issues. Recently, members of the AFIT faculty were invited by the Brazilian Air Force to participate in a logistics seminar offered by their Instituto de Logística da Aeronáutica in Sao Paulo. Several faculty members lectured on topics related to international logistics, modern logistics systems and reparable inventory management. Dr. Jan Muczyk, Dean of the Graduate School of Logistics and Acquisition Management, was also invited to speak at a meeting of the Brazilian Air Force's Logistics Command leadership on the topic of "The Changing Nature of External Threats, Economic and Political Imperatives and Seamless Logistics."

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The Tactical Versus Strategic Role of the C-17: An Analysis of Operation Joint Endeavor

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Introduction

The recent shift from a strategy emphasizing forward deployed forces to one of power projection for both war and military operations other than war is changing the Air Force logistics planning process. In contrast to the forward deployed force strategy, power projection relies far more heavily on strategic airlift and air mobility forces.[1] This new paradigm for future military operations was tested recently in Somalia, Rwanda, Bosnia and Haiti.

Presently, the Air Force and the Air Mobility Command (AMC), the Air Force command responsible for managing air mobility forces, face several important challenges. Strategic mobility has long been considered a weak link in the US military force structure. With the pending retirement of the C-5, C-141, and C-130 airlift aircraft, one key challenge is the doctrinal problem of how to properly amalgamate the C-17 aircraft in a force projection role. The critical question is: Should the aircraft be a strategic or a tactical airlifter, or can it fulfill a mixture of both strategic and tactical missions?

AMC doctrine for rapid mobility and force projection relies on aerial refueling of airlift aircraft, thus allowing aircraft to deliver cargo and personnel directly to the final destination in a theater of operations. However, such movements in contingencies prior to the introduction of the C-17 required improved airfields at the final destination. Without an improved airfield, an additional tactical (intratheater) movement to the strategic (intertheater) movement was required to reach the final destination. With the C-17, a seamless direct delivery sortie combining both strategic and tactical movements from the Continental United States (CONUS) to any unimproved airfield in the world is now possible.

The objective of this research was to determine the best method of employment for the C-17. To accomplish this, actual airlift movements for Operation JOINT ENDEAVOR were analyzed with a linear programming model. The model was designed to minimize the total cost of cargo movements by determining the number of C-17 and C-130 aircraft sorties required to deliver the actual amount of cargo moved during the operation. Results from this analysis were used to determine if a tactical, strategic or direct sortie mission was the best method of employment.

Background

Currently, the major portion of intratheater airlift is accomplished by C-130 aircraft. After cargo and personnel are transported to a theater of operations through strategic or intertheater movement, C-130 aircraft are traditionally used to deliver cargo and personnel to the final destination. The final destination can be, and often is, an austere location with an unimproved airfield.

During Operation JOINT ENDEAVOR, the C-17 blurred the traditional lines between theater and strategic airlift. This blurring stemmed from the C-17's capability to haul 180,000 pounds of cargo and land on either unimproved or improved airfields. Further, the aircraft was designed to haul outsize cargo, specifically the Army's M-1 tank, anywhere in the world. Consequently, the C-17 has the capability to provide a seamless direct delivery by combining both strategic and tactical movements.

In the direct delivery role, the C-17 provides efficient and rapid mobility to theater commanders. For instance, one C-17 can deliver 18 pallets of cargo directly to the final destination in theater. The alternative would rely on one C-17 to deliver cargo to the theater and then require three additional C-130 aircraft to deliver cargo to the final destination. In the latter case, aerial port operations would be required to download the C-17 and upload the C-130s, taking additional time for delivery of needed cargo. Additional storage space would also be required, creating possible congestion problems. By using C-17s for direct delivery, not only are workload and delivery time reduced, but the risk of losing and/or damaging cargo is lessened.

In past contingencies, moving personnel and materiel from the strategic transport mediums to the tactical mediums has been a slow and labor intensive process.[2] On the battlefield of the future, there will be an increase in efficiency, speed and lethality. The warfighter needs rapid support. The warfighting challenges are compounded by the need to respond to operations other than war such as natural and man-made disasters, humanitarian assistance and nation building. Time is often of the essence and the air mobility system needs to be flexible and responsive to both support and enhance the capability of the user.[3] "If the war fighter is to succeed, the airlift system must address the customers' needs and not expect the customers to sacrifice their capabilities for the sake of eliminating air mobility constraints."[4]

The lack of established bases for transshipment and the vulnerability of forward bases require airlift systems capable of providing direct delivery from the CONUS to the point of use or final destination without the availability of an established support infrastructure. Further, the US needs to field an airlift system that considers cost factors in determining the airlift platform and systems.[5]

Methodology

A linear programming model was developed to compare the costs of using the C-17 in a direct sortie role to the costs of using the traditional C-130 as the intratheater airlifter. The model was used to determine the best employment method for the C-17 by minimizing the total cost of transporting cargo from Ramstein Air Base, Germany, to Tuzla, Bosnia, during Operation JOINT ENDEAVOR. During this operation, cargo was shipped from the CONUS to Ramstein and then flown via theater airlift or driven to the final destination in Bosnia. Since the cost of transporting cargo from the CONUS to Ramstein was borne regardless of the employment method used, this study focused on the cost of transporting cargo within the theater. Thus, the model was used to determine the required number of C-17 and C-130 sorties to deliver actual cargo at the least cost within the theater.

Two different time periods during the operation were selected for analysis: December 1995 and February 1996. December 1995 was a surge period for the operation while February 1996 was a sustainment period for the operation. The total cargo amounts carried by C-130, C-17 and C-141 aircraft during the two time periods were used. We assumed that all cargo was palletized with each pallet weighing 5,000 pounds. The round trip flying time for the C-17 and C-141 was two hours, while the C-130 required three hours.

The model used 90,000 pounds of cargo for the C-17, 18 pallets at 5,000 pounds. The C-130 would carry 25,000 pounds or five pallets. The landing weight for the C-17 was 430,000 pounds (60,000 pounds of fuel). This value was within the weight limits established for Tuzla. No weight restrictions for C-130 operations at Tuzla were imposed. Aircraft operating costs per flying hour were $3,574 and $5,694 for the C-130 and C-17 respectively. All operating costs were calculated using Fiscal Year 1996 costs.

Two constraints were used in the model. First, since not all cargo was readily available to fully upload aircraft, the cargo load for each aircraft in the model was constrained by using the average actual weight transported by the aircraft during each month. Second, the model was constrained by using four C-17s and only flying two round trips or sorties per day. This simulated using the majority of aircraft in a strategic role, with only four in a tactical role for this operation. Most ground problems did not occur in Tuzla, since originally the plan had a C-17 arriving every hour for downloading.

The model was solved by minimizing the total cost of operating the aircraft and calculating the number of sorties per aircraft type needed to move the cargo for each month.

Results

As Table 1 shows, 295 sorties (239 C-130; 23 C-141; 33 C-17) were flown from Ramstein to Bosnia hauling 7,360,754 pounds of cargo during December 1995. Using the actual average weights for the month and adding the constraint of four C-17s flying twice a day, the model shows that only 89 C-17 sorties would be required, at a total cost of $1,013,782. The total cost savings would have been $2,145,978.

In February, there were 362 sorties (278 C-130; 40 C-141; 44 C-17) transporting 8,031,340 pounds of cargo. The model shows that only 142 C-17s sorties would be required at a total cost of $1,611,976. The total cost savings would have been $2,254,852.

Month	Sorties	Cost	Cargo (Pounds)	Savings
December				
Actual Employment				
C-130	239	$2,562,558	4,010,858	
C-141	23	$221,398	621,303	
C-17	33	$375,804	2,728,593	
Total	295	$3,159,760	7,360,754	
Direct Sortie Employment				
C-17	89	$1,013,782	7,360,754	$2,145,978
February				
Actual Employment				
C-130	278	$2,980,716	4,092,804	
C-141	40	$385,040	1,442,048	
C-17	44	$501,072	2,496,488	
Total	362	$3,866,828	8,031,340	
Direct Sortie Employment				
C-17	142	$1,611,976	8,031,340	$2,254,852

Table 1. Comparison of Methods

Conclusion

The objective of this research was to determine the best method of employment for the C-17. The results indicate the C-17, when used in a direct delivery role, can definitely produce savings and reduce delivery time. For the month of December, the model showed a cost savings of $2,145,978 and a requirement for only 89 missions instead of 295 missions if only the C-17 had been used. Assuming eight missions per day, the whole month's cargo could have been transported in 12 days. Since the operation was in a surge period during this time, the reduced delivery time may have been beneficial to the operation. During the month of February, a sustainment period in the operation, only 142 C-17 missions would have been required instead of 362 missions actually flown at a cost savings of $2,254,852. Consequently, less airlift aircraft would have been required to provide sustainment.

With the funding for airlift support coming from the supported commander, any savings a commander can realize in air mobility operations would be beneficial. In the two months analyzed in this study, the direct delivery method of employment for the C-17 could have saved $4,400,830. Further, the additional costs associated with downloading and uploading necessary for transshipping all cargo to the final destination could have been avoided.

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DTIC ’98 Annual Users Meeting and Training Conference

This year the Defense Technical Information Center (DTIC) is hosting its 25th Annual Users Meeting and Training Conference. The conference will be held at the DoubleTree Hotel, National Airport, 300 Army Navy Drive, Arlington, Virginia, from 2 – 5 November 1998. The agenda is packed full of exciting and relevant topics, and the exhibit room will feature vendor displays representing every aspect of Information Technology (IT).

“Maintaining the Information Edge” is the theme for the conference, and the sessions are geared to this topic. This year’s keynote speakers include: Lieutenant General David J. Kelley, Director, Defense Information Systems Agency; Carol Cini, Associate Director, US Government Printing Office; and Richard Luce, Director, Los Alamos Research Library. Mr. Louis Purnell, the luncheon speaker, will relate his exploits during World War II as a Tuskegee Airman.

The conference offers four days of varied training sessions that will enable DTIC users to collaborate on the latest IT topics. Presentations will address the most current issues affecting the research, development and acquisition communities. Not only will the conference sessions acquaint attendees with the latest policy and operational developments, they will also provide practical details on valuable and diverse domestic and foreign information resources, security issues, the World Wide Web, virtual libraries, video streaming and the storage and dissemination of electronic documents.

For more information, please contact Ms. Julia Foscue, the DTIC ’98 Conference Coordinator, at (703) 767-8236, DSN 284-8236, or e-mail at jfoscue@dtic.mil. Or, access the DTIC Homepage on the World Wide Web at http://www.dtic.mil

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Global Supply and Maintenance for the Berlin Airlift, 1948-1949[1]

Roger G. Miller, PhD

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

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

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

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

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

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

Major General William H. Tunner, Commander, Combined Airlift Task Force, is considered the father of modern airlift. (Official Air Force Photo)

Ultimately, Skymasters flew the narrow southern corridor at carefully controlled three-minute intervals, landed in Berlin at the same intervals and returned to their home bases through the center corridor around the clock, seven days a week. This rate, Tunner noted, "provided the ideal cadence of operation with the control equipment available at the time." He explained, "At three-minute intervals, this meant 480 landings at, say, Tempelhof, in a 24-hour period. Under ideal circumstances, this schedule could mean 1,440 landings daily at three air fields."[4] Tunner viewed the corridors between Western Germany and Berlin as a conveyor belt with aircraft spaced evenly along the route. All the aircraft moved at the same speed, executed their maneuvers at the same spot and followed the predetermined schedule to the second. Like a conveyor belt, the airlift could be slowed down or sped up as necessary, but it was relentless in its regimentation.[5]

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

Maintenance and Supply for the Airlift

An enormous logistical endeavor in its own right, the Berlin Airlift was made possible by a massive logistical effort that stretched from the flight lines at the airfields in Germany, through depots in Germany and England, to maintenance and supply facilities across the United States. The effectiveness of this system was critical to the success of the airlift. The most serious problem faced by the airlift, other than flying under inclement conditions, was the servicing and maintenance of the airplanes that performed the work.[6]

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

Maintaining the C–54s still presented serious problems. First, since the few Skymasters that had operated in Europe prior to the

Completed maintenance dock area for repair of C-54 aircraft engines, 20 September 1948. (Official Air Force Photo)

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

The limited inventory of C–54 parts Air Force-wide compounded the situation. There were simply too few parts to stock the supply pipeline and ensure a steady flow of parts so that they were immediately available when required. The shortage of parts in the pipeline system meant that standard practices, like delivery of parts by ship, were insufficient to maintain supply levels, and thousands of tons of parts, equipment and supplies had to be flown from the US to Europe.[9]

USAFE Letter 65-60, published on 19 August 1948, established basic supply and maintenance procedures for the Airlift Task Force (Provisional). Essentially, all common items of Air Force supply came from USAFE's primary supply facility, Erding Air Force Depot. Erding also maintained the necessary stocks to support depot-level maintenance for C–54 engine accessories, instruments, surfaces and electronic components. Task Force Headquarters designated Rhein-Main as the specialized supply depot for C–54 support, and directed it to establish a 60-day supply level for the big aircraft.

Oberpfaffenhofen Air Force Depot in Bavaria established electronics maintenance for radios and radars. When American units were based at two airfields in the British zone of occupation—operations began at Fassberg in August and at Celle in November 1948—they requisitioned C–54 parts from Rhein-Main. Finally, Erding supplied equipment for the initial installation of AN/ARC–3 radios in the C–54s. Replacement parts and spares for the radio came from Rhein-Main.[10]

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

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

Looking down the line of maintenance docks during night crew operations of the C-54 aircraft maintenance project at the Oberpfaffenhofen Air Force Depot. (Official Air Force Photo)

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

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

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

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

Field Maintenance

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

Maintenance at the field level was divided into three functions. First, each aircraft received a daily preflight check. Second, "turnaround" maintenance provided routine servicing when an aircraft landed. It also addressed pilot complaints. Third, maintenance personnel conducted routine checks at 50, 100 and

150 hours. To accomplish these checks, a squadron had 148 maintenance personnel assigned—often many less were on hand—divided into three shifts working 12 hours on and 24 hours off. Each shift, in turn, was further divided into three crews. An "alert crew," usually 12 to 16 men, carried out the preflight checks of the airframe, engines, landing gear, fluids and electrical systems. They also inspected the radio and radar systems. The alert crews also conducted turnaround maintenance. In this process, aircraft pilots notified the tower of any complaints or problems before they landed. If the problem was minor, the alert crew called for fuel, oil and another load and accomplished repairs on the flight line. If the work was beyond their capability, they turned the aircraft over to the appropriate crew that specialized in engines, electrical systems, hydraulics, radios, props or other systems.[17]

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

Inspection and maintenance of airlift planes at Oberpfaffenhofen Air Force Depot. (Official Air Force Photo)

200-Hour Inspections

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

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

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

In October, Airlift Task Force Headquarters increased the daily quota of aircraft from four to six and assigned Major Jules A. Prevost, a retired maintenance expert from Pan American Airlines recalled to active duty for 60 days, to Oberpfaffenhofen. Major Prevost established a "block system" that slightly increased production; however, at the same time, the depot began preparation to close down the 200-hour inspection program and transfer it to Burtonwood. In all, Oberpfaffenhofen completed 43 aircraft inspections in August, 108 in September, 137 in October and 96 in November. The last C–54 completed inspection at Oberpfaffenhofen on 22 November 1948.[22]

During World War II, Burtonwood served as one of the largest modification and repair centers in England. Reduced to a storage area for mothballed RAF bombers after the war, the facility had been allowed to deteriorate: roofs leaked, buildings sagged, equipment rusted and facilities decayed. A USAFE survey team went to England in August to inspect the installation, and by the end of the month, the Air Ministry had informally agreed to the establishment of the depot. The construction necessary for

reopening Burtonwood began on 1 September, and Colonel Paul B. Jackson, Director of Supply and Maintenance at Oberpfaffenhofen, transferred to the 303rd Air Repair Squadron at Burtonwood on 2 November. Oberpfaffenhofen also built 13 wooden maintenance docks and six wing docks and sent them to England. Oberpfaffenhofen also supplied experienced men who applied, in the enclosed hangars at Burtonwood, the methods and techniques established at the depot in Germany.[23]

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

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

1,000-Hour Inspections

Behind the Berlin Airlift stood the worldwide maintenance and supply capability of the United States and, in particular Air Materiel Command, headquartered at Wright-Patterson AFB, Ohio, with its system of depots at Sacramento, California; Ogden, Utah; San Antonio, Texas; Oklahoma City, Oklahoma; Mobile, Alabama; Middletown, Pennsylvania; and Warner Robins, Georgia. A steady stream of airplanes, engines and subsystems flowed in and out of the depots as the airlift grew. The depot at San Antonio overhauled Pratt & Whitney engines, while those at San Antonio, Middletown, Mobile and Sacramento reconditioned starters. Generators were reworked at Sacramento,

The Douglas C-54 Skymaster was the backbone of the Berlin Airlift. (Official Air Force Photo)

Ogden, Oklahoma City and Mobile, and propellers were overhauled and reworked at Sacramento, San Antonio and Warner Robins. San Antonio, Warner Robins and Sacramento overhauled communications equipment and all of the depots repaired instruments.[26]

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

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

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

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

Aftermath and an Epitaph

Statistics on the Berlin Airlift vary from source to source. The official USAFE summary of the airlift, *Berlin Airlift: A USAFE Summary*, provides perhaps the most complete and accurate data available. According to that source, the Berlin Airlift delivered a total of 2,325,509.6 tons of cargo to Berlin. Of this amount, Operation Vittles delivered a total of 1,783,572.7 tons, while Operation Plainfare delivered 541,936.9 tons. US deliveries included 1,421,118.8 of coal, 296,319.3 tons of food and 66,134 tons of miscellaneous cargo. British deliveries included 164,910.5 tons of coal, 240.386 tons of food and 136,640.4 tons of miscellaneous cargo. Among other commodities, the miscellaneous category included 92,282 tons of liquid fuels, mostly delivered by British civilian aircraft operating under contract. British civilian aircraft also delivered 146,980 tons of the cargo included in the British statistics. In terms of percentages, the US Air Force contributed 76.7 percent of the total tonnage, the Royal Air Force transported 17 percent, and the British civil airlift made up the difference with 6.3 percent.

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

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

The Berlin Crisis of 1948 was the West's first great victory of the Cold War and it had profound consequences. The Berlin blockade proved a disaster for Joseph Stalin and his foreign policies by providing graphic evidence of Soviet ruthlessness and inhumanity. Frightened by Soviet cynicism and brutality, Western Europe took a long close look at the "red menace" and turned to each other and the US for protection. Soviet policies drove these nations to seek safety within a unified defense system and the Berlin Crisis, thus, led directly to the creation of the North Atlantic Treaty Organization. Further, Soviet threats and pressure failed to prevent the establishment of a free and independent West Germany, and, in fact, accelerated the process. By mid-1949, the West Germans adopted a democratic constitution, proclaimed the Federal Republic of Germany and elected a free parliament.

For the US Air Force, the Berlin Airlift demonstrated the need to throw off the "milk-run" mentality of the airlines and earlier military air transport operations. Modern airlift required

professional organization and exceptional precision in all aspects of transportation, communications, maintenance, contracting and supply. Above all, the airlift validated the need for large transports designed specifically for use as military transpor. The Lockheed C–130 Hercules, Lockheed C–141 Starlifter, Lockheed C–5 Galaxy and McDonnell Douglas C–17 Globemaster III of today's Air Force are the direct descendants of the C–47s and C–54s of the Berlin Airlift and the lessons learned during that great endeavor.

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

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

Notes

1. Except where noted, the following narrative is based upon Roger G. Miller, *To Save a City: The Berlin Airlift, 1948-1949* (Washington, DC: Air Force History and Museums Program, 1998).
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3. William H. Tunner, *Over the Hump* (New York: Duell, Sloan, and Pearce, 1964. New Imprint. Washington, DC: Office of Air Force History), 174-75.
4. *Ibid*., 174.
5. Harrington, Daniel F., "Against All Odds," *American History Illustrated*, (Feb 82), 32.
6. Hist, "USAFE and the Berlin Airlift, 1948: Supply and Operational Aspects," (HQ USAFE, 1 Apr 49), 90-91, Box 809, Germany 381, Sec 5 to Sec 7, RG 341, National Archives (NA).
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8. Hist, "USAFE and the Berlin Airlift, 1948,", 121-23.
9. *Ibid*., 121-23.
10. USAFE Letter 65-60, subj: Supply and Maintenance Procedures for Air Lift Task Force (Prov), 19 Aug 48, atch. to Hist, "USAFE and the Berlin Airlift, 1948."
11. Hist, "USAFE and the Berlin Airlift, 1948," 111-12, 115.
12. *A Special Study of Operation Vittles* (Air Force Operations Magazine, Apr 49), 75-76; *Berlin Airlift: A USAFE Summary, 26 June 1948-30 September 1949* (HQ USAFE), 94-95.
13. Hist, "USAFE and the Berlin Airlift, 1948," 93-95.
14. *A Special Study of Operation Vittles*, 78.
15. *Berlin Airlift: A USAFE Study*, 95.
16. *Ibid*., 95.
17. *A Special Study of Operation Vittles*, 78-81.
18. *Ibid*.
19. Ltr, Major General William H. Tunner, Cmdr, Airlift Task Force (Prov), to Major General Laurence S. Kuter, Cmdr, MATS, 3 Aug 48, Berlin Airlift Files, History Office, Air Mobility Command.
20. Hist, "USAFE and the Berlin Airlift, 1948," 50-51, 63, 96-100; *A Special Study of Operation Vittles*, 86-88.
21. Hist, "USAFE and the Berlin Airlift, 1948," 96-100.
22. *Ibid*., 100-102.
23. Memo, Major General R.C. Lindsay, Deputy Director, Plans & Operations, subj: US Military Courses of Action with Respect to the Situation in Berlin, Aug 48, Box 177 "381 (8-20-43) Sec 17-19," Central Decimal File, 1948-50, RG 218, NA; Art, "200 Hour Maintenance—Burtonwood," *Task Force Times*, 8 Dec 48; *A Special Study of Operation Vittles*, 88.
24. *Berlin Airlift: A USAFE Summary*, 34.
25. *Ibid*., 94; Hist, "USAFE and the Berlin Airlift, 1948," 100-102.
26. *A Special Study of Operation Vittles*, 98-100.
27. *Ibid*., 101.
28. Ltr, Major General Laurence S. Kuter, Commander, MATS, to Major General William H. Tunner, 13 Aug 48, Berlin Airlift Files, History Office, Air Mobility Command; Rpt, subj: Summary of Operation "Vittles," 15 Dec 48, atch to Memo for Mr. Symington, subj: Status of Implementation of the NSC Recommendations for Augmenting the Berlin Airlift, 16 Dec 48, w/atch, Box 808 "Germany 381. Sec 2 to Sec 4," AF Plans-Project Decimal File, 1942-54, RG 341, NA.
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30. Hist, "USAFE and the Berlin Airlift, 1948," 88-90.
31. Jackson, Robert, *The Berlin Airlift* (Wellingborough, Northhamptonshire: Patrick Stephens, 1988), 9.

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Have You Thought About—

The history of war proves that nine out of ten times an army has been destroyed because its supply lines have been cut off . . . . We shall land at Inchon, and I shall crush them.

Douglas MacArthur

'That's the reason they're called lessons' the Gryphon remarked: 'because they lessen from day to day.'

Lewis Carroll, Alice's Adventures in Wonderland

Mobility is the true test of a supply system.

Captain Sir Basil Liddell Hart, Thoughts on War

(***The Political Economy of Privatization for the American Military*** continued from page 11)

savings are available to provide greater access to health care for retirees." *See*: Statement of Chairman Steve Buyer, Federal Document Clearing House Congressional Testimony, 30 Apr 98.

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(**CANDID VOICES** continued from page 15)

5. Command team training teaches the officer how to interact as a member of battle staff. In fact, during CAS[3], the officer may be the only logistician in his or her small group.
6. "Preparing for CLOAC," and "ALOG Digest—CLOAC Replaces Branch Courses."
7. *FY 98 Course Catalog*, 28.
8. *Command and General Staff College Circular 351-3, Chapter 2.*
9. Personal interview with Paula McDonough, CLOAC Director of Operations. The cost savings were used by the Training and Doctrine Command to justify implementing the program.
10. *Ibid.*
11. "Preparing for CLOAC," as Captain Johnson writes, "Combining the studies of five different Army branches creates a tremendous opportunity to gain a better understanding of what each branch really does. The experiences students share with their peers are something they will always remember, and they will remember those experiences more vividly than textbook answers."

Captain Vaughan is presently an Instructor of Logistics Management, and he teaches the Defense Distribution Management Course at the Army Logistics Management College, Fort Lee, Virginia. He would like to thank Paula McDonough, Director, CLOAC Operations; Janic Heretik of the Army Logistician; Lieutenant Colonel Don Murvin, USAF; and Tom Reichert.

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(***The War in the Persian Gulf*** continued from page 27)

47. *Ibid*.
48. "Operation Desert Shield: Logistics Considerations for Sustained Deployment," 8.
49. "Depot Operations Supporting Desert Shield," 20.
50. *Ibid*., 20.
51. *Air Mobility Command's Achievements and Lessons for the Future*, 18.
52. *Ibid*., 20.
53. "Depot Operations Supporting Desert Shield," 18.
54. *Air Mobility Command's Achievements and Lessons for the Future*, 18.
55. *Ibid*., 21.
56. *Ibid*., 19.
57. *Ibid*., 20.
58. *Air Mobility Command's Achievements and Lessons for the Future*, 22-24.
59. *Ibid*., 24.
60. *Ibid*., 25.
61. *Ibid*., 26.
62. *Ibid*., 16.
63. *Ibid*., 22.
64. *Ibid*.
65. Ott, James, "Desert Shield Deployment Tests CRAF's Viability," *Aviation Week and Space Technology*, 31-32, 10 Dec 90.
66. *Ibid*., 31.
67. *Ibid*., 32.
68. *Ibid*.
69. *Ibid*.
70. *Air Mobility Command's Achievements and Lessons for the Future*, 29.
71. *Ibid*., 33.
72. *Ibid*., 36-38.
73. "Depot Operations Supporting Desert Shield," 22.
74. "Operation Desert Shield: Logistics Considerations for Sustained Deployment," 9.
75. "Depot Operations Supporting Desert Shield," 23.

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(***The Tactical Versus Strategic Role of the C-17: An Analysis of Operation Joint Endeavor*** continued from page 32)

Vision 2025 has the premise that to project power we need capable forces at the right place and time. The ability to project forward from the US to anywhere in the world is clearly a requirement for the next century. As this study shows, the C-17 adds a new flexibility for power projection by having the capability to perform this mission with less cost and time if employed in a direct sortie role. Theater commanders must understand this capability and incorporate it into force deployment plans.

Notes

1. *Vision 2025*, Vol. 2, Chap. 4, Air University, Maxwell AFB AL. 1997, 6-7, 15.
2. *Ibid*., 6.
3. *Ibid*.
4. *Ibid*., 7.
5. *Ibid*., 15.

Major Hershman is presently the Chief of Air Operations, NATO, Headquarters North, Stavanger, Norway. Dr. Cunningham is presently the Professor of Logistics Management, Department of Graduate Logistics Management, Graduate School of Logistics and Acquisition Management, Air Force Institute of Technology, Wright-Patterson AFB, Ohio. Major Moore is an Assistant Professor of Logistics Management, also in the Department of Graduate Logistics Management.

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