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Global logistics Issues

EAF Support Challenges
Support Services Contractors
Logistics Crime

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Operational Logistics in NATO
War Stoppers and DLA's Warfighting Integration Team
Computing Wartime Strategic Airlift Spares Requirements
Air Force Research Laboratory Logistics Research

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Air Force Logistics Management Agency

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Operational Logistics in NATO

PETER SCHMITZ
COLONEL, GEA

MAJOR
JOHN RAUSCH

Logistics is traditionally an unglamorous and underappreciated activity. To generalise, when the battle is going well, the strategist and tactician are lionised; it is only when the tanks run out of gas that people go head-hunting for the logisticians.

Lieutenant General William G. Pagonis, USA (Retired)

Pagonis is right. The military logistician is merely working in the background; supporting is his business. Ideally, he is a military calculator, a planner, an organiser, and a supporter with operational knowledge. The demands on North Atlantic Treaty Organisation (NATO) logisticians, particularly after recent significant changes in strategy and structure, are tremendous. NATO's reluctant take-over of its augmented responsibility for logistics necessitates a pragmatic approach. Lessons learnt from the recent Kosovo air campaign underpin this demand.

The fundamental changes that both NATO strategy and organisation have undergone during the course of this decade make demands on alliance logisticians that amount to a quantum leap. Completely new challenges, both in terms of quality and quantity, have evolved, and by comparison, the past looks rather tranquil.

New Strategy

Until the end of the 1980s, operational logistics in NATO was clearly determined by the security situation in Central Europe. In all strategic and operational aspects, military planning was focused on the need for repelling a massive attack from the East directed against the depth of the Central European region. The principal requirement, within the scope of *forward defence, was to* develop a sustainable military reaction capability that could cope with short warning times. This capability required a large number of operational units stationed in the potential theatre of operations, as well as efficient reinforcement and mobilisation mechanisms.

The logistics preparations reflected this scenario: solid stockpiling required for actual defence operations, deliberate storage of equipment and critical supplies in the expected theatre of operations, proven reinforcement and mobilisation measures, and established logistics support channels to operations areas (called *stovepipes* in military terminology). These would have allowed operational readiness to be quickly stepped up to maximum combat power in times of crisis and war. Additionally, the nations providing troops were also responsible for their combat service support. At the time, this made sense considering the clear-cut allocation of geographical areas and the fact that logistics support channels were generally short.

Before 1990, NATO operational logistics was focused on Central Europe (Figure 1). The lines of communication were short (with the exception of strategic reinforcements from the United States and Canada), and logistics was a national responsibility.

The end of the Warsaw Pact marked a radical change in NATO's strategic concept. Surely, national defence and defence of the Alliance remain paramount and important tasks. However, the focus on operations in Central Europe became a past matter. Now any region in NATO's area of responsibility (augmented even by the territory of the three new NATO partners) must be looked upon as a potential theatre of operations. Accordingly, numerous contingency plans need to be prepared, taking into account different operational options, force structures, and combinations of contributed forces by NATO partners.

By adopting the new strategic concept, NATO declared its willingness to also accept mandates from international organisations (for example, the United Nations, Organisation for Security and Cooperation in Europe, and Western Europe Union) for carrying out peace support operations (PSO) outside the Alliance territory. The term PSO reflects a broad spectrum, from humanitarian missions up to peace

(Continued on Page 37)

EAF Support Cha

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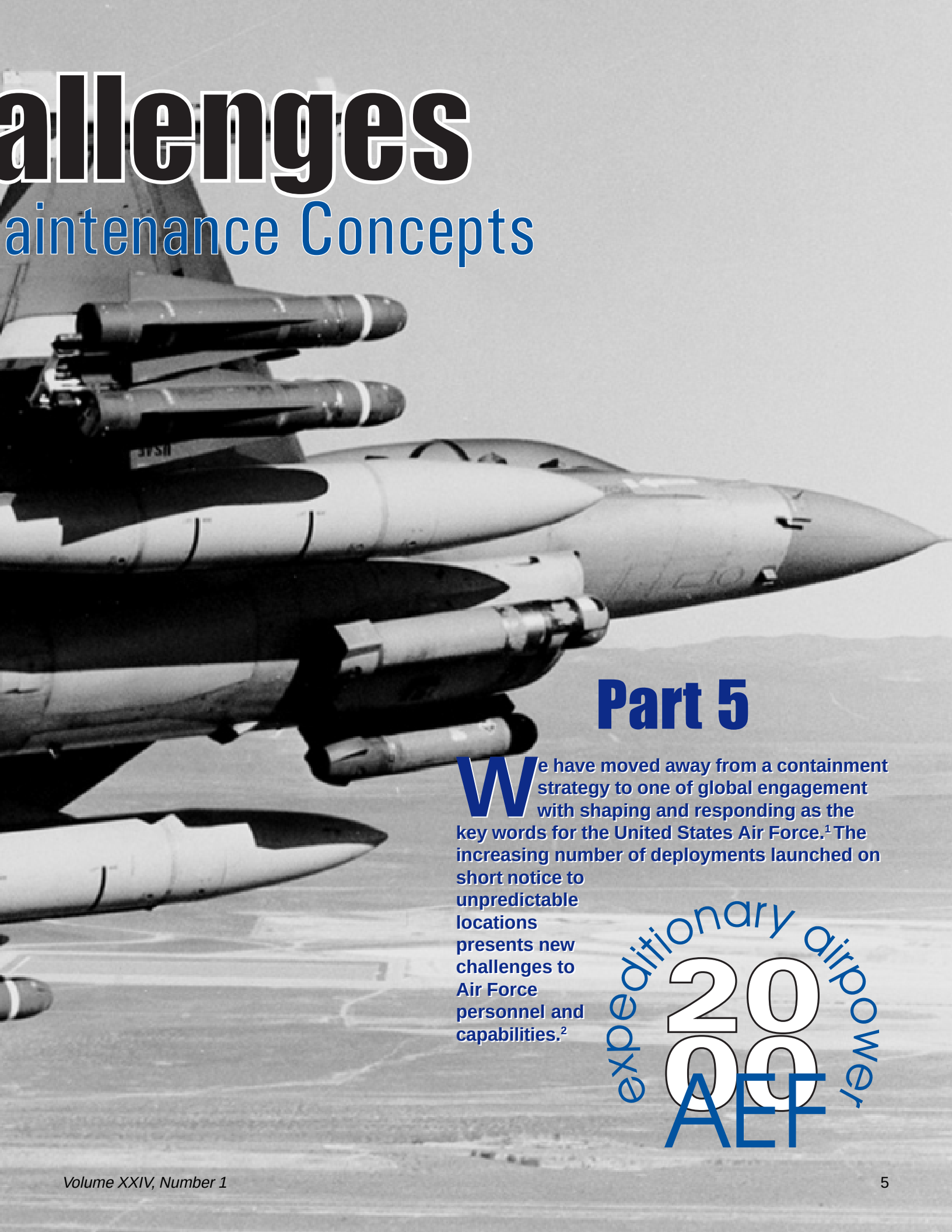
Amatzia Feinberg, RAND
Hyman L. Shulman, RAND
Louis W. Miller, RAND
Robert S. Tripp, RAND



allenges

aintenance Concepts

Part 5

We have moved away from a containment strategy to one of global engagement with shaping and responding as the key words for the United States Air Force.[1] The increasing number of deployments launched on short notice to unpredictable locations presents new challenges to Air Force personnel and capabilities.[2]

expeditionary airpower 2000 AEF

This paradigm shift presents new challenges to legacy support structures and the evolving Agile Combat Support (ACS) system. Support must spin up almost immediately to sustain operations, minimize airlift demands to increase deployment speed, and have the flexibility to respond to uncertain locations and mission requirements. Concurrently, cost pressures and the personnel implications of an expeditionary force have led the Air Force to reexamine the complete ACS system in order to understand how alternative structures, technologies, and methods affect capabilities.

This article specifically examines alternative low-altitude navigation targeting infrared for night (LANTIRN) intermediate maintenance operations and explores the implications of support equipment investments in conjunction with various logistics concepts. The LANTIRN system consists of two pods (navigation and targeting) employed by F-16s and F-15Es. The alternative support structure options range from the current decentralized practice of deploying intermediate maintenance with the fighting units to a network of consolidated (or even single) support locations. Support equipment upgrades, policies, and capabilities combine with these structure options to form a rich array of possibilities from which the Air Force may choose the best ACS system to meet uncertain scenarios.

Scenarios, Support Structures, and Equipment Upgrades Create the Trade Space

The Air Force currently maintains LANTIRN pods using a decentralized logistics structure, deploying full sets of testers from home operating bases to forward operating locations (FOL) with the aircraft. Other options rely on varying levels of consolidation. These range from using a single Continental United States (CONUS) support location (CSL) to using a CSL in network with two to four forward support locations (FSL). This analysis centers on the implications of various levels of consolidation chosen for the LANTIRN intermediate-level support operations relative to operational scenarios ranging from peacetime to two coincident major theater wars (MTW).

While structure decisions may focus on support locations, they should not do so exclusively. Adopting new procedures or technologies can affect how different support structures compare to each other in terms of capabilities and costs. While the Air Force does not plan on upgrading pod performance or purchasing additional LANTIRN pods, three investment options to upgrade the support equipment used to repair these pods—including zero investment, advanced deployment kit (ADK,) and midlife upgrade—were evaluated. The upgrades offer a reduced footprint and enhanced support equipment performance and reliability. The current intermediate-level LANTIRN mobility shelter set and proposed upgrades are shown in Figure 1.

During the study, expected warfighter capability levels relative to a range of deployment and transportation times were computed by combining scenarios, support structures, and investments. Additionally, system cost implications—in terms of equipment, spares, and infrastructure investments, as well as transportation and labor expenditures—over a 15-year time horizon, the expected life of the program, were assessed. Analysis showed that the decision to centralize or decentralize LANTIRN repair operations hinges not on the expected system costs but on the capability and risk levels the Air Force is willing to accommodate in its operational plans.

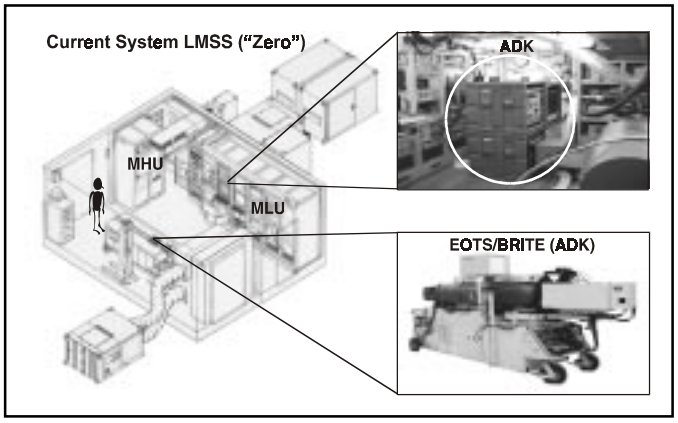


Figure 1. Current and Proposed LANTIRN Support Equipment

Analysis of the Fundamental Factor—Time

When weighing the implications of centralized or decentralized support, one must consider the deployment and inter/intratheater transportation times associated with each option. Whereas forecasting this time element for MTW scenarios is difficult, the expected capability levels relative to a range of both deployment and transportation times were assessed. Figure 2 illustrates the results of targeting pod analysis for a two-coincident MTW scenario. Only the targeting pods are shown since they are more mission essential and generate greater demands on the maintenance system.

Given the inherent pod inventory constraint, a pod availability goal was set for both engaged and nonengaged aircraft. Availability is defined as the number of serviceable pods available for use on aircraft for specific missions. Since the Air Force currently does not have a specific availability goal for LANTIRN pods on aircraft, a value (80 percent) somewhat higher than that used for the entire aircraft fully mission-capable rate was chosen.

Next, the expected pod availability for the nonengaged aircraft (trainers) was computed as a function of deployment or transportation time. Deployment time was defined as the number

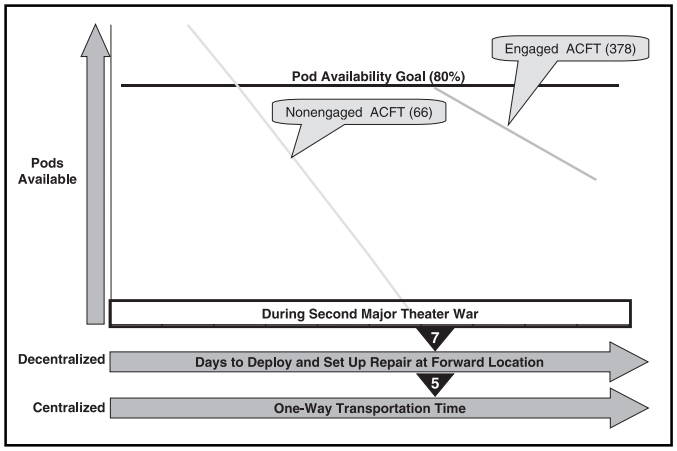


Figure 2. Expected Pod Availability Relative to Deployment or Transportation Time

of days it takes repair to set up functional operations at the forward operating location once surge missions begin, in other words, the number of days *after* flying begins when repair comes on line. If deployment takes longer than 7 days during the second MTW, there will be no pods available to fly training missions. Furthermore, if deployment times increase beyond this breakpoint, then the Air Force will risk degrading pod availability to the *engaged* aircraft.

The centralization options introduce a different time factor in the analysis. Now, transportation time (defined as order and ship time [OST]) becomes the critical system sensitivity. Since equipment and some people are prepositioned near areas of potential conflicts, deployed units must transport unserviceable pods to the regional repair operation. Again, the targeting pod availability was computed during the second MTW as a function of the one-way transportation time from an FOL to a regional repair facility. Here, the critical breakpoint is 5 days, beyond which *engaged* aircraft capabilities may degrade.

Structure Tradeoffs

Strategic and Operational Risks. While centralized operations may be more susceptible to terrorist attacks or may be located too far from yet unforeseen contingencies, the decentralized support structure is extremely sensitive to the availability of deployment airlift during the early phases of large-scale missions. Both structures may suffer if resupply times do not meet the performance assumptions used to set spare parts levels. Operationally, a decentralized structure is very sensitive to tester downtime. If a single set of testers is deployed, a breakdown by just one will temporarily eliminate repair capabilities. In a consolidated structure, the greatest operational risk is OST. The severity of the effects of subpar performance depends upon how actual resupply time differs from the assumptions used to plan readiness spares packages and pod kits for a specific deployment package.

Deployment Footprint. Among the goals of the Expeditionary Aerospace Force are (1) quick-hitting expeditionary operations and (2) deployment predictability to improve stability in the personal lives of Air Force personnel. These goals require rapid deployment of strong combat forces, putting a premium on reducing footprint or the amount of initial airlift space needed to transport operating materiel and combat equipment. While consolidation options may reduce the number of people needed in regional operations by up to 150, requiring smaller personnel deployments (under 60), the greatest footprint reduction is realized through the elimination of equipment movement. Conversely, decentralized support of a two-MTW contingency would require movement of 85 to 252 people and more than 180 equipment pallets, depending on upgrade investment.

Organizational Issues. Although the thrust of this analysis focuses on the quantitative issues associated with various logistics structures, one cannot overlook the less tangible cross-organizational implications of the dipole options space. Decentralized support requires that individual squadron or wing commanders compete for valuable airlift early in the campaign. This includes competing not only with other LANTIRN units but also with other commodities. As a result, mobilization plans may need to be modified to prioritize deployment time lines. While centralized support requires minimal tactical airlift (pods are relatively small), commanders would have to share a global asset pool. This pool includes not only personnel and repair equipment but also tactical transport and the pods themselves.

Support Option Advantages and Disadvantages

While the centralized option requires fewer test sets and fewer highly skilled personnel, the annual transportation costs may be higher. The analysis shows that these annual costs, coupled with labor expenses, are virtually the same across the seven options analyzed. So the recurring peacetime costs and, consequently, present value of *all* costs are essentially equal, as shown in Figure 3.

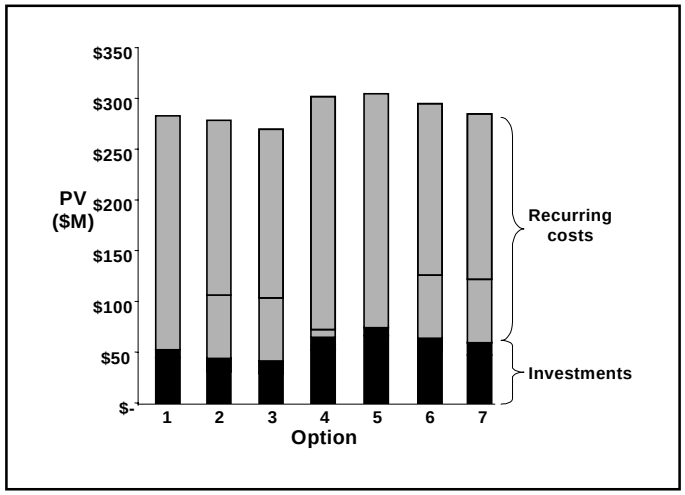


Figure 3. Present Value of Investment and Recurring Costs by Option

Another advantage of the regional support structure is the drastically reduced deployment footprint. Specifically, very few people need to deploy to support the two MTWs. Furthermore, since FSLs are removed from theater operations, both the support equipment and people face lower risks. Although regional operations may become more vulnerable to attack (both conventional and cyber), proper preparations and communications design can alleviate these threats.

Co-location of test equipment not only reduces the effects of single-string failures but also eliminates the need to transport repair equipment to support various contingencies. Since test set transport and setup times can be quite long and equipment readiness is unpredictable once it is unloaded in theater, the regional structure offers a much more stable support system. However, daily pod transportation risks increase with the consolidated options. Since pods must be moved off base for repair, the system's sensitivity to transportation delays is amplified. Pods will pass through additional transportation channels, and more people will be involved with the loading and unloading process. While there is no data indicating pod sensitivity to transport, rough handling in the new channels may become an issue in the proposed regional structure. Standardized training procedures and tools can mitigate this potential problem.

The analysis also shows that the decentralized structure requires greater support equipment investment, thus increasing

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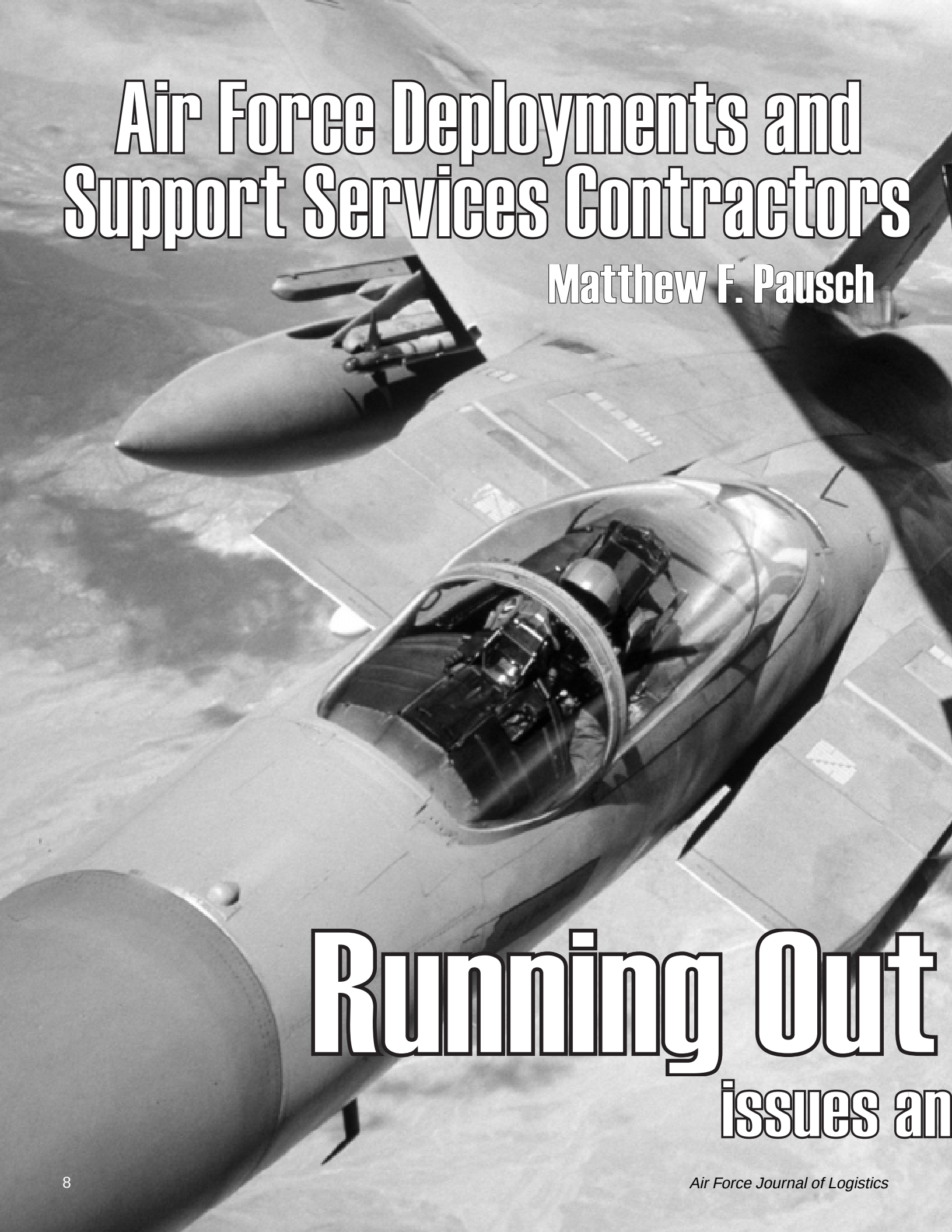
Air Force Deployments and Support Services Contractors

Matthew F. Pausch



Running Out

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The growth in use of contract services by the Air Force has become a matter of genuine concern . . . focused particularly on what missions and jobs the Air Force has, plans, or should perform with military and civilian personnel versus what missions and jobs have been, can, and should be performed by contract services.

General Curtis E. LeMay, Vice Chief of Staff
Letter to Deputy Chiefs of Staff, 6 October 1958

Concerns over the proper use of private sector contractors for military support services are not new. In fact, the US military has employed the private sector in these activities since the Revolutionary War.[1] Today, the Air Force faces major budget and personnel constraints and will continue to do so for the foreseeable future. The unwillingness of the American public or Congress to fund military programs at the levels requested by the Services makes maximizing current and future funding a top priority. One key tool for the Air Force in this continuing struggle is the use of competitive sourcing (CS). Under CS, functions not considered inherently governmental or core are competed with the private sector. The intent of this process is to reduce costs and improve efficiency.

Competitive Sourcing Concepts and Definitions

In 1996, the Defense Science Board Task Force defined outsourcing as "the transfer of a support function traditionally performed by an in-house organization to an outside provider."[2] This is in contrast to privatization, where facilities, equipment, and other government assets are usually transferred. Most of the actions taken in the support services arena examined herein involve competitive sourcing (the term used to describe both outsourcing and privatization) of existing activities or the use of the private sector to supplement existing military capabilities. According to *Office of Management (OMB) and Budget Circular A-76* (the federal government-wide document used as guidance on most outsourcing actions), only those activities considered commercial activities—defined as those "resulting in a product or service that is or could be obtained from a private sector source"—can be

competed.[3] Inherently governmental functions, defined as "so intimately related to the public interest as to mandate performance by federal employees (including military personnel)" are not to be competed with the private sector. This determination is based on several factors, including levels of required government control and oversight.[4] The *Circular* also delineates several categories of commercial activities excepted from competition, including national defense activities, defined as "a commercial activity . . . being subject to deployment in a direct military combat support role."[5] Department of Defense (DoD) and Air Force guidance closely mirrors the *OMB Circular A-76* language.[6]

Air Force Priorities

Air Force goals in the competitive sourcing arena are ambitious, place a greater focus on core activities, attempt to improve performance and cost effectiveness, generate savings for modernization, and maintain readiness.[7] CS actions have generally been successful in cost and personnel reduction. Figures from early 1999 indicate Air Force manpower savings in actions competed under *OMB Circular A-76* during the 1990s averaged 36 percent.[8] Unfortunately, problems with such savings arise from the primary and secondary consequences of increasing private sector involvement in Air Force support services. These consequences include the risks associated with disrupting mission capability and activities and the inability to adequately perform during critical periods—initial deployment or mission sustainment. The number of Air Force military and civilian positions currently considered eligible for a public/private competition is, however, relatively low. According to 1995 Air Force data, out of a total military and civilian employee base of just under 600,000, about 309,000 positions were considered to be performing commercial activities. Of these positions, about 49,000 were considered eligible for competition based in large part on national defense or deployability exemptions.[9] The Air Force expects to reduce its total fiscal year 1998 end strength of 544,000 by subjecting at least 54,000 additional positions to competitive sourcing initiatives by fiscal year 2005.[10]

Air Force criteria for determining which functions may be subjected to public/private competition begins with the total baseline population. The Air Force then subtracts individuals in deployable unit type codes (UTC); all rated and medical personnel; certain other forward-based personnel; the Continental United States (CONUS) rotational pool for overseas presence; and other military essential, inherently governmental positions or those not subject to contract because of statutory restrictions.[11] The more detailed decision criteria cited touch on a key concern. The Air Force, in its efforts to meet ambitious outsourcing and cost-savings goals, is using criteria that do not always examine what effects competitive sourcing current functions may have in other areas and may not always be consistent in applying them. For example, regardless of their criticality to military effectiveness, individuals assigned against a deployable UTC are exempted, thus forming a large pool of *untouchable* positions, regardless of criticality to military effectiveness. The effect of competing those activities eligible for outsourcing on deployment effectiveness, however, is not addressed by a specific criterion. Evidently, these activities must not be considered direct combat support or otherwise militarily essential positions.

This problem leads to an acknowledgment of the need for a clear delineation of what functions are core—those considered *direct military combat support* activities. While this question initially seems simple, the analysis can become complicated. Contractors already provide flight-line mission support for certain combat aircraft in theater on the flight line. Personnel providing support in supply, transportation, repair, and maintenance in country may well be considered to be providing services directly related to combat support, but the line is not clear, and the definitions become fuzzy.[12] Maintaining competition exemptions for all UTC-deployable functions presently filled by military personnel is the Air Force's current position, but the continuing drive for cost containment may make that position untenable in the future.

Current Status of Air Force Fuels and CE Support Functions

Air Force fuels and civil engineering (CE) support functions provide some illustrative examples of the potential problems arising from CS actions. Currently, both of these functions are either considered for—or are already being subjected to—public/private competition on an extensive scale in CONUS locations. Civil engineering and supply (including fuels activities) are approved CS processes targeted to achieve overall Air Force reductions cited earlier. The Air Force plans to subject more than 7,000 civil engineering and almost 4,000 supply positions to competition.[13] A review of current data indicates fuels functions at more than ten locations, involving more than 500 positions, have been subjected to competition. In the Air Education and Training Command and Air Force Materiel Command (AFMC) alone, more than 2,000 CE positions are currently being reviewed as candidates for further outsourcing.[14] In light of the imperative to cut costs and manpower, CS actions in the fuels and CE support arena are not surprising.

Fuels activities are generally assigned to supply squadrons in separate fuels flights. These flights manage the requisition, receipt, storage, issue, quality, and accounting of all petroleum fuels and cryogenic products.[15] A CONUS-based or deployed fuels management flight generally has responsibility for fuels operations (control, distribution, and storage of fuels, propellants, and cryogenics), as well as quality control and inspection, accounting, training, and mobility.[16] In Air Force operational commands, fuels support activities generally tie directly into or interface on a regular basis with other key operational functions, including operational support, contracting, transportation, and CE squadrons.

Since 1993, responsibility for managing the Air Force fuels infrastructure and the general provision of fuel has been divided between the Air Force and the Defense Logistics Agency's (DLA) Defense Energy Support Center (DESC) (formerly the Defense Fuel Supply Center). Today, DESC is responsible for renovation or major maintenance, repair, and environmental expenditures related to fuel operations worldwide, as well as new construction. The Air Force is responsible for minor maintenance and fuel operations at existing installations and tactical fuel operations. In addition, DESC owns all DoD fuel until it is dispensed to mobile equipment, such as ships, aircraft, and ground vehicles.[17]

The fuels career field currently employs around 3,500 people, with the vast majority being active duty Air Force personnel. From

this field, the Air Force staffs its temporary overseas commitments (Southwest Asia, for example) and operates and maintains its CONUS installations. The current Air Force operations tempo has resulted in several hundred of these fuels specialists being in temporary duty status overseas on any given day.[18] In addition, as the Air Force moves into fully staffing the Air Expeditionary Force squadrons, fuels support personnel are *embedded* in each of the expeditionary units.[19]

Efforts to subject this function to significant competitive sourcing or privatization are ongoing. In 1998, the Department of Defense contracted with the Logistics Management Institute (LMI) to assess the potential for privatizing fuel infrastructure at military installations. LMI reviewed five sites in detail (including all three Services) and, in October 1998, provided a report with four alternative strategies for attracting the private sector to the DoD fuels arena. These strategies included accepting a private firm's services on DoD assets in return for a portion of the fuel product (*product plus tariff*), shared use, bundling of several DoD assets to promote privatization, and exchange of land for real estate.[20] All these alternatives involved private sector operation of the fuels support activity. The report concluded, "DoD should consider privatizing the fuel infrastructure at sites where it is financially advantageous."[21]

The Deputy Under Secretary of Defense for Logistics tentatively endorsed this conclusion in July 1999, with privatization of CONUS fuels infrastructure to be pursued, where appropriate, on a test basis before the end of 1999.[22] During fiscal year 1999, the Air Force analyzed two locations for carrying out these privatization tests: Nellis AFB, Nevada, and Hickam AFB, Hawaii. Both bases, despite being identified as high-priority sites in the LMI study, were rejected for immediate privatization because of the fear of added loss of trained active duty fuels support personnel and construction financing issues, respectively.[23]

In addition to this activity, staff from the Office of the Deputy Under Secretary of Defense for Logistics proposed the transfer of responsibility for all CONUS, Alaska, and Hawaii fuels operations from the Services to DLA in fiscal year 2001. This proposal included the transfer of all civilian fuels and fuels-related employees to DLA, with all military personnel to be phased out of day-to-day operations over a 3-year period beginning in 2001. DLA would "give priority to providing the lowest cost operational mix of commercial and civil servant workforce based on economic analysis, within the constraints of civil service manpower billets transferred to DLA."[24] While this initiative was rejected after stiff opposition from major military commands, the proposal was symptomatic of the level of frustration felt at senior DoD levels over the pace of fuels outsourcing/privatization.[25]

Most active duty CE personnel are assigned to separate CE groups or squadrons, with duties including fire protection, power production, operations, and utilities.[26] CE personnel are also organized by teams for deployment as part of Prime Base Engineer Emergency Forces (Prime BEEF) and/or RED HORSE (Rapid Engineer Deployable, Heavy Operations Repair Squadrons Engineer) teams for heavy construction.[27] In light of their involvement in base construction and maintenance, CE activities interact with most Air Force base operations when in the CONUS or deployed.

Considering its CE support requirements, the Air Force has attempted, throughout the downsizing and draw down initiatives of the last several years, to ensure its CE deployment requirements are met. As noted previously, positions considered deployable are not currently subject to outsourcing, although the Air Force basically staffs its CONUS bases using both installation requirements and potential deployment requirements.[28] Only those positions considered nondeployable would be subjected to outsourcing competitions. Based on Air Force guidance regarding implementation of *Defense Reform Initiative #20* (a DoD document providing guidance on what should be considered inherently governmental or otherwise exempt from competition), there are virtually no CE positions under current coding that could be competed. If contractors are brought into a deployed location, they are used as additional resources for mission sustainment, not to replace existing military positions. The opening of a *bare base* is still considered a job for the active duty Air Force CE component. In light of the pressures involved and the commercial alternatives available, however, this practice may not continue to be the standard.

While efforts to keep deployable positions considered essential exempt from CS consideration have generally been effective to date, there are already stresses in the system. For example, the fuels career field is already approximately 130 active duty personnel short of its desired level, based on current staffing levels and the number and intensity of overseas deployments.[29] Nevertheless, the perceived need to meet the cost and manpower targets cited have driven proposals to make deeper cuts.[30] This process could result, if pressures to cut costs and manpower do not ease, in reducing numbers of active duty personnel to a level that, even if contractors take over many services, may endanger mission effectiveness.

Support Service Contractor Performance Questions

Responsive support service contractor performance is a key requirement of the component commander, especially when military operations or combat begins. The criticality of such support goes without saying. The Air Force cannot meet mission requirements without timely, effective support, and the inability of a contractor to perform raises serious concern. For example, in a 1997 deployment, a fuels supply contractor promised adequate fuel deliveries from local sources at a base in Bahrain, where part of the Air Expeditionary Force was to be based. Immediately before deployment, the local contractor notified the Air Force it would only be able to supply about one-third of the required fuel. US embassy involvement was required to obtain the necessary fuel to fill the gap.[31]

Continued downsizing and outsourcing has resulted in a force with little additional capacity to fill in if contractors are not present. The DoD Inspector General found in a June 1991 audit, "If contractors leave their jobs during a crisis or hostile situation, the readiness of vital defense systems and the ability of the Armed Forces to perform their assigned missions would be jeopardized."[32] That statement was made when 1 American in 50 deployed to the Persian Gulf was a civilian; the Bosnian conflict included civilians at a rate of 1 in 10.[33] By 1998, the US military force commitment in Bosnia as part of the SFOR (stabilization force) was capped at 7,800 personnel. One study estimates the number of contractor personnel (both US and local nationals) exceeds the number of deployed military forces.[34] A

contractor's ability to provide surge capability is a critical factor in how successful a private firm's performance will be measured. However, requiring a contractor to maintain a surge capacity for performance may be looked upon as inefficient excess capacity, costing the government dearly in peacetime.[35]

A March 1999 Air Force Inspection Agency (AFIA) report addressed many of these issues. The report included findings that the status of contractor personnel as combatants or noncombatants under international law when deployed with military forces and the ability of the component commander to keep contractors performing in combat conditions were not yet resolved.[36] While most contractors have stayed and worked in previous combat and near-combat situations, there are currently no requirements beyond contractual terms to keep a contractor and its employees in the field should combat occur.[37] Recent analysis of this problem seems to indicate the military, in light of its dependence on these contractors, will have no other alternative than to accept and try to minimize the risk of contractors choosing to leave.[38] If these personnel leave in significant numbers, the military will not be able to handle the load on its own, and core warfighting abilities and military personnel safety will be threatened.

A more insidious threat to US military capabilities in a contractor-rich, deployed environment is the potential for corporate blackmail. This threat could be directed against multinational corporations or US companies whose primary or subsidiary operations and personnel support DoD deployments. In the future, the Department of Defense could be faced with key contractors deciding their personnel will not deploy or will be withdrawn from a deployment based on threats against worldwide corporate interests. Corporations with multinational interests may decide the loss of a DoD contract is less of a business risk than the loss of more vital business interests or personal safety in other areas. A potential adversary's ability to disrupt or delay the military's ability to project and sustain forces by successfully threatening US corporate interests directly supporting those forces, may prove to be a troubling Achilles' heel in the coming years.

Contractor Personnel Protection Concerns

Contractor employee force protection, particularly in light of increased private sector support services, is another troubling issue. Most support service contractors cannot provide rear area security and rely on the military for force protection. This leads to resource and mission problems for the military:

> Force protection people are a scarce commodity. Often at overseas locations, other support personnel augment the force protection personnel. The Khobar Towers after action report even recommended the use of other (nonforce protection) personnel to augment the force protection mission. As military support forces are privatized, the resources for augmentation of the security forces dwindle . . . .[39]

This problem is exacerbated by the expansion, through potential opponents' weapons systems, of the battle line. For example, conventional weapons, such as long-range artillery and missiles on the Korean peninsula and in Southwest Asia, extend the hazard for private sector personnel to at least 53 miles behind the battle line.[40]

Increased private sector support services usually also result in an increase in the local national population hired to support US deployments. For example, under the initial logistics civilian augmentation program (LOGCAP) contract awarded to Brown & Root, the local national contingent at times numbered about 13,000-14,000, with a US or expatriate contingent of about 1,700 leading and supervising their operations. These foreign nationals were initially screened by checking with the local police. Those who passed this screening were placed under 100 percent surveillance by US or expatriate personnel during working hours.[41] If similar practices are followed on subsequent support contracts, persons who sympathize with actual or potential adversaries may be allowed into US military facilities until more extensive security checks are completed. This problem becomes more acute as the ratio of military and civilian personnel on deployments continues to narrow and surveillance is limited when US contractor personnel are restricted to specific bases or locals because of heightened threats. For example, after the US embassies in Kenya and Tanzania were bombed in 1998:

> . . . unarmed personnel [contractors] were restricted to the bunkers unless escorted under arms to other locations. *Contract supervision for 75 days was severely restricted to nonexistent*. Military forces were also taken off the line to perform escort duties for unarmed DoD civilians and contractor personnel.[42]

As cited by the AFIA:

> It must be assumed that LNs [local nationals] pose a significant overt or covert risk to the deployed forces. As the number of contractor personnel increase so must the government oversight. *Outsourcing 10 support positions does not mean that 10 more military forces are available to support mission requirements.* The increases in support positions are not only QAEs [quality assurance evaluators] but also personnel involved in force protection [Emphasis supplied].[43]

In prior conflicts, the risk incurred from one or a few local nationals being unsupervised or having minimum security checks would have been relatively low. However, today, the ability of one person to sow biological or chemical weapons through a densely populated US military encampment presents perhaps too high a risk.

Cost Concerns

A key factor in moving support functions toward public/private competition is the generally accepted assumption that competition of such processes with the private sector leads to substantial savings for the government. While the potential savings may vary between analyses, cost savings of approximately 30 percent are considered typical.[44] This cost-saving assumption generally focuses on the private sector's ability to control wages, the need to pay for military or federal civilian pension and other benefits, and the multiskilled performance flexibility attributed to private sector employees (particularly when compared with often unionized federal civilian employees). Other sources measuring private industry outsourcing do not find the level of savings cited, but reductions of about 9 percent, with corresponding increases in capacity and quality, can be found.[45]

Other factors not necessarily included in this assumption of cost savings, however, should be taken into account. While many military service functions may be identified for competitive

sourcing based on the availability of the same or similar private sector services, the cost savings in such areas, measured in actual cost performance after contract award, may not be so clear. The downstream cost-saving question was addressed in a December 1996 analysis of facility management costs at Naval Air Stations (NAS) Fallon, Nevada (contractor-provided), and Miramar, California (government-furnished), for fiscal years 1992 to 1996. Taking into account regional cost and requirements differences, the study found that out of nine facility management areas studied, only three showed significant savings from contractor services. One area had similar costs, and five areas were "significantly cheaper at NAS Miramar using in-house forces."[46] The study concludes:

> In summary, any blanket statement that outsourcing is cheaper is not always true. Careful studies are needed on a case-by-case basis before deciding which functions to outsource. Cost savings are achievable through outsourcing, but they are also achievable by using in-house forces.[47]

Concerns about downstream contractor costs are not limited to facilities contracts. The LOGCAP omnibus support services contract is another instance where cost data can be interpreted differently. The public pronouncements on the success of the contract are widespread and generally accepted, with savings of $140 million dollars being cited.[48] Other reports, however, refer to Army concerns that it is paying too much for these services—the contractor in Bosnia exceeded the first year precampaign planning estimate by more than $110 million—even while expressing satisfaction with the contractor effort.[49] Prior federal outsourcing contract studies indicate that, while cost savings in the 20-30 percent range are predicted, these savings are often based on initial estimates rather than long-term savings. The actual savings are often considerably lower or, in some cases, nonexistent.[50]

Another part of the total contract cost calculation must take into account added costs taken on by the Services (for example, force protection and other types of support for contractor personnel) when using the private sector during deployments. Private firms currently enjoy fairly low training costs when providing these services, as they often employ former military personnel who have the training, security clearances, and other attributes that allow them to quickly meet contract requirements. Hiring these personnel today reduces the private sector's training and security clearance costs. As the Department of Defense continues to downsize and outsource, these costs are almost certain to rise. All these considerations taken together will almost certainly reduce actual cost savings when the Services use deployable contractor support services.

Careful choices must be made and detailed market analyses used when determining whether a deployable function deemed *commercial* should be subject to competition, using the actual total costs of private sector performance (including the factors cited). This review should also take into account whether reengineered military organizations could produce similar cost savings, especially if statutory and regulatory barriers to such actions are removed.[51]

Continuing defense budget reductions may well result in a lower overall potential for a robust, competitive marketplace for certain types of military service support contractors. If this market does shrink and the number of contractors diminishes, the ability of these contractors to make acceptable market profit will diminish without the higher prices paid by the military. In combination with the emerging preference under procurement reform initiatives for extended contract periods, close cooperation between contractors and the government in drafting performance requirements, and the eventual reduction in the military's organic ability to perform these functions, continued CS actions could result in the DoD substantially subsidizing the private sector's ability to provide these basic services. Using competitive sourcing to take advantage of perceived short-/medium-term cost savings may result, over the long haul, in more expensive contractor-provided support services.

Active Duty Force Concerns

The downsizing efforts of the last 10 years have cut into the number of people available for duty in support services and has contributed significantly, along with an overall increase in the number of deployments, to an increase in operations tempo for active duty support personnel. The use of outsourcing as a way to mitigate the effects of such downsizing and stretch the military's ability to cover missions has worked to a degree, but limitations in the application of this solution may be coming to the fore.

If the impetus for outsourcing these functions continues, the Air Force will have to be concerned about the loss of a trained pool of military personnel. Once the Air Force outsources such functions, there will be little opportunity to retain these skills in house. There is no assurance as these functions are relinquished that the Air Force will be able to maintain its technical proficiency in these areas or that contractors will retain an adequate knowledge base (at least without substantially increased training costs), especially when short-term contracts (less than 5-year base periods) are used. One solution to this problem is to simply exclude certain key functions from competition, as the Air Force did in excluding about 100 of the more than 600 CONUS utility systems under review. The Air Force rationalized that these facilities must be run by military personnel to ensure CE units are properly trained and can perform their duties in a deployed environment.[52]

Another concern is the need to ensure a place for deployed active duty personnel to *come home to* if base support services continue to be outsourced. If, for example, CS actions result in CONUS support operations being increasingly performed by contractor personnel, deployed active duty personnel in those functions may find their roles usurped by the private sector upon their return. This could result in the active duty force being required to be more multiskilled to cover different specialties not subject to contracting out—not a bad result on its face, if training and experience in applicable specialties can be maintained. The other result might be, however, that as active duty military personnel are increasingly relegated to military essential, deployable activities, these people may find deployments steadily increasing, with even greater negative impacts on force retention and morale than those experienced today. Such concerns dictate a corporate rethinking of the existing system to ensure mission demands are met.

The Contractor Management/ Integration Imperative

A key problem in this arena is the Services' lack of comprehensive planning to manage and integrate private sector support

contractors in a deployed environment. In fact, there is no evidence the Services can even centrally track contractors in any particular deployment or even their reason for being there. In 1991, the DoD Inspector General issued a report that included statements that the Department of Defense had;

> . . . no capability to ensure continued contractor support for emergency-essential services during mobilization or hostilities, no central oversight of contracts for emergency-essential services, no legal basis to compel contractors to perform, and no means to enforce contractual terms.[53]

The DoD's responses to this IG report sidestepped the issue, stating, among other things, the need to identify "the number of contracts is not the important factor; the need is to make sure we are able to carry out our mission."[54] This information, however, is vital. No component commander today can make rational decisions about combat or support requirements without knowing what contractor support can be relied upon.

The 1999 AFIA report reveals the Air Force is still facing similar problems. The report summarized that overall contractor support was highly effective and that its implementation was more than adequate for noncombat operations.[55] The summary's balanced tone, however, belies critical findings in potential wartime support. The report revealed there are no essential contractor service planning procedures or standardized approach for establishing contractor personnel oversight at deployed locations and current processes are reducing deployed contractor effectiveness.[56] The report included determinations that inspectors could find no consensus on who *owned* the support contractors and:

> *. . . most locations did not have any idea how many contractors were on an installation or who the contractors were. In some instances, command and control of contractors was maintained thousands of miles away* [Emphasis added].[57]

The criticality of the contractor visibility issue arises out of the need to ensure essential support gets to the deployed forces when needed. It does not seem, however, that Air Force policies and doctrine truly address how contracted support will be deployed in a rational and planned manner. Some senior military personnel interviewed as part of the AFIA report believed civilians not included on UTCs must be excluded from deployments because of concerns over force protection and logistics support. Other Air Force units, on the other hand, are already pursuing placing contractor employees on their UTCs because of the mission-essential nature of their tasks.[58] The report also found:

> Once the issue of placing contractors into an [sic] UTC is resolved, the focus changes to moving them to the battlefield. Here, the TPFDD [time-phased force and deployment data] is the process used to accomplish this in the most time and resource effective manner possible. In fact, one interview mentioned that if contractors are not in the UTC/TPFDD, but are required on the battlefield, there could be massive confusion and delays caused by the military and the contractors competing for limited transportation resources. *If doctrine establishes that contractors will be present on the battlefield, then policy needs to be developed to detail how that will effectively happen* [Emphasis added].[59]

While the Services are beginning to consider integrating and coordinating deployed contractor support, solutions seem to be a long way off. For example, senior military service logistics and supply personnel participating in an integrated joint logistics wargame, Focused Logistics Wargame 2010, in the summer of 1999 found use of in-theater logistics and support contractors was a major issue. The October 1999 wargame results were not encouraging, as a key finding in the assessment of contractor logistics support execution was the "lack of coordination between the acquisition and logistics communities is creating an unmanageable logistics support environment on the battlefield."[60] Concerns regarding this issue included:

- Contracts were being written without adequate consideration for theater integration.
- In-theater personnel faced a complicated mix of support arrangements.
- The flow of contractor support and materials was not integrated under the theater CINC's control.
- The uncoordinated flow of contractor personnel into the theater complicated the CINC's responsibilities for force protection, clothing, housing, medical, transportation, and legal arrangements.[61]

The participants focused on the DoD's greater reliance on contractor support for these services, the segregation of the acquisition and logistics communities, and the lack of standards or requirements in the planning process as key causes of this problem.[62] The impact of this problem, which surfaced in every wargame event where extended sustainment support was required, included the:

- Free flow of personnel, materiel, and equipment without theater CINC visibility or control.
- Subsequent creation of multiple support mechanisms that complicate theater logistics coordination.
- Lack of force protection, base operations support, and status-of-forces agreement/legal coordination with theater CINC requirements.
- Lack of integration of contractor and DoD information systems.[63]

A draft joint publication, including guidance on contractors in the theater, addresses some of the concerns and calls for integration of theater support contractors directly into logistics plans and orders.[64] However, the draft document is silent in terms of how a supported theater commander would ensure movement and visibility of deployed contractors, coordinate their actions and incorporate them into TPFDD documents, move contractor assets and personnel into the theater, and ensure contractor compliance with local laws and regulations and theater-specific policies. In addition, the spring 1999 revision of Air Force Doctrine Document 2, *Organization and Employment of Aerospace Power*, makes no specific mention of contractor support despite detailed discussions of the logistics requirements in deploying air expeditionary wings.[65]

A key issue to consider when measuring a contractor's effectiveness in such situations is whether the Air Force can integrate it into the entire deployed force. The risk of not including these services as actual factors in planning or exercises is obvious. Without practicing use of these functions or taking advantage of their availability in peacetime, the risk of delays and nonperformance in operational or wartime deployments increased sharply. Despite the concerns cited, the perceived

success of using contracted support services will almost certainly lead to their increased use in future deployments, with both positive and negative consequences.

The LOGCAP/AFCAP Alternative

In Bosnia I have three MACOMs: DISCOM, Signal, and Brown & Root.

Brigadier General Pat Oneal (ADC[S], 1AD), Winter of 1996[66]

One potential solution to the contractor coordination problem in deployed operations is to turn over large parts of the support services process to one large firm. This concept has gained acceptance within the US Army under its LOGCAP, which has procured base operating support during every major Army deployment since 1992.[67] Originally intended to provide basic life support, engineering, and maintenance work for the Army, the initial contractor Brown & Root worked closely with the Army to expand contract coverage in Somalia, Haiti, and Bosnia to include other services such as air traffic control, all fuel storage and refueling operations, additional civil engineering tasks, and other activities.[68] The Army is pleased with the results of the LOGCAP and follow-on efforts putting such services in the private sector. This concept, however, does not come without a price and problems. Concerns over cost overruns (the contractor in Bosnia exceeded the first year precampaign planning estimate by $111.3M) and the increasing size of the program led Congress to request a General Accounting Office (GAO) review of the program. The 1997 GAO report found the Department of Defense needed to improve its contingency contracting efforts in many areas, including guidance, cost reporting, and monitoring.[69]

The Air Force is using a similar concept through a $450M contract awarded in 1997 to Readiness Management Support for installation support capabilities typically performed by CE and services personnel under the Air Force contract augmentation program (AFCAP). The AFCAP contract specifically tasks the awardee with sustainment responsibilities after at least some beddown tasks are completed, as well as all traditional CE capabilities except for crash/fire/rescue and explosive ordnance disposal, and all traditional services capabilities, except mortuary and field exchange services.[70] In addition, under an Army contract, the Air Force used Brown & Root for installation and supply support services, including base operations and airfield management, supply and maintenance, crash and rescue services, and aircraft refueling at Taszar Air Base, Hungary, during Operation Allied Force.[71] The appeal of using these types of contracts (lower troop requirements and easier contractor coordination) makes them an attractive alternative to extensive military service support infrastructure in deployed operations.

Other Potential Management Solutions

Another potential way to ensure a component commander maintains visibility, capacity, and control over deployed contractor support services is to restrict use of contractors to the locations where the deployed military supply distribution system begins (a theater management center or TMC) and ensure the component commander has control over the logistics system through creation of a distribution management center (DMC).[72] The DMC commander would be the single focal point for distribution of supplies on the battlefield or operational area and would have the authority to cut through command and agency layers to ensure essential materiel flows to critical locations. The DMC would be tasked to create a workable theater supply distribution plan linked to the CINC's logistics guidance and sustainment flow from the CONUS.[73] Integration of private sector firms into the logistics system would be done cautiously and in a limited way with the TMC's primary focus in sending supplies being the supported commander. Private firms supporting units on the battlefield or operational area would be coordinated through the DMC, increasing control over distribution management.

A key difficulty in implementing this approach would be providing powerful independence to the DMC to control logistics and support activities across organizational boundaries. Another issue would be the criteria identifying the point where DMC control over supply distribution from private firms would begin.[74] The use of omnibus deployment support contracts such as LOGCAP and AFCAP may be able to mitigate many of the concerns cited regarding the need to coordinate, harmonize, and integrate contractor activities, as the theater commander has one point of contact. The TMC/DMC concepts could also mitigate these problems in a different way through centralizing contractor control in a deployed environment.

One partial solution to concerns over contractor performance would be to ensure that all contractors and their employees would be subject to the *Uniform Code of Military Justice* in a combat zone. The feasibility and complexity of imposing such a requirement is beyond the scope of this article. If implemented, this could raise confidence in contractor performance in deployed environments, even if it limited the number of contractors willing to operate in these theaters. A related initiative would be to mandate, via contract, employment of a certain percentage of Air National Guard or Air Force Reserve personnel in key positions. This concept could prove highly effective in meeting the need for responsive deployment of both military and contractor personnel. Depending on the contingency, key personnel with necessary skills would already be in theater, either called to active duty or employed by the appropriate private sector contractors.

An alternative to contractor performance would be to allocate a significant percentage of initial deployment support service activities to the National Guard or the Reserve. If properly managed and resourced, this could eliminate many of the concerns regarding active duty force overdeployment and whether such active duty forces would have positions at CONUS bases should these be subjected to competitive sourcing. The functions placed under National Guard and Reserve responsibility would only be called upon as needed for deployments. Use of this concept could, in large measure, offset many of the concerns cited regarding use of contractors, including force protection, cost overruns, and failure to perform once the battle line moved close to support elements.

One concern with this concept involves the ability of such National Guard or Reserve support service activities to deploy in a timely manner in short-notice contingencies. Such concerns might call for the retention of certain levels of specialties in a rapid reaction, active duty support force. National Guard and Reserve forces could follow soon to continue this activity once deployed and either continue performance in a sustainment mode or turn the activity over to the private sector. Another concern

regarding this concept would be the ability of and need for such National Guard or Reserve activities to maintain proper levels of training and expertise to act quickly and effectively in a deployed environment and still meet Air Force cost and budget reduction targets without putting undue additional strain on the Guard and Reserve. This could be accomplished as long as the Air Force, using the Total Force concept, made the appropriate commitment to training, equipping, and employing these forces.

A second alternative that could be pursued would involve the transfer of responsibility and overall control to the service with the predominant need for the required support services involved in a joint deployed environment. If, for example, a deployment depended primarily on fixed-wing aircraft deployment, the Air Force would take the lead on providing support services. An Army detachment would take primary responsibility in a deployment if rotary-wing aircraft were the primary focus. This concept could lead to further cost and personnel-saving opportunities through reengineering of support service activities. However, the initial cost of coordinating these activities would likely be high and the interservice obstacles formidable.

In determining whether contracted support services are effective, the ability of the force commander to have visibility and control over and the ability to integrate these private sector providers in an area of operations is absolutely vital. This capability must become second nature, rather than using contractors on a *trust-me* basis. To make this concept work for the Air Force, these ideas will have to become robust, thoughtfully considered concepts taking into account both the problems and the advantages of using the private sector in certain key areas. Methods to encourage the maturation of this concept should include:

- Enhancing partnering arrangements through special contracting rules and developing and implementing standard acquisition policies and requirements for such support services.
- Clearly determining which functions must be performed by military personnel and which can be contracted out.
- Developing integrated information systems between deployed contractors and participating Air Force units.
- Integrating LOGCAP or similar constructs in logistics planning.
- Involving outsourced support services in theater-level exercises, with senior representatives from current deployment-ready firms already under contract attending.
- Expanding Air Force, joint, and interagency workshops and wargames/exercises to feature use of LOGCAP or similar constructs for essential support services.[75]

Only after such steps are taken will use of an omnibus support contractor or a number of support contractors be truly integrated into the Air Force's deployable logistics infrastructure, inefficiencies reduced, and synergies exploited.

Core Functions Reassessed

While these potential solutions are essential for easing the pressure from ongoing competitive sourcing in Air Force support services, the most important changes to be made are at a more basic level. Changes must be made when determining whether support service activities are core or otherwise not subject to competitive sourcing competitions. The Air Force and its appropriate activities must continue to reassess the decision criteria regarding which support service activities will remain core are made, such as the current Air Force policy to exclude deployable positions from competition. The Air Force and the other Services have ostensibly used contractors to *supplement* their personnel in deployment actions, in essence, determining these tasks are not *core* in terms of having to be performed by military personnel. In fact, reviews of programs such as LOGCAP demonstrate the Services are, in fact, using contractor support to replace military personnel.

CS proponents often look to the private sector for justification to contract out parts of the DoD mission considered noncore, basing the analysis on the business concept of keeping in house only those functions or processes that provide the customer value and the corporation a competitive advantage. A key issue, however, is, while private companies develop specific core competencies (McDonald's in fast food delivery, Microsoft in consumer and business software, and so forth), *these competencies are integrated, complex systems*, not discrete functions. Core competencies can, in fact, be defined as those processes giving the firm a competitive advantage, built and sustained through a few highly focused mixtures of skills, technologies, process design, and concentrated corporate culture.[76] *Core competencies are surely not just discrete functions that can be performed separately by other companies.*

The private sector has acknowledged this and keeps those functions in house that directly impact their ability to provide the consumer their preeminent product. The federal government and the Department of Defense, however, generally use the *OMB Circular A-76* analytical model of reviewing discrete functions and whether the private sector can perform them, with only limited exceptions. In many cases, for simple tasks and those not directly affecting national security, this approach is valid. However, in cases where commercial tasks directly impact the deployed warfighter, whether on the battle line or behind, and where private sector performance of such tasks raises serious cost, security, or performance concerns, the Air Force must reassess whether such functions should be considered core—*not just focus on location or deployability but on the secondary/downstream effects on deployment effectiveness of using the private sector to perform these functions.*

The following criteria should be central to any such reassessment:

- A consideration of the type of services required when deployed overseas, anticipated length of deployments for this support service specialty, and likelihood this specialty will be in combat conditions during deployment.
- An assessment on what level of risk a private sector employee would subject other civilian and military personnel to if used in a combat support situation.
- An analysis of the effect of using various mixes of public and private sector assets and personnel to flexibly and effectively deploy Air Force assets. This should consider the effect of using contractors both in deployed forces and at CONUS bases.
- A review of the perceived need for each support specialty in likely deployments (two major regional conflicts versus humanitarian operations and so forth).

Adopting these recommendations and analytical criteria should ensure the Air Force receives maximum performance from its deployable forces (active duty, National Guard/Reserve, and federal civilians), as well as contractor personnel, at a reduced cost, without adding unnecessarily to force protection, contractor management/integration, or active duty deployment stress problems.

Recommendations and Conclusions

The benefits of contractor support are well known and numerous. Cost reduction, fewer military resources devoted to nonmilitary tasks, and synergies with private industry are just a few. While the Air Force will, for the foreseeable future, continue to pursue competitive sourcing as a key tool in meeting budget and personnel constraints and finding new moneys to modernize weapon systems, careful consideration needs to be taken in establishing criteria for such actions and analyzing where these activities may go too far. This concern becomes critical when discussing the actual or potential competitive sourcing of support services involved in expeditionary or other deployments. The ability of a component commander to track private sector contractors, utilize their capabilities in theater and integrate them effectively with the deployed force, and ensure essential support in combat and near-combat situations is absolutely vital to successful employment of Air Force units and contractors overseas.

In balancing these fundamental considerations, it is no longer enough to review commercial activities in a functional manner, focusing on whether there is a private sector market available to provide the service. The Air Force must also examine the downstream/secondary costs of moving these services into the private sector, including additional Air Force assets in contractor oversight and force protection, retention of active duty forces as potential deployments increase, and risks to the active duty force should key contractors or their personnel fail to perform as required.

Support service personnel today are closer to potential battle lines than ever before and are often the first or among the first to deploy. In low-intensity conflicts with a sympathetic security environment, such as humanitarian relief operations or peacekeeping after a political settlement is reached, extensive deployed contractor support services may entail few risks. In higher intensity conflicts, where security becomes a greater concern and the need for timely and effective performance becomes even greater, the risk of using contractor services also rises.

This discussion leads to a number of options for the Air Force as it faces pressure for increased competitive sourcing. The Air Force may determine the risk of continuing competitive sourcing these support services is too great and eliminate these positions from further consideration. In light of the continuing pressure to reduce costs and personnel and with the existence of commercial sources for these functions (LOGCAP, AFCAP, and so forth), acceptance of this alternative seems unlikely. Another alternative is to employ one or a number of the alternatives in this analysis to try to balance risk and cost savings. Finally, the Air Force can decide to continue to march forward with existing competitive sourcing practices and assume remaining military personnel can handle the increased burden of fewer resources and greater responsibilities involved with increased deployed contracted support.

Based on current trends, the Air Force will likely continue in its present course, hoping that informal arrangements and evolutionary change in the employment of deployable contractor supply support will cover its needs and eventually reduce stress on the active duty force. This approach may well prove unsuccessful. Even if the potential solutions provided herein—including use of omnibus private sector contractors for virtually all deployed support services, coordination of deployed support contractors through a distribution management center, greater utilization of Air National Guard and Air Force Reserve personnel for such deployable functions (separate from or in conjunction with the private sector or the other Services), and use of more joint supply services—are fully utilized, they will satisfy only part of the equation. The Air Force must also reassess its criteria for determining which processes and functions will be subject to competitive sourcing and make this decision based on the overall effect on the Air Force in deployment actions. This reassessment could eventually lead to a determination that the problems associated with this type of competitive sourcing outweigh its benefits, ultimately leading to a halt in this process. Performing this assessment sooner, rather than later, is imperative, as the future budget implications of reduced cost savings must be acknowledged and the loss of trained Air Force personnel for these functions, once private firms take over performance, is almost always permanent.

In the end, all this comes down to a risk analysis. The Air Force is balancing the need to reduce costs with the need to ensure timely, effective, and dependable support services in deployment actions. A detailed assessment of fundamental support service needs during deployments—balancing the benefits (potentially reduced costs and fewer Air Force personnel involved overseas) of private sector support with its risks (increased force protection and contractor oversight costs, potential lack of control, and integration over vital support services)—is essential if the Air Force is to protect its personnel, continue to perform at a high level of excellence, and meet budget and manpower targets.

The stakes are high. The failure of these deployed contractors to perform adequately, in combination with the increased strain upon a smaller number of military members, can increase the chances of mission failure and that US military and civilian personnel will become casualties. These concerns must be addressed. Only once this is resolved can the Air Force truly find the right mix between the public and private sector in its most important role, supporting the national security strategy around the world.

Notes

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2. Department of Defense, Office of the Under Secretary of Defense for Acquisition and Technology, *Report of the Defense Science Board Task Force on Outsourcing and Privatization*, Washington, DC, April 1996, 6a.
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Logistics (

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Crime

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Logistics managers devote substantial skill and effort in designing efficient and responsive logistics systems. Sometimes, however, external shocks or changing circumstances require the best of logistics systems to be modified or to respond and adapt in unexpected ways. Such is the situation today in domestic and global logistics networks that must deal with the burgeoning problem of logistics crime.

Consider these recent events that are symptomatic of the growing problem of logistics crime both abroad and domestically:

- Masked robbers brandishing pistols burst into an Irvine, California, distribution center, tie up warehouse employees, shoot to death an escaping dock worker, and use the firm's own truck to load up and make off with more than $12M in memory chips and circuit boards.
- A senior buyer for a nationally prominent firm is charged in Kentucky with accepting bribes from at least two of the firm's major suppliers over a period of years. Contracts in the millions of dollars are involved.
- More than $600K worth of Macintosh computers are stolen from a parked C. R. England trailer in one of Colorado's largest cargo thefts ever.
- Armed pirates in a small motorboat board a 20,000-ton container ship in a safe anchorage area outside the harbor at Rio de Janeiro at midnight. The night watchman is apprehended at gunpoint. A second boat approaches them, and more armed pirates climb aboard. The crew is subdued at gunpoint, and the captain is confronted and required to open two safes and to reveal the vessel's stowage plan. A third boat comes alongside the ship, and massive amounts of high-value cargo, cash, and the crew's valuables are taken.
- Armed bandits in Mexico, posing as highway police, commandeer a trailer loaded with $300K worth of merchandise from the United States. The rig is later found (empty).
- In Dade County, Florida, a driver shows up at the freight forwarder and picks up a trailer full of fashion merchandise. The crime is discovered when the real driver shows up 30 minutes later.
- Last fall at the port of Los Angeles where intermodal containers were strewn about awaiting transport, in the early morning hours, thieves cut a security fence and stole the contents of ten containers, bringing the number of stolen or pilfered containers at that port for the year to more than 400.
- On I-880 north of San Jose, California, a van with no license plates pulls alongside an 18-wheeler that just left a computer supplier and tries to get the driver to pull over. When the driver ignores the attempt, the van's occupants open the side door and brandish assault rifles. The truck driver instinctively swerves toward the van in an attempt to drive them off the road. The van brakes and scrambles away.

This article addresses the nature, prevalence, and impact of logistics-related crimes on supply chain players and action logistics managers can take to control their exposure to logistics crime. Emphasis is on cargo theft, which is pandemic with invasion robberies, piracy, and hijacking.

The Nature of Logistics Crime

In today's environment logistics-related crimes can and do occur at any point in the supply chain. The harsh reality is that all points and all players are potential targets for this kind of crime.

Table 1 categorizes logistics crime from the manufacturer or shipper's perspective. Two major categories of crime, onsite and offsite, exist. Onsite crimes occur at the manufacturer, depot, or distribution facility. Offsite crimes occur at a third-party operation, typically when components or products are either in a carrier's transportation equipment or facility or in a public warehouse.

Onsite Crimes		Offsite Crimes	
Insider*	**Outsider***	**Insider***	**Outsider***
Pilferage Theft Fraud Bribery	Invasion robbery Burglary	Pilferage Fraud	**Cargo theft on station** Invasion robbery Burglary Thief driver Document fraud Phantom ships **Cargo theft off station** Document fraud Trailer/container theft Hijacking Piracy
Note: Crimes ancillary to logistics include drug smuggling, money laundering, and transportation of illegal aliens. *Insider/outsider categories relate to perpetra tors. Any category of logistics crime may involve insider information.			

Table 1. Categories of Logistics Crime

Onsite and offsite crimes can be further stratified into two subcategories: insider and outsider crime. Insider crimes are those that are committed by employees of either the firm or a third-party logistics services provider. Outsider crimes, although often facilitated by insider information, are committed by people external to the legitimate logistics network. Within each of these subcategories, the following types of crime can be identified.

- **Pilferage**. The stealing of incidental quantities of materials or merchandise or theft of part of the contents of a shipping package is pilferage.
- **Theft**. The term theft is used when whole cases, pallet loads, or containers of items are stolen. Whereas pilfered items are typically taken for the thief's own use, the spoils of theft are generally sold for profit. Theft can be committed by insiders hiding in a facility until after hours (breakouts, unauthorized entry after hours, or tampering with inventory records. Theft by outsiders is defined as burglary or robbery.
- **Fraud**. Deceit for economic gain is fraud. Fraud is generally the use of some form of false identification that causes an element within the logistics network to give up or relinquish control of an item. In logistics, this crime is typically document fraud for authorization to release a trailer or container or fraudulent bills of lading designed to direct legitimate cargo to an alternative location for illegal sale.[1]
- **Bribery**. Giving money or substantial gifts with the intent to influence a recipient's actions constitutes bribery. The payer's intent is to gain quid pro quo from the recipient. The line between gratuities from suppliers, carriers, and third-party logistics providers and bribes is hazy and is defined by the magnitude of the exchange and the intent and response.
- **Cargo Theft**. The illegal appropriation of merchandise or materials that are being staged for movement or that are in transit defines cargo theft. Common forms of cargo theft include invasion robberies; drivers with false identities arriving to take in tow a loaded trailer; fraudulent documentation; hijacking of trucks; theft of parked rigs, trailers, or containers; piracy in port or on the high seas; and cargo acquisition by phantom ships. Phantom ships, operated by a syndicate, are general cargo vessels with repainted markings, false crew credentials, and fake registrations.

The Prevalence of Logistics Crime

Although logisticians are sensing an alarming increase in logistics-related crimes, hard data are hard to come by. This is the case for three reasons.

First, reporting systems for collecting logistics-related crime statistics are limited. For example, no mechanisms exist for aggregating data on procurement bribery, pilferage, or contract fraud.

Second, law enforcement officials have no unique category for reporting *logistics crimes*.[2] Theft of an 18-wheeler full of furs, for example, is recorded as vehicular theft, not cargo theft. After-hours theft of pallet loads of cellular phones from a manufacturer's warehouse is reported as a burglary. If the crime occurs during operating hours and the perpetrators use guns, a robbery is recorded, not a logistics crime.

Third, a propensity exists for under-reporting logistics-related crimes for reasons of insurance, publicity, and nuisance.[3] Some acts of piracy go unreported to protect the liner company from increased insurance premiums. Trucking companies do not always report trailer or container theft for fear of adverse publicity. Some victims of logistics crimes in the corporate world view the reporting and subsequent investigations as a further loss with little likelihood of a positive resolution. The crimes go unreported.[4] Nonetheless, statistical data on piracy and domestic cargo theft are becoming more available.

Piracy

Table 2 portrays summary facts on piracy. Note that reported acts have increased more than threefold since 1994.[5] The highest risk area for piracy is Southeast Asia, although Somalia and Brazil have had significant problems in their coastal waters with marauders boarding ships to plunder cargo.[6] Geographically, the problem is so severe in Somalia that ships have been advised to stay at least 50 nautical miles away from that country's coast.[7]

More acts of piracy occur in the South China Sea and in the Strait of Malacca than anywhere else in the world.[8] The South China Sea is dotted with many uninhabited islands on which pirates can hide before and after their attacks. In the Malacca Straits, there are stretches where passages are so narrow and the water so shallow that precise navigation is required. Because of this, slow moving ships are often easy targets for the pirates. Once on board, they can commandeer the entire ship or make off with selected items.

Both small groups of thieves and highly organized bands of pirates, armed with modern high-tech weapons, commit acts of piracy and intelligence concerning what the ships are carrying.[9]

Reported Occurrences	Piracy by Region	Piracy by Country
1999—285 1998—264 1997—229 1996—205 1995—127 1994— 90	1. Southeast Asia 2. Africa 3. Central & South America	1. Indonesia 2. Thailand 3. Philippines 4. Somalia 5. Brazil 6. Nigeria 7. Guatemala 8. Ecuador

Table 2. Facts on International Piracy

Piracy is also turning increasingly violent. In 1998, 51 crewmen were killed, 30 injured, and more than 400 were taken hostage.[10] In just one incident of piracy in 1999, 23 Chinese seamen were murdered.[11] The situation has become so threatening that the International Chamber of Commerce is now posting a weekly Internet report for ship operators warning of piracy attacks, their locations, and tactics.[12]

According to the International Maritime Bureau, in addition to the traditional form of piracy where malefactors board the vessels, an average of 20 phantom ship attacks occur each year. So-called phantom vessels sail under carefully faked documents and are used to steal upwards of $200M in cargo every year from East Asian docks. Most of these phantom ships are operated by groups of Chinese working out of Hong Kong, Taipei, Bangkok, and Singapore who target bulk cargoes that have a ready market—metals, minerals, timber.[13]

Cargo Theft

The predominant type of logistics crime today is cargo theft on land. This is estimated to be a thriving $10B activity in the United States.[14] For comparison purposes, $10B is 3.1 percent of the nation's annual surface transportation freight bill. Hijackings, burglarized trailers, container theft at ports, bank robbery style invasions of distribution centers, and other forms of cargo theft are growing at such alarming rates that firms, industry associations, and law enforcement joint task forces are launching a major counterattack.[15]

Several factors contribute to the recent escalation of cargo theft:

- The pervasive use of containers in domestic and international logistics has encouraged cargo theft because of the increased profit potential.[16] Simply put, stealing a container is a much more efficient form of theft than going after individual cartons or loaded pallets. Oftentimes, sophisticated criminals target containers with merchandise valued in the millions. For example, one 40-foot container full of expensive perfumes or electronics can be worth upwards of $16M.
- The huge increase in international trade has increased both the opportunity for cargo theft and created ready markets abroad where the loot can be sold for a fraction of its true value. The theft of cargo for export is rampant at our nation's seaports.
- Computers have made it much easier for insiders and hackers to gain access to shipment information that can be shared with accomplices and used to create fraudulent documentation.
- Cargo theft is a low-risk activity. These crimes receive little public attention, and until recently, authorities had not put a high priority on cargo theft. Since cargo crimes often involve multiple jurisdictions, police agencies have not known how to investigate cargo theft. Additionally, sentencing guidelines for those convicted of this kind of crime are weak.[17]
- The electronic revolution has generated small-size, high-value merchandise that is portable with a ready market. Thieves are increasingly targeting this *value-dense* cargo.
- The profit potential of high-value cargo with a ready market has been discovered by both organized and multinational criminal elements.[18]
- Drug traffickers have expanded their operations into cargo theft. The theft of computer chips and electronics has proven to be just as lucrative as the drug trade and is far less risky. For example, an ounce of cocaine and a Pentium chip can each be fenced on a street corner for about $600.[19] Obviously, it is far safer to be stopped with a Pentium chip than with cocaine. Thieves can drive down the road with computers and not worry about transporting something illegal.
- Additionally, organized crime in the United States has joined with drug traffickers based in Latin America, Southeast Asia, and Eastern Europe to trade computer parts for drugs. These consortiums receive cocaine shipments from abroad, pay for them with stolen high-tech cargo, and ship the loot abroad where it is sold as legitimate cargo. According to cargo crime experts, the fact that microprocessors have become the drug criminals' currency of choice is the single biggest contributor to the escalation of cargo theft in the United States.[20]

Table 3 identifies the cargoes and areas most victimized by thieves. Clearly, high-value products are disproportionately targeted, particularly computer chips and electronics.[21]

Predominant Items Targeted by Thieves	High Cargo Crime Areas Domestically	High Cargo Crime Regions Abroad
1. Computer chips	1. Los Angeles/Long Beach area of Southern California	1. Russia
2. Electronics (for example, computers, cell phones, televisions)	2. New York City/New Jersey	2. Eastern Europe
3. Furs, sports & designer apparel	3. Miami & South Florida	3. South Africa
4. Other highly targeted cargoes: tires, tobacco, liquor, perfume, jewelry & gems	4. San Jose & the I-5 Corridor to Los Angeles	4. Brazil
	5. Memphis	5. Mexico
	6. Chicago	

Table 3. Targets of Cargo Theft

At present, Los Angeles/Long Beach is considered the cargo crime capital of the United States. Southern California, New York City/New Jersey, and the Miami area are collectively known as the Bermuda Triangle of cargo crime because of the prevalence of container thefts at ports and intermodal terminals, thefts at distribution centers, stolen trailers, and truck hijackings.[22]

The situation has become so acute that some underwriters in London have recently withdrawn from insuring certain goods (computers, stereos, televisions, and designer jeans, for example) that move through these three cargo centers.[23]

In southern California, I-5 is a major crime corridor. Gangs of illegal immigrants from Columbia, Ecuador, and Peru (known to authorities as the South American Connection) rent trucks in Los Angeles, drive up to Silicon Valley in northern California to perpetrate robberies at high-tech distribution centers, and return to Los Angeles to export the loot or fence it locally.[24] Other criminals case distribution centers in the San Jose area to observe motor freight shipping patterns. They then hijack the trucks loaded with electronics and bring the contraband down I-5 where it can be exported from ports.[25]

Outside the Bermuda Crime Triangle, Memphis and Chicago are also high crime areas because they are major distribution nodes in several logistics networks.

Internationally, Russia is the country most vexed with cargo theft.[26] Cargo crimes in both Russia and Eastern Europe inhibit supply chain connections with the West because reliable distribution networks in country are difficult to establish and keep secure. Other major international cargo crime areas include South Africa, Brazil, and Mexico. The escalation in lawlessness

in South Africa, where 5,773 truck hijackings alone were reported in 1998, has caused major disruptions in distribution networks.[27]

Kodak reports losing $1M a year in cargo theft in Brazil, where the biggest problem is the hijacking of trucks.[28] Other companies report similar problems in Mexico.[29] In fact, one US manufacturer has lost so many shipments of running shoes to highway bandits in Mexico that the firm now puts sneakers for the left foot in one trailer and those for the right foot in a separate rig. Another major manufacturer doing business in Mexico allows for two hijackings per month in its operating budget.[30]

Table 4 summarizes a number of salient cargo theft characteristics.

<table>
<tr><th colspan="4">$10 billion per year direct cost</th></tr>
<tr><td colspan="3">Insiders help orchestrate up to 85% of cargo thefts.*</td><td>15% exclusively outsiders.</td></tr>
<tr><td colspan="3">60% of crimes occur during transit.**</td><td rowspan="2">40% of cargo crimes occur in warehouses or transfer facilities.</td></tr>
<tr><td colspan="2">85% of in-transit cargo theft involves motor carriers.</td><td>Other modes.</td></tr>
<tr><td colspan="2">Organized crime involved in 40% of thefts.</td><td colspan="2">Small local gangs or individual criminals commit 60% of cargo crimes.</td></tr>
<tr><td colspan="4">*Authoritative estimates on the involvement of insiders in cargo theft vary between 50% & 85%.
**For high-tech cargo, 70% of theft occurs in transit. New security measures at electronics distribution facilities nationwide have reduced the proportion of crimes occurring onsite.</td></tr>
</table>

Table 4. Domestic Cargo Theft Profile

Insurance investigators and law enforcement agencies believe more than half of all cargo thefts involve employees or ex-employees.[31] When the definition of insiders is expanded to include contractors and business partners, some estimates of the proportion of thefts orchestrated by those in positions of trust are as high as 85 percent.[32]

Prior to 1997, more than 50 percent of all cargo theft occurred at distribution or transfer terminals. However, an increase in on-station vigilance and new security measures in the last few years has led to a shifting of cargo theft to in-transit crimes. In-transit crimes now account for 60 percent of all cargo theft.[33]

Of the cargo crime occurring during transit, 85 percent of the losses involve motor carriers, followed by maritime, rail, and air.[34]

The FBI's Cargo Crime Task Force estimates that 40 percent of cargo thefts are carried out as an organized criminal conspiracy with the collusion of port workers, truck drivers, freight forwarders, dispatchers, and warehouse employees.[35]

The Impact of Logistics Crime

Logistics crimes impact both the emotional and physical security of the people involved in the supply chain or logistics networks, disrupt reliability in logistics services, increase insurance and transport rates, cause financial loss, contribute to higher prices, and have an economic cost on society.[36] The national shortage in truck drivers has been compounded by drivers leaving this field of employment out of fear of being hijacked. The International Maritime Bureau reports on the emotional toll piracy is taking on crew members at sea where attacks by modern *Bluebeards* are turning more violent.[37] Warehouses have become dangerous places to work with recurring instances of employees being maced, knifed, shot, and pistol-whipped.[38]

Today's supply chains are designed for high efficiency with lean inventories. Inventories for continuous replenishment are largely in quasi warehouses on wheels or rails, afloat, or aloft. This pull-type logistics system makes cargo theft highly disruptive with plant shutdowns and customer service failures often being the end result.

In economic terms, logistics crimes in all their dimensions have an obvious impact. Pilferage increases costs. Bribery distorts and suboptimizes a firm's resource allocation decisions. Theft in the electronics industry is estimated to add $150 to the price of a personal computer.[39] Stolen products may reappear on the market at a low price and compete with goods that have moved through legitimate channels. Insurers are increasing deductibles (in many cases from $50K to $500K per incident), raising premiums, and in some cases, refusing to insure certain cargoes in specific transportation lanes.

In terms of cost to society, the RAND Corporation determined cargo theft has multiple costs. In addition to the direct loss associated with the crime, indirect costs of reporting and internal investigations, enhanced security measures, police investigations, lost and displaced sales, reduced profits to the transportation industry, and increased prices to consumers can be a sixfold factor.[40]

The dollar magnitude of pilferage is difficult to assess. Risk management experts report that pilferage is pervasive, operating as a cancerous growth and, for most firms, a larger problem than theft. John Case, a leading security management consultant, states that as a national average for industrial and retail firms, three out of ten employees pilfer and the cost of pilferage far exceeds the cost of theft.[41]

Collective Approaches to the Problem

Government and law enforcement agencies, industry associations, and professional groups are taking concerted actions to deal with the crisis in logistics crime. These include the following actions.

- The National Association of Purchasing Management has formulated guidelines and training materials to deal with gratuities and the potential for bribery in procurement. Logistics management consultants have also developed new expertise in crime prevention and have substantially increased their services in the areas of loss prevention strategies, physical facility design for security, and new crime deterrent technologies.
- Twenty-five high-technology companies have banded together to organize the Technology Asset Protection Association to issue security guidelines on international cargo handling and strategies for evaluating security procedures of carriers.[42]
- The American Trucking Association, a strong voice for elevating the status of cargo theft to a federal crime, recently established a national cargo theft information and prevention service. This capability allows trucking firms and law enforcement officials use a secure Internet to share details on cargo crimes.[43]
- The Western States Cargo Theft Association, a law enforcement and industry partnership dedicated to eradication of cargo theft and hijacking in California, now communicates information on criminal methods and appropriate defensive strategies. Their Internet site posts hefty rewards for tips leading to the recovery of specific heists.[44]
- The National Cargo Security Council was formed in 1997 as a coalition of transportation providers and government agencies for developing *best practices* to foil cargo crime.[45]

- In early 1999, President Clinton set up the Interagency Commission on Crime and Security at US seaports. This commission—involving senior officials from Treasury, Justice, and Transportation—has already recommended stiffer penalties to deter cargo theft at port cities and may recommend mandatory licensing of all dock workers.[46]
- On 9 January 1999, Senator Thomas A. Daschle (D-South Dakota) introduced Senate Bill 9 (Subtitle H, *Deterring Cargo Theft*). This pending legislation, cosponsored by 17 Senators, expands the definition of cargo crime under federal jurisdiction, increases federal sentencing guidelines for cargo theft, and establishes a national database on cargo theft. The bill will also require the Attorney General to submit an annual report to Congress, evaluating law enforcement activity relating to the investigation and prosecution of cargo theft.[47]

Suggestions for Logistics Managers

Examining an organization's exposure to logistics-related crimes suggests that managers must deal with the prospects of onsite crimes committed by both insiders and outsiders. In addition, managers must control their risks incident to offsite crimes when their products are in the custody of a third party or being transported by private fleet.

Written and Communicated Policies and Procedures

Managing an operation's exposure to logistics crime begins by developing clear policies and a loss prevention plan. The process requires engaging and coordinating with logistics partners (contracted operations and transportation companies, for example) and may require the retention of a loss prevention consultant.[48]

A firm must articulate to its employees and partners its expectations concerning honesty and its policies and procedures relating to crime prevention. Further, it must communicate to all trusted agents the impact that logistics crime can have on their common well being.

A loss prevention plan will incorporate written policies and procedures and directives for physical security measures, employee screening, document and communications security, evaluation of transportation providers, driver identification and control, and employee and work management.

Loss prevention campaigns with prominently displayed posters and tips bulletins—coupled with recurring training sessions to communicate corporate policies on accepting gratuities, no-exception accountability records, safeguarding the confidentiality of documents and computer records, controlled access, need-to-know communication restrictions, reporting suspicious behavior, challenging unknown individuals, and using an anonymous tip line—form the basis of an internalized loss prevention plan. Employees must understand the organization's top-to-bottom commitment to high ethical standards and loss prevention.

Physical Security

The ultimate in physical security begins with a building design that divides the facility into cells protected by locked doors that can only be opened by electronic code.[49] Such a system, coupled with controlled access from the outside and electronic tracking of all movement of people and inventory within, makes invasion robberies, thefts, breakouts, and pilferage almost impossible.

The full range of physical security measures includes fences, security guards who do random and double-back patrolling, ample interior and exterior lighting, closed-circuit television cameras, a uniform identification and sign-in system, employee parking lots away from inventory storage areas and outside fences, intrusive detection alarms (infrared, acoustic, or mechanical), good housekeeping, separation of shipping and receiving areas, and all dock doors closed when not actively receiving. Other measures include limiting the number of exits employees can use and rotating security guard assignments to discourage fraternization with employees who may turn out to be dishonest.

Employee Screening

The majority of logistics crimes can be traced to insiders, including reconnaissance done by temporary employees, suppliers, customers, and contractors.[50] As a result, a comprehensive loss prevention plan must involve criminal and credit checks on new employees, independent contractors, and other insiders. Such screenings require careful adherence to law.[51]

Document and Communications Security

Firms should insist on no-exception accountability. No cargo should move without a document (or a computer record with bar code and scanner tracking), even if it is being shifted within the warehouse itself. Bills of lading and packing lists must be controlled. Employee access to electronic data interchange (EDI). (Dishonest employees use access codes belonging to coworkers to trace shipments for a robbery or to deliberately misdirect a shipment to set up a theft.) Limit discussions on inventories and shipments to a need-to-know basis. Drivers must be cautioned not to talk about the loads they carry, both on the CB and at truck stops. Thieves must not be guided to the merchandise with labels; nondescriptive packaging must be used and logos removed from containers.

Evaluation of Transportation Providers

Because the majority of cargo theft occurs offsite, the evaluation of security practices of the transportation providers and freight forwarders is crucial.[52] Security conscious third parties will incorporate such practices as:

- Employee background checks.
- Instructing drivers to be mum on cargoes and routes.
- Parking the rear of the truck against a wall or never leaving a truck unattended.
- Advanced locking mechanisms on the rear of cargo trucks, including alarmed devices, controlled access to and within freight terminals, transponders, and the Global Positioning Satellite system for multimodal and worldwide tracking of freight.
- Use of secure containers with heavy duty barrier seals that are drill and pick resistant.
- EDI transmittal of documentation to limit ability to change bills of lading and so on.[53]

One of the best ways to assess the security practices of a carrier is to insist on seeing evidence that the carrier's insurance company has audited and approved the plan.

With respect to carrier liability and insurance, shippers must understand limitations to which they may be subjected. For example, a carrier may limit its liability to $250K per trailer or

container even though the value of the contents far exceeds this amount. Insurance is typically not available for motor freight into Mexico.

With the high levels of cargo theft today, insurance companies have substantially raised the deductibles carriers must pay (particularly for high-value cargo).[54] Shippers need to evaluate the financial posture of prospective carriers to ensure carriers can meet these hefty deductibles. It is particularly important to assess the financial position of carriers who are self-insured.

For international shipments, shippers must be alert to the fact that carriers are being denied insurance protection for some high-risk ports (south Florida, for example).[55] For ocean freight (particularly freight moving through areas of high piracy), the shipper must confirm the freight is protected by an *all risks* policy.

Driver Identification and Control

Firms should demand photo identification and authorizing documentation from all outside drivers. Providing a driver waiting room or establishing a line in the warehouse that drivers are not allowed to cross is also prudent.

Employee and Work Management

Security consultants report that compensation levels directly affect theft rates, since employees view pilferage as a tax-free bonus for being underpaid.[56] Mangers must not only promote a sense of mission efficiency and cost objectives among employees but also ensure that pay is equitable.

Managers must also design work assignments in procurement, warehousing, and shipping to ensure separation of duties. Additionally, buyers, traffic managers, inventory managers, and other key players should occasionally be rotated to other duty areas or positions. Separation and rotation of duties reduces the ability of one individual to perpetrate a logistics crime.

Employees must be trained in the *need-to-know* communications philosophy on the job and instructed in not talking about their company's affairs and procedures in public.[57]

Employers should provide a problem-solving forum or an employee assistance program for associates with financial difficulties, substance abuse problems, or even mental health difficulties. Such a program can defuse the propensity for insiders to perpetrate logistics crimes.[58]

Finally, employees must be made formally accountable for losses. This is best done through training and by having each employee sign a form that states clearly all company policies relating to honesty and integrity, including causes for dismissal.

Conclusion

Logistics managers need to become aware of the growing risks of becoming a victim of logistics crime. These crimes can occur onsite (bribery, pilferage, and records tampering) or offsite (container theft, robbery, and hijackings). Further, most logistics-related crimes of both categories involve insiders.

The most burgeoning problems are cargo theft (domestically and internationally) and piracy on the high seas. In dollar magnitude of loss, however, the most significant problem may be pilferage. Perhaps the most pernicious problem is bribery of decision makers because this crime can go undetected for long periods and distorts critical resource allocation decisions.

The trends in cargo crime are particularly serious: escalating rates, growing involvement of drug traffickers and organized crime, increasing violence, and more sophisticated executions involving insiders and fraud tied to the computerization of freight handling.

The FBI recently reported, "The theft of cargo has become so widespread that it constitutes a serious threat to the flow of commerce in the United States."[59]

The growth in logistics crime in the last decade has gone from random and insignificant to a serious problem that is increasing costs to logistics players, consumers, and society at large.

Efficiency in supplier choice and reliable inbound deliveries and efficiency and reliability in outbound distribution are at the heart of modern economic activity. Logistics crimes not only are expensive but also disrupt the reliability and efficiency that form the backbone of modern logistics networks.

Leading-edge logistics managers of today must modify their practices and introduce new controls to reduce the risk of being victimized by logistics crimes.

Notes

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The DLA Integrated Consumable Item Support Model

LIEUTENANT COLONEL
JOSEPH M. CODISPOTI

As the nation's logistics combat support agency, the Defense Logistics Agency (DLA) is charged with the primary role of providing supplies and services to America's military forces around the globe. As a provider of supplies, DLA manages more than 4 million consumable items—more than 90 percent of the consumable items in the Department of Defense.[1] Traditionally thought of as a *nuts-and-bolts* supplier of low-cost, low-impact items, under the Consumable Item Transfer (CIT) program, DLA has inherited the management of thousands of consumable items from the Services. As a result of CIT, DLA now manages many more high-impact, *showstopper* items that directly support warfighting.

Although DLA defines itself as a *combat support* organization, it spends comparatively little energy defining the combat requirements it could be expected to support during contingencies. A perusal of the Agency's strategic plan indicates a clear orientation toward peacetime support, not the expected wartime needs. The plan addresses a need to comprehend customer requirements and produce integrated combat logistics solutions, but combat support is absent from the Agency's specific goals and objectives. However, DLA is not completely to blame for its peacetime orientation. The Services typically do not identify credible wartime requirements to DLA and do not appropriately identify which DLA items are critical to the operation of combat essential systems.[2] Nevertheless, DLA is not well postured to project and potentially meet the Services' wartime requirements.

ICIS Tasking and Objective

The Integrated Consumable Item Support (ICIS) model is DLA's effort to help the Agency take a proactive approach to warfighter support.[3] In December 1993, former DLA Director Vice Admiral Edward Straw voiced concern about DLA's inability to determine how well it could support large-scale contingency operations. The Desert Shield/Desert Storm experience left him concerned about how much longer DLA could have supported a medium- to high-level operations tempo. Of particular concern was the mandate to slash the inventories DLA had relied upon during the Gulf War. How long could DLA support future wars with significantly reduced inventories? Admiral Straw's concern led to the formation of a task group to develop a tool to answer the following questions:

- What are my war stopper items?
- What weapon systems will be affected by lack of these war stopper items?
- When will I run out of stock?
- What investment decisions should I make today to better support tomorrow's contingencies?

The task group (eventually named the Warfighting Integration Team and hereafter referred to as the ICIS team) set out to develop a tool to meet the director's tasking. The objective was to "continuously assess DLA's ability to meet Service consumable item support requirements during major theater war and other high demand scenarios." The final product would be DLA's ICIS model.[4]

The first two challenges in the director's tasking were to identify DLA's *war stopper* items, hereafter referred to as critical items, and determine the weapon system application. The ICIS team defined critical items as items whose failure would render a combat essential system not mission capable (NMC) or partially mission capable (PMC).[5] Combat essential systems, identified by the Services, are major end items used by combat arms, combat support, or combat service support personnel in the theater of war. War stopper items could thus range from power supplies on F-16 aircraft to filters on water purification units.

With the concurrence of the Air Force Materiel Command (AFMC) Studies and

Analysis Office (AFMC/XP-AO), the ICIS team used the following criteria to identify Air Force critical items:

Mission Item Essentiality Code (MIEC) (3^d position) = E or F
Level of Indenture (LOI) = 1 or 2
Source, Maintainability, Recoverability Code (SMR) (2^d position) = O

Using these criteria, the team captured items that would cause an NMC or PMC condition (MIEC criteria) and be removed and replaced by the warfighter on the flight line (LOI/SMR criteria). These are the same criteria used by AFMC to determine items most likely to have an immediate impact on combat operations.[6]

The applications, programs, and indentures (API) file, managed by the AFMC Item Management Division (AFMC/LGI), contains the set of component items for Air Force aircraft and engines. Equipment specialists in the air logistics center system management shops maintain the database for their respective aircraft and engines. The ICIS team receives the API annually, applies the critical item criteria, and produces a *filtered* list of Air Force critical items, by weapon system, for use in ICIS analyses.[7] This process builds the database to answer the first two questions in the tasking—what are my critical items and to what weapon systems do they apply? The ICIS team completes the joint force critical item set by using Service databases to pick out items and weapon system applications. The important aspect of the critical item identification process is that DLA is using Service data and an approved methodology.

To answer the third question—when will I run out of stock?—The ICIS team modified DLA's sourcing model to create the new general sourcing model (GSM). The GSM basically compares expected demand to DLA inventory and projects how well DLA might be expected to support the combat operation.[8]

The fourth question in the tasking was overcome by events when funding for war reserve stock for DLA-managed materiel was transferred from DLA to the Services. The director's intent was to determine how much readiness could be gained with increases in war reserve funding. Armed with ICIS assessment results, the director could better defend requests for increased war reserve funding from Congress. Although the original intent of the director's tasking is no longer valid, DLA can still use ICIS to identify potential sustainment problems and initiate proactive investment measures; for example, surge clauses, direct vendor delivery capabilities, or as a last resort, increased inventory.

Assessment Process

The ICIS assessment process can be divided into three basic parts: input, sourcing, and output.

Input. The basic building block for the ICIS assessment is a flow of forces and equipment to a theater of operations. The time-phased force and deployment data (TPFDD) is the primary force flow data source in ICIS. For Air Force units, the TPFDD will identify the type of unit, number/type of aircraft, number of troops deploying, deployment location, and required delivery date at the deployment location. Gleaning this data from the TPFDD, ICIS can determine, for example, that 72 F-16C/D aircraft and 1,500 Air Force troops are deploying to Kwangju Air Base on D-plus-3-day.[9]

The next piece of critical input data is the planned operating tempo (OPTEMPO) for weapon systems. The Air Force data source is the Readiness Spares Package (RSP) Authorization Document, also known as the *War Mobilization Plan-5*, or WMP-5. This document provides planned sortie rates/durations for each combat aircraft identified in war plans. It is used by the supply community to build RSPs and used in ICIS to determine projected flying hours for deployed aircraft. Suppose the WMP-5 OPTEMPO for F-16 aircraft is 2.5 sorties per day with an average sortie duration of 2 hours. ICIS would apply these rates to all F-16 aircraft deployed to the theater. In our example, the F-16s at Kwangju would be flying 360 hours per day (2.5 sorties x 2 hours/sortie x 72 aircraft).[10]

The next bit of information would be the critical item set and failure factors for those critical items. As described previously, the Air Force critical item set is extracted from AFMC's API file. The failure factors are derived by comparing the annual demand for the item with the flying hour profile for the weapon system. The annual demand is extracted from DLA's requisition history file and the annual flying hour profile is extracted from the programs portion of the API file. If the Air Force requisitioned 50 Type A circuit cards for the F-16 during 1998 and the F-16 fleet flew 10,000 hours in 1998, the failure factor for Type A circuit cards would be 50/10,000, or .005 per flying hour. Continuing our example, the F-16s at Kwangju would demand 1.8 (360 x .005) circuit cards per day. ICIS would calculate demand for Type A circuit cards (and all other F-16 items) for the entire F-16 fleet in theater and pass the expected daily demand to the assessment process. The model will repeat this process, for all item/weapon system combinations, each day of the scenario.[11]

Sourcing. The daily demand per item is segmented by weapon system and Service. For example, if a DLA item is common and critical to F-15 and F/A-18 aircraft, ICIS will project separate demand streams for Air Force F-15C/D and F-15E, Navy F/A-18C, and Marine Corps F/A-18D aircraft. Sourcing is accomplished by comparing demands to inventory (actual and projected due-in), and demands are either filled or placed on back order. Using this basic process, ICIS assesses how well DLA could be expected to support joint force requirements for the given operational scenario.[12]

Output. ICIS produces three basic types of output: metrics, a problem item list, and an operational availability (A_o) model interface file. The first of three metrics is fill rate, which is the percentage of demands filled during the assessment. If the expected demand for an item is 10,000 and DLA fills 9,000 demands, the fill rate is 90 percent (9,000/10,000). The second metric is average number of back orders, which depicts the *potential hurt* for an item. An item with a very high average number of back orders has the potential to impact a significant number of combat essential weapon systems. The final metric is projected response time (PRT), which measures the time from the date of demand until the item is received in the theater. The higher the PRT, the longer it takes, on average, for DLA to satisfy demand. As noted earlier, ICIS creates separate demand streams for each item/service/weapon system combination. As a result, ICIS creates separate sets of metrics for each combination.[13]

The second output is the problem item list. This feature uses the same three

metrics but allows the user to specify problem item criteria to produce a prioritized list of potential problem items. For example, the user could set parameters to request items with a fill rate less than 70 percent and PRT greater than 100 days. The user then sorts by PRT to list items starting with the highest PRT of record on down to a PRT of 100 days. The problem item list provides logisticians a tool to sort through the thousands of items and focus on the most critical few.[14]

The third output is an interface file for the A_o models, such as the Air Force's aircraft sustainability model (ASM).[15] The ICIS Team met with AFMC/XP-AO and LGI to collaborate on ASM-ICIS input. The first test file was passed to AFMC in late summer for evaluation. AFMC is gleaning fill rate and PRT for Air Force critical items and fusing the expected back order information for DLA-managed items with non-DLA managed items, mainly Air Force-managed recoverable items. The ASM will then produce a composite *hurt list* that shows the items with the potential for causing the greatest number of holes in combat essential aircraft. The ASM-ICIS collaboration will mark the first time a Service will have considered the impact of DLA-managed items on A_o. The ICIS team is pursuing similar collaborative efforts with the Army and Navy; the Marine Corps has no A_o model.

Commodities

ICIS currently assesses all DLA-managed commodity types, except Class VIII (Medical). The Kwangju F-16 example illustrated the combat critical Class IX (Repair Parts) commodity assessment. ICIS also assesses Class I (Subsistence); Class II (Clothing and Textiles); Class IIIB (Bulk Fuel); Class IIIP (Packaged Petroleum, Oil, and Lubricants [POL]); Class IV (Construction); and noncombat critical repair parts, which includes support for intermediate and depot maintenance. Subsistence assessments consider the unique production and distribution capabilities with a *warm and highly* preplanned industrial base. Bulk Fuel assessments, which are beyond the scope of this article, use a unique sourcing routine tailored to this very specialized commodity.[16] The remainder of this article focuses on the commodities (excluding fuel) that directly affect the A_o of combat essential weapon systems and equipment—namely, repair parts and packaged POL.

Air Force Data Limitations

The ICIS model exposes holes in the Air Force logistics data arsenal. Deficiencies vary by commodity type but are most acute in the critical repair parts realm. The following is a summary of deficiencies for repair parts and packaged POL.

Packaged POL. The Army is the only Service adequately tracking packaged POL consumption. Given the criticality of oils, lubricants, hydraulic fluids, and other packaged POL products, the Air Force needs a master packaged POL database. For lack of data, ICIS uses peacetime consumption to project Air Force wartime demand.[17] The aircraft maintenance, transportation, and civil engineering communities could identify the types of packaged POL required for deployed aircraft/vehicle types, as well as facilities and support equipment, and develop consumption factors based on flying or operating hours. They should also account for fluid change requirements supporting planned maintenance and/or prescribed by technical orders. The end result would be consumption factors, based on actual operations, for use in projecting combat requirements. Today's factors, based on pounds per person per day, are *squishy* at best for assessment purposes and perhaps only marginally useful for projecting nonunit cargo lift requirements. Additionally, many of these items are environmentally hazardous. A better educated requirements projection may help reduce the stocks initially deployed, as overseas disposal can be costly and politically sensitive.

Repair Parts. This commodity represents the most critical subset of DLA-managed items. While the Air Force maintains a configuration database in the API file, data robustness varies dramatically by weapon system. For example, the ICIS-filtered critical item set for the F-16 includes around 200 items, while the C-130 critical item file includes around 4,000 items.[18] While some disparity can be attributed to the size and complexity of the weapon system, a great deal is actually attributed to the comparative energies of the equipment specialists who populate the API. Representatives in the F-16 System Management Division admitted that API management was an extremely low priority for their equipment specialists. When the paucity of F-16 data was elevated to General George T. Babbitt, then Director of DLA, his handwritten note to the Air Force Deputy Chief of Staff for Logistics sparked intensive effort in AFMC to populate the API.

As noted, Air Force failure factors in ICIS are derived from peacetime demand and peacetime flying hour programs. A more precise failure factor could be gleaned from base-level issues, provided maintenance technicians properly annotate the SRD on issue requests.[19] The current ICIS methodology is sufficient but does not use the best available data.

Perhaps the largest omission in the critical repair parts area is the total lack of data for systems other than aircraft and aircraft engines. AFMC has no API equivalent for vehicles, support equipment, communications equipment, materiel-handling equipment, or other deployable equipment items. Even if such a database existed, the Air Force does not clearly or consistently document in the TPFDD the numbers and types of equipment deploying to the theater. By contrast, the Army assigns a line item number (LIN) to every piece of unique equipment introduced to the inventory. Army planners identify specific pieces of equipment by inserting the LIN and the quantity deploying in the Level 4 detail of the TPFDD. The Air Force could use the SRD for the same purpose, identifying the type of equipment by SRD and quantity deployed in Level 4 detail. Currently, ICIS must be programmed to read a free text field to determine the deploying weapon system—a process hampered by the unique annotations of each planner populating the TPFDD database.[20] By identifying deploying equipment in the TPFDD, identifying critical component parts, and tracking repair part failure factors for equipment other than aircraft, the Air Force could alleviate a hole in its wartime repair parts data.

The intermediate/depot repair part portion of ICIS currently projects

(Continued on page 43)

Understanding the National Security Policy-Making Process: Why Logisticians Should *Care*

Major Vicki J. Rast

This article highlights research findings from interviews with 135 US Government policy makers and briefly accents the importance of understanding the national security policy-making process for logisticians.

Policy Outcomes: Interagency Conflict Leads to War Termination

The nature of the gap between diplomacy and warfighting ensures the interagency national security process develops policy to bring about *war termination* in the form of a cease-fire. However, it fails to achieve *conflict termination* in the form of a sustainable peace. This policy outcome is the result of interagency conflict that occurs because of defects in leadership, the absence of strategic vision, dissimilar organization cultures, disparate world views (for example, political ideologies and philosophies regarding the use of force), and the absence of an integrated interagency planning mechanism to conduct ongoing crisis analysis and option generation. Together, these factors impede the effective development of crisis analysis, end-state vision, termination criteria, and termination strategy.

While it seems obvious to the observer, crisis analysis remains the most crucial aspect of policy development but presents the greatest opportunity for analytical dysfunction. Because decision makers lack strategic vision and focus on tactical-level issues, policy tends to address distinct parts of the conflict system (that is, the nodes—Bosnia) but not the problems engulfing the system as a whole (for example, the Balkans). Further, because the interagency process lacks an integrated planning mechanism and decision makers exclude issue-specific experts from crisis analysis processes, decision makers fail to address the underlying causes and conditions of conflict, promoting instead a *temporary solution* to the immediate crisis in the form of a cease-fire. The effects of interagency conflict on clearly visualizing the end state exacerbate this problem further.

The ways in which decision makers frame crises hold great import for the development of the desired end state. By extension, this analysis frames the end-state vision. The *nature of the crisis* determines goals regarding the post-intervention environment. Again, the tactical focus employed by the decision makers causes them to frame the end state largely in terms of containing the conflict to prevent spillover. This tactical focus likewise negates the decision maker's ability to clearly see the integration of the diplomatic, economic, military, and social instruments of power in a fashion that brings about long-term systemic change. Such a perspective promotes the development of conflict termination criteria that establish goals in terms of simply ending the fighting.

The focus on inducing or forcing a cease-fire prevents decision makers from recognizing the relationship between termination criteria and the political objectives that shape *end-state* vision. Consequently, the clarity of a cease-fire (in terms of organized hostilities) overshadows the development of other *less assessable* termination criteria (for example, *elections* as a political criterion). In conjunction with self-limited crisis analysis and the absence of the desired end state, overreliance on a cease-fire as a verifiable criterion prompts decision makers to frame the remaining termination criteria in ways that fail to induce necessary systemic change but may bring about temporary improvements in a tactical sense. By extension, these factors act in concert to produce an intervention and termination strategy that employs courses of action aimed at ending the physical violence. However, they stop short of achieving positive systemic change toward sustainable peace.

If you don't know where you want to go, any road will take you there. The truthfulness of this axiom applies in its entirety to termination strategy development. Even though decision makers may agree that something should be done, their inability to define the destination ensures that termination strategy development becomes an exercise in driving without a map (termination criteria) toward an unspecified location (end state) as a product of an incomplete conception of what needs to be done (crisis analysis). The inability to articulate those three elements of conflict termination policy produces an environment wherein development of the fourth (termination strategy) defaults to the lowest common denominator—the use of force to induce a cease-fire through creating a damaging stalemate. In the final analysis, the absence of an integrated interagency planning mechanism can only produce a strategy aimed at creating this temporary cease-fire (war termination) but not sustainable conflict termination. As the cases of the Persian Gulf and Bosnia illustrate, *the application of force cannot end conflict for the*

long term. Domestic politics magnify this problem, as the American public remains unwilling to accept casualties. Further, the perceived need to demonize the enemy to mobilize public support prompts decision makers to develop strategies that promote conflict escalation through the application of overwhelming force so they can sustain domestic (and international) support for their actions. Coupled with the need to save face, this dynamic ensures decision makers become more psychologically entrapped as they frame prior expenditures of *blood and treasure* as investments toward future success.

In the final analysis, these boundaries synergistically constrain the decision maker's capacity to consider alternative courses of action, making the use of force to bring about a cease-fire the most implementable option, irrespective of both short- and long-term consequences of that strategy.

But I'm a Logistics Officer . . .

Many of you in *this particular audience* are probably asking, "What is a maintenance/logistics officer doing thinking about these types of national security problems?" My response to this query is straightforward. *Every person* in uniform, as well as anyone else who has influence in the security policy process, needs to be thinking about national security, projections for future military intervention in particular. While I currently play a special role in educating mid-career officers through their intermediate service school experience, each of us has a duty to understand the roles that we as logisticians, commanders, and warfighters play in achieving national objectives and maintaining national security. This duty demands that we educate our comrades in arms regarding airpower's unique role in achieving objectives and maintaining security.

In the post-Cold War disorder, this understanding requires that we effectively articulate our roles to superiors and subordinates alike—both uniformed and civilian—and that we critically analyze the ways in which airpower can best achieve these objectives. At the squadron level, such communication requires that we internalize airpower's contributions toward achieving the vision for the desired end state (during both peacetime and wartime). We must persuasively communicate that vision to our first- and second-term aircraft crew chiefs, supply technicians, logistics planners, and mechanics, as well as our lieutenants and captains. Our ability to retain and attract qualified people correlates directly with our individual ability to demonstrate that what we do *every day* directly affects national security. Young people today want to know they can make a difference. Because our career fields constitute the vast majority of Air Force personnel, our ability as logisticians to articulate that influence is a direct reflection of our individual leadership, leadership that affects retention rates in critical specialties. Without a broader understanding of the national security process and the role the Air Force plays (see, for instance, former Air Force Secretary Sheila E. Widnall's "Air Force Contributions on National Security Strategy"), we fail to convince our people that what they do makes a difference, a perilous failure on our part! Our leadership and understanding play a crucial role above the unit level as well.

At the strategic level, our lack of understanding of the national security policy-making process hampers our ability to articulate the role airpower uniquely plays in the pursuit of national interests and core objectives. A multidimensional problem too complex to elaborate herein, this weakness impacts our ability to fund the programs the Air Force foresees as future requirements while simultaneously limiting innovative thinking within the interagency, joint, and combined arenas. Reflect for a moment: what roles do you as a logistician play in this process?

The problem for many of us is that we begin thinking about these role-specific issues far too late in our careers (senior 0-4 or 0-5 level). By this time, our professional experiences have shaped our analytical techniques, promoting the adoption of the *we've always done it that way* mentality or, worse yet, prompting *nonrated* officers to have no opinion at all on these matters.

Consequently, our capacity to develop alternative airpower employment ideas tends to mirror prior experience, focusing almost exclusively on bombing, airlift, and maintaining air superiority. Unarguably critical competencies, we have to ask if they represent the *only* ways in which airpower can contribute to maintaining national security. Hence, once assigned to key staff positions on the Air Staff, Joint Staff, or commander in chief's staff—contrary to popular opinion, rated officers *do not* make these decisions in isolation—logisticians *unnecessarily* suffer steep *learning curves* to enhance critical analysis skills while honing their abilities to influence decision-making processes. As professionals in the application of armed violence, we need to develop our understanding of policy process dynamics before serving in these critical assignments. Granted, some lessons can be reinforced only through personal experience. However, enhancing our understanding of the policy process early in our careers ensures we enter these positions with our eyes and minds wide open. If, indeed, we are learning through our mistakes, at what cost does this learning occur? Who pays the interim and, perhaps, long-term price for our *learning curves*? This point bears repeating. It is our responsibility as professional officers to develop an understanding of policy process dynamics before we begin to serve in positions that affect national policy, acquisition, and research and development of new weapons systems in particular.

In the end, our ability to comprehend and articulate the role logisticians play in the national security process affects our nation's capacity to employ airpower effectively and efficiently. Whether serving at the unit level (being primarily responsible for sortie generation) or at the command and staff level (envisaging and controlling the tactical, operational, and strategic employment of air assets), logisticians must be able to think innovatively about the use of airpower. Only then can we maximize our specialty's unique contribution as we help leaders understand the role airpower plays in securing national objectives, while simultaneously convincing airmen of all ranks that their dedication and effort contribute directly to sustaining the security and prosperity of our nation.

Major Rast is on faculty at the Air Command and Staff College. An aircraft maintenance officer, she has experience with F-16 deployments during Operations Desert Shield, Desert Storm, and Southern Watch.

Air Force Research Laboratory

Deployment and Sustainment Research and Development

The Air Force Research Laboratory Deployment and Sustainment Division (AFRL/HES) conducts research to improve Air Force logistics functions at the retail and wholesale levels and protect Air Force personnel in potentially toxic environments at deployed locations. Applications cover a broad spectrum of field, depot, and space operations with customers throughout the Air Force, Department of Defense, other government agencies, academic institutions, and US industry.

To obtain more information about the following ongoing research projects, contact the program managers listed below or visit the Deployment and Sustainment Division's home page at www.he.afrl.af.mil/hes/index.htm

ABDAR Technology

Objective. Enhance Air Force aircraft battle damage assessment and repair (ABDAR) by providing battle damage assessors, technicians, and engineers with quick and easy access to assessment and repair information.

Approach. A contracted research effort with four major phases began in August fiscal year 1995. In Phase I, a requirements analysis was performed to identify information required by assessors and engineers to assess damaged aircraft. In Phase II, the design effort focused on providing ABDAR information to the user through a portable maintenance aid (PMA). The PMA will contain all the information required, including assessment and repair logic, technical orders, parts information, wiring diagrams, schematics, and troubleshooting data. A graphical user interface will allow the user to easily access and comprehend ABDAR information. The Phase III effort involved implementing the software design, authoring technical data, and integrating the system. Data for a specific test-bed aircraft was developed for presentation on the PMA. Finally, in Phase IV, system enhancements were made and a field test was conducted to evaluate system effectiveness and user acceptance.

Payoff. Fast and accurate battle damage assessment and repair will lead to improved combat effectiveness, by reducing the time to get damaged aircraft back to mission capable status. Less experienced users will have better access to ABDAR information, reducing the reliance on highly trained assessors. Minimizing the amount of paper technical data and supporting information presently required will enhance deployment capabilities.

First Lieutenant Steve Grace, AFRL/HESR, DSN 785-8422, Comm (937) 255-8422, steven.grace@he.wpafb.af.mil

Monocular Display Devices and Alternative Computer Control Devices to Aircraft Maintenance

Objective. Assess promising new monocular display and alternative computer input technologies for the presentation and retrieval of maintenance technical information for flight-line and depot maintenance.

Approach. A series of experimental studies is being conducted to evaluate the devices for supporting various maintenance tasks. Initial efforts focused upon evaluating monocular display devices (MDD) and alternative computer control devices (ACCD) in a variety of environments. Efforts are focusing upon testing a variety of newly developed MDD and ACCD technologies. MDD devices include occluding and see-through displays. ACCDs include state-of-the-art speech-based controls and electromyographic (EMG) controls. EMG devices use electrical signals accompanying muscle contractions to input user commands. Seven studies and numerous usability evaluations conducted since 1991 have demonstrated significant improvements in performance of technicians using MDDs under a variety of conditions and for a variety of tasks. Initial ACCD studies using speech recognition technology have shown significant benefits to the technology but have also identified problems encountered due to noise. Studies are planned for using advanced speech recognition and special microphones placed in the ear. This work is being conducted as a joint effort with the AFRL Crew Systems Interface Division.

Payoff. The payoffs to the Air Force will include improved maintenance performance, reduced maintenance down time, and reduced maintenance costs.

Barbara Masquelier, AFRL/HESR, DSN 986-7005, Comm (937) 656-7005, barbara.masquelier@he.wpafb.af.mil

Deployable Waste Management System

Objective. Develop and evaluate a deployable waste management system to support bare-base operations. The system will process the primary types of waste produced during deployed operations, including municipal solid waste, medical waste, petroleum, fuels, waste water, and air emissions.

Approach. The initial step will be to characterize (identify) materials that must be processed at typical deployed operations sites. Characterization of waste streams is necessary in order to ensure that the system will handle all materials encountered throughout a deployment. Concurrently, innovative technologies will be evaluated for application in the system. The technologies include revolutionary new processes as well as commercial off-the-shelf (COTS) systems. The most promising technologies for processing each type of waste will be identified. Also, opportunities to minimize waste at the source will be investigated. Preliminary system designs will be developed for evaluation of the most promising technologies and waste reduction techniques. Analytical models of the designs will be tested to evaluate the processing of waste streams expected from

a bare base. The analysis results will be used to determine which design will be fabricated for testing. After completion of the system, performance testing will be conducted involving individual component tests as well as total system tests. Following individual component testing, the system will be assembled to evaluate overall performance. Initial tests will be conducted in the laboratory, followed by tests in the field.

Payoff. This effort will demonstrate the feasibility of a DMWS that provides cost-effective processing and neutralization of waste products produced during bare-base operations. Proper management of the waste materials will provide a safer, healthier environment for Air Force personnel, reduce the amount of cleanup required at the completion of the operations, and reduce environmental damage, promoting better relations with the host nation.

Jill Ritter, DSN 986-4391, Comm (937) 656-4391, jill.ritter@he.wpafb.af.mil

Logistics Control and Information Support

Objective. To provide logistics personnel at all echelons within the wing-level complex proactive access to real-time, accurate information needed for decision support, and more effective utilization of logistics resources.

Approach. The Logistics Control and Information Support (LOCIS) program is researching and developing technologies for an enhanced command and control capability for wing-level logistics personnel. LOCIS will provide easy access to logistics information to support *proactive* problem identification and resolution. LOCIS technologies will automatically collect and synthesize information required for key logistics decisions. The most important pieces of information will be retrieved from existing maintenance, supply, munitions, and fuels information systems. Using advanced information technologies, LOCIS technologies will automatically supplement this information with data from legacy information systems to provide immediate, useful information to logistics decision makers. In addition, LOCIS will use automated data collection technologies to supplement existing data with real-time data. LOCIS technologies will provide logistics decision makers with a look-ahead simulation capability to identify problems in the planning/ replanning process.

Payoff. LOCIS will provide logistics personnel the information and tools needed to better perform their duties. Through the use of real time, accurate information, and the application of advanced decision aids, logistics personnel will be more effective in the day-to-day use of their assets and in short-notice deployment operations.

Barbara Masquelier, AFRL/HESR, DSN 986-7005, Comm (937) 656-7005, barbara.masquelier@he.wpafb.af.mil

Logistics Contingency Assessment Tool

Objective. To demonstrate new technologies and processes to improve the deployment planning process, reduce deployment footprint, reduce deployment response times, and use deployment resources more efficiently and effectively.

Approach. The logistics contingency assessment tool (LOGCAT) is a vision for improved wing-level deployment planning and replanning. Currently, the LOGCAT vision comprises four integrated initiatives, survey tool for employment planning (STEP); unit type code cevelopment, tailoring, and optimization (UTC-DTO); beddown capability assessment tool (BCAT); and logistics analysis to improve deployability (LOG-AID). STEP will use advanced integration of computer hardware and software to automate the collection, storage, and retrieval of deployment site survey information. STEP consists of three major subsystems: a suite of computerized/multimedia site survey data collection tools, deployment site knowledge database, and graphical and collaborative user interface for retrieving information from the deployment knowledge database. Transition of the STEP to the Standard Systems Group (SSG) for operational implementation was completed IN fiscal year 1998. UTC-DTO uses advanced software to automatically develop UTCs, automatically tailor UTCs based on individual deployment scenarios, and optimize the packing of UTC equipment onto 463L cargo pallets. BCAT uses advanced database design to compare deployment site force beddown capabilities against deploying force requirements and produce a list of resource shortfalls. Transition of the BCAT to the SSG for operational implementation was completed in fiscal year 1998. LOG-AID is analyzing the deployment process firsthand to define requirements, identify additional opportunities, and improve deployment-planning processes. Where appropriate, additional planning tools and processes will be developed and integrated with the BCAT, STEP, and UTC-DTO tools to form a demonstration deployment planning system. The deployment planning demonstration system was evaluated in a field test at Mountain Home AFB in September 1999. Current efforts are focused on assisting the transition of the technology for operational use.

Payoff. Improved wing-level deployment planning and execution will increase Air Force combat capability. Reducing the mobility footprint will reduce requirements for scarce airlift assets, enabling deployment of additional combat capability. Reducing deployment response time will increase the deterrent effect of our military forces on distant enemies and allow policy makers to respond more quickly to aggressive actions should deterrence fail. More efficient and effective use of mobility resources will allow the Air Force to maximize its power projection capabilities.

Captain Adrian Crowley, AFRL/HESR, DSN 986-4558, Comm (937) 656-4558, adrian.crowley@he.wpafb.af.mil

Logistics Research Requirements Survey

Objective. The primary objective of this effort was to determine the feasibility of using a Web-based survey instrument to identify needed research in the logistics and maintenance environments. The ultimate goal is to develop a methodology to help identify research opportunities that directly support the expeditionary airpower and mobility capabilities.

Approach. The basic approach was to select a specific area of logistics to test the proposed survey methodology, develop survey questions relevant to that area, collect responses from personnel in the field via the Internet, and analyze the data collected to evaluate the methodology and identify specific research requirements. Supply was selected as the specific area of study because of its focused and defined boundaries. Once it was determined that supply would be the chosen area, the survey team conducted field interviews with a wide variety of supply personnel to determine key themes and concepts to be addressed. Questions were developed, a COTS survey tool selected, and questions were created and validated with follow-up interviews. The survey was then made available over the Internet for supply personnel to input their responses. The availability of the survey

was announced to supply personnel via the supply management chain. The response from the field was very positive, and a large amount of data was collected. The final report is presently being prepared.

Payoff. The laboratory will be able to respond more quickly and accurately to current research needs in the areas of maintenance and logistics. Technologies to reduce costs and increase operational capabilities will be made available to the warfighter.

Cheryl Batchelor, AFRL/HESR, DSN 986-4392,Comm (937) 656-4392, cheryl.batchelor@he.wpafb.af.mil

Predictive Failures and Advanced Diagnostics

Objective. The objective of this effort is to develop technology to reduce aircraft down time by enhancing the capability of maintainers to identify the causes of system failures through better diagnostics and, where possible, the imminent system failures (failure prognostics) so that repairs can be made before an actual failure occurs.

Approach. Research the various areas that make up the diagnostics and prognostics process and focus on the improvements that offer the best return on investment. Initial efforts will involve an analysis of the diagnostic process, identification of those variables presently used to diagnose faults, identifying other variables for which data may be available (such as built-in test sensor data), and identification of historical information (such as failure rates and component failure histories for specific aircraft/components and for fleet aircraft/ components). These data sources will then be used to develop advanced diagnostic algorithms. The algorithms will employ state-of-the art pattern recognition techniques, data-mining applications, intelligent agents, and self-adapting artificial intelligence techniques. The algorithms will then be tested using an aircraft subsystem as a test bed. In Phase II, the diagnostic algorithms will be extended and adapted to predict system/ component failures. This capability will be based upon recognition of patterns of system behavior that typically occur just before a component fails, plus other factors such as time between failure.

Payoff. This effort will yield advanced capabilities in two areas: diagnostics and prognostics. The diagnostics capability will significantly increase the accuracy with which technicians are able to diagnose the causes of system failures, thereby restoring the aircraft to operational status sooner and reducing the consumption of spare parts. The prognostic capability will make it possible to replace about-to-fail parts before they fail, reducing system failures, in-flight aborts, and aircraft accidents. It will provide for more effective provisioning and placement of parts, ensuring that the right part is in the right place at the right time. It will provide a critical capability for Agile Combat Support and will be an enabling technology for the Air Expeditionary Force scenario.

Paul Faas, AFRL/HESR, DSN 986-4390, Comm (937) 656-4290, paul.faas@he.wpafb.af.mil

Cognitive Process Modeling

Objective. Develop and demonstrate advanced modeling and simulation techniques that can easily generate high-fidelity computer models of human behavior as well as state-of-the-art intelligent agents for use in synthetic environments, distributed simulations, and information systems.

Approach. The maturation of intelligent agent technology has created the opportunity to apply such technology to the modeling and simulation of human and organizational behavior and the development of advanced human-computer interfaces. In the area of modeling human behavior, the Research Laboratory is applying intelligent agent modeling techniques to the development of advanced command and control echelons, technical controllers, and human performance organizational models. The development of such models will increase the realism of joint synthetic battlespace exercises while reducing their cost. In addition, these types of models will allow the simulation of information operations. One of the major goals of the effort is to provide users with a flexible scenario generation capability that will enable them to easily adapt available models to a wide variety of exercises with minimal effort.

In the area of human computer interfaces, intelligent agents are applied to the creation of interfaces that use agents to selectively monitor and react to state changes in the world. When user-specified conditions are met, the agents become active and perform actions on behalf of the user. New capabilities being developed include standard user-interface profiles (by position), the ability for a user to request customized information (from disparate data systems), and *look-ahead* and *what if* scenario planning tools. While the target demonstration is Air Mobility Command's Tanker Airlift Control Center, the technology developed in this effort will be applicable to a wide range of logistics applications. It is intended that users with no programming experience will be able to program the intelligent agents, thus allowing users to decide what information they wish to track and how they want the intelligent agents to respond to changes in the world. The goal is to make the tasking of agents no more difficult than using a spreadsheet. In addition, the agents will operate over computer networks, thus allowing users to monitor and retrieve information at remote locations

Payoff. With the Air Force and the Department of Defense relying more on modeling and simulation technology for a variety of applications—including acquisition, testing, training, wargaming, mission rehearsal, and operational representation of the battlespace—the development of advanced intelligent agent technology will satisfy critical technological voids in these simulations by providing realistic representations of human cognition as well as advanced agent technology to enhance the effective utilization of military information systems.

Dr Michael J. Young, AFRL/HESS, DSN 785-8229, Comm (937) 255-8229, michael.young@he.wpafb.af.mil

Modular Aircraft Support System

Objective. Design, build, and demonstrate proof-of-concept aerospace ground equipment (AGE) that supply electricity, cooling air, nitrogen, hydraulic, and related utilities for aircraft maintenance in modular, multifunction carts. Increase the affordability and reduce the airlift required to deploy AGE through modular designs with advanced concepts and technologies.

Approach. The Modular Aircraft Support System (MASS) program is supported through an integrated product team (IPT) with members from the Air Force support equipment community and laboratories. The IPT will jointly develop requirements, provide customer input, coordinate research and development (R&D) efforts, and support technology transition. Phase I

(Continued on page 43)

EXPLORING THE HEART OF LOGISTICS

Computing Wartime Spare Parts for Strategic Airlift

F. Michael Slay, Robert E. Burleson,
Senior Master Sergeant Jeffery D. Meyenburg

US warfighting doctrine calls for small, mobile forces that can be quickly inserted into regions far outside the borders of the Continental United States. The mission of the Air Mobility Command (AMC) strategic airlift forces is to support these deployments.

To meet these taskings, these aircraft must be able to operate worldwide with very high mission capable rates. Down time due to parts and maintenance must be kept to a minimum because every plane is needed. However, experience indicates that wartime spares support, as presently computed, is inadequate for the task.

A new approach to the modeling of AMC's wartime spare parts requirements has been developed that greatly reduces wartime not mission capable rates with only a 6 percent increase in the total investment in wartime spares. Furthermore, it can easily be implemented in the existing Air Force computation system with some appropriate parameter changes.

AMC Operations

The nature of strategic airlift operations forces the Air Mobility Command to have a unique logistics structure. While other aircraft normally operate from their home base or out of a deployed location with deployed maintenance, airlifters must fly everywhere. A fighter or bomber sortie typically launches from and returns to the same location. An airlifter normally flies a route, typically originating at a main operating base (MOB), either on the East or West Coast, continuing on to various pickup and delivery locations around the world, and returning to the MOB (Figure 1).

Unfortunately, since airlifters fly everywhere, they also break everywhere. When they break, it is essential that they be returned to service quickly. In tactical air operations (for example, F-15 and F-16), a squadron can usually substitute a working aircraft for a not mission capable (NMC) aircraft with little or no impact on the mission. However, the dispersed nature of strategic airlift operations limits the availability of substitute aircraft. Moreover, when an airlifter becomes NMC en route, it is typically loaded with cargo. Even when a substitute is available, fixing the aircraft is usually faster, cheaper, and easier than flying the substitute to the location and reloading the entire cargo. Thus, returning broken aircraft to service quickly is essential to efficient airlift operations.

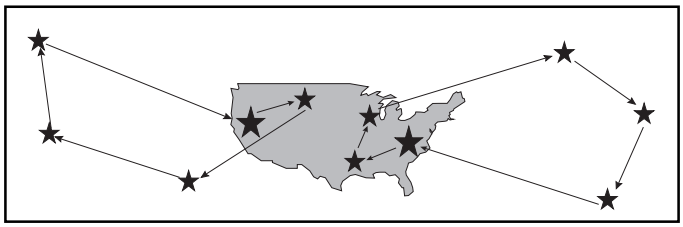

Figure 1. Airlift Routes

For this reason, AMC prepositions people, parts, and tools at various strategic locations. These forward supply locations (FSL) put maintenance and supply elements closer to where they are actually needed. Each FSL supports the activity in a region, such as Europe or the Far East. A stateside primary supply point (PSP), located at an MOB, supports each FSL. The MOBs are supported by the five air logistics center depots.

The Problem

To support wartime operations, the Air Force computes, for each strategic airlift aircraft type (C-5, C-17, and C-141), two kinds of wartime readiness spares packages (RSP), an in-place readiness spares package (IRSP) for each MOB, and a mobility readiness spares package (MRSP) to support en route and deployed location operations. RSPs provide the additional spares needed to support the higher tempo of wartime operations. They are critical to AMC's ability to keep its strategic airlifters operating with a minimum of down time because of parts shortages. RSPs are computed based on a planned level of activity (as reflected in a specific warplan) along with estimates of failures, repair and resupply times, allowable number of not mission capable supply (NMCS) aircraft, and so on. Currently, the RSPs are built using the aircraft sustainability model (ASM), which was designed to compute requirements for aircraft in a tactical environment (for example, for fighters that take off and lands at the same base).

The RSPs for a particular aircraft type, such as a C-5, are computed by splitting the fleet in two, with half of the fleet en route and the rest divided among the MOBs. Typically, there are two MOBs, each getting a quarter of the total fleet. The en route half is modeled as if all the aircraft are at a single base. While this provides for ease and tractability in the computation, it is not accurate.

The inaccuracy derives from two oversimplifications: all the en route aircraft are co-located, allowing for cannibalization, and their demands are all at one place, yielding economy-of-scale effects in supply. While both affect MRSP composition, co-locating the aircraft is more significant. Because the aircraft are actually widely dispersed, en route cannibalization is rarely possible. Even when it is, the priority of returning *all* the aircraft to service weighs against cannibalization. Thus, the en route parts computation should assume no cannibalization (a model option never before used by the Air Force). This profoundly affects the computed mix of spare parts. The impact of having all the demands at one location is similar, if less dramatic. For a low-demand item, a single spare at the one location can eliminate virtually all back orders. However, if demands for the item are dispersed throughout the globe, a single spare will rarely be close at hand. Only having a spare *at each location* would preclude virtually all back orders.

There are other problems. The current computation ignores the relationship between forward stocks and the spares at the MOBs. It assumes that half the fleet is en route (though all co-located) while the other half is divided up among the MOBs. The current computation uses reasonable estimates of the resupply times for each location, but there are no connections. Each spares package is computed independently.

In reality, all the aircraft fly to all the locations, and these locations do not operate independently. The forward locations are resupplied by the PSPs/MOBs. The FSLs are resupplied from PSP stock at the MOB, and the MOB repair shop handles both locally generated repairs and those from FSLs. Thus, all demands ultimately flow through the MOBs. By ignoring this rear echelon role, the current computation grossly understates the demands on the MOBs.

Obviously, a better method is needed—one that models AMC operations and logistics with greater accuracy.

Approach

The system must compute both MRSPs and IRSPs. While the IRSP computation is, by itself, straightforward and needs no fundamental revision, the relationship between the IRSPs and the MRSPs needs to be included. The MRSPs should reflect the PSP support, and the IRSPs should reflect the demands from the FSLs.

Theoretically, all the MRSPs and IRSPs could be computed together by one grand multi-echelon, multi-indenture model. Unfortunately, no such model exists, and even if one did, it would be difficult to put it into the Air Force requirements system. The requirements model already embedded in the Weapon Systems Management Information System/Requirements/Execution Availability Logistics Model (WSMIS/REALM)—the aircraft sustainability model—must be used.[1]

The ASM is an optimization model, computing the minimum cost inventory to yield a given number of aircraft mission capable (MC) on a given day. It is a dynamic, multi-echelon, multi-indenture inventory model, but the multi-echelon computations it is designed to handle are not nearly as complex as the AMC environment. Typically, the ASM is only run for a single site.

Fortunately, it is possible to use a collection of single-site ASM runs (one for each location) to approximate a true multi-echelon computation. The key is correctly accounting for the relationship between the locations and properly portraying the multi-echelon tradeoff of spares between the forward kits (MRSPs) and the kits at the MOBs (IRSPs).

Research was conducted concerning the behavior of multi-echelon tradeoffs using the ASM and the Logistics Management Institute (LMI) aircraft availability model—the current Air Force standard for computing peacetime reparable spares requirements. The models rarely put safety stock at the rear echelon, stocking only enough parts there to fill the pipelines. Furthermore, the exceptions were all special cases involving programmed depot maintenance—a situation in which the rear echelon safety stock is needed to support local operations, not the forward echelon.

This is a striking result and a breakthrough in how to model the AMC case. The safety stock level at the rear echelon to support forward locations can simply be set to zero.

Thus, the IRSP computation is straightforward. The ASM is run to a target number of aircraft MC using the correct demands (including those from FSLs). Because the safety stock to support the forward locations is zero, the IRSP stocks are initialized to the pipeline quantity. The ASM can still buy safety stock to support local operations (to reach the MC target). For IRSP computations, cannibalization is allowed, since aircraft in maintenance at the MOBs are actually co-located.

The IRSP computation assumes that the PSP responds immediately to demands from the forward locations. This assumption provides the key to the MRSP computation—the resupply time to the forward locations should not include any supply delays. That is, the order and ship time (OST) from the PSP to the FSL should be used as the resupply time for the MRSP computation.

Thus, the MRSP computation is also straightforward—standard ASM runs (with the appropriate parameters) can be used. Note that for the MRSP computation, cannibalization is turned off since, as explained earlier, cannibalization en route is rare. Figure 2 shows the connections between the various RSPs.

It is possible to compute MRSPs and IRSPs individually (using existing Air Force requirements systems) and yet have them effectively linked. The MRSP computation would assume support from the IRSPs; the IRSPs would be computed to provide that support.

If the model is to reflect AMC operations and logistics accurately, many details must be resolved. What are the resupply times? If the en route aircraft are not all at a single location, at how many locations are they? (That is, how many MRSPs should we compute?) How much activity will occur at each location? These and other issues are treated in detail in LMI Report AF801R1.[2] Highlights from the report follow.

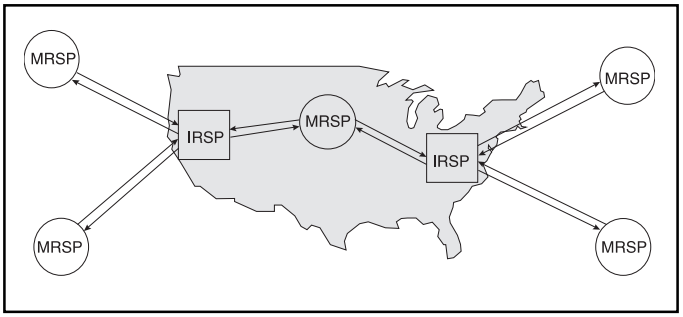

Figure 2, New RSP Configuration

Resupply Times

What resupply time would be most appropriate for use in computing MRSPs and IRSPs for strategic airlifters? Specifically, what should the OST be from depot to PSP? From PSP to FSL? To answer these questions, current AMC resupply times were analyzed. In general, peacetime pipeline performance is not a very good predictor of wartime performance, because in war, most units will deploy to an overseas location and rely on logistics support structures and pipelines not used in peacetime. However, AMC is unusual in that, for the most part, it will use the same logistics support structures/pipelines in war that it uses in peace (though wartime will be more intensive), making it reasonable to utilize peacetime pipeline performance as a measure of expected wartime support.

More than 57,000 OST transactions (December through August 1997) were analyzed for all of AMC's MOBs and FSLs to compute average resupply times from the depots to the MOBs and from the MOBs to the FSLs. These times were computed with and without depot delay and with and without a cap on upper end outliers. Capping outliers prevents a significant upward skewing in the average times.

For the purposes of the AMC IRSP computation, an 8-day resupply time (depot to MOB) (not counting delays) was used. An additional 2-day depot delay was recommended. Though this is less than the reparable item pipeline data analysis tool average, it is an achievable standard.

For the MRSP computation (MOB to FSL), a resupply time of 10 days is recommended. To this figure, no delay time is added, because the MOB is assumed to fill all orders. While this assumption is not always accurate, the MOB NMCS figures cannot be computed without it. Using this assumption does not introduce significant error because the IRSP stock was initialized to the pipeline. Furthermore, when the MOB does not fill a forward requisition, en route NMCS aircraft will need to be increased while decreasing NMCS aircraft at a MOB. Since the MOB would not make this trade unless it is reasonable to do so, this will make the model slightly conservative.

Number of Locations

The current computation builds an IRSP for each MOB and a single MRSP to support all en route operations. The MRSP is then segmented into smaller packages for actual use in various theaters. The new computation builds an IRSP for each MOB and a collection of MRSPs. Currently, three MRSPs are built for the C-17 and five each for the C-5 and the C-141. These numbers are a function of the fleet sizes and will change as the C-17 fleet grows and the C-141 inventory shrinks. Since there are far more than five segments, these MRSPs must be further segmented. This part of the process has not changed.

Activity Levels

The *USAF War and Mobilization Plan, Volume 5 (WMP-5)*[3] defines a worldwide level of activity for each mission design operated by AMC. The current RSP computation in WSMIS/REALM splits this activity between the IRSPs and the MRSP, with half of the planes and activity allocated to the IRSPs and half allocated to the MRSP.

The new method replaces the current procedure with a more accurate division of aircraft and activity based on AMC's detailed analysis of various multiple regional conflict scenarios. For the scenarios, the airlift flow model, a simulation of wartime airlift operations, was run repeatedly by the AMC Studies and Analysis Flight. The results were averaged to produce regional activity levels applicable to the various RSPs, and the total activity was prorated accordingly. Since a majority of the activity is en route, the MRSP now receives more than half of the total.

However, this proration was not generated simply on the basis of the flying hours from the Air Force manual. Rather, using the results from our earlier demand forecasting research, the total activity should be prorated on the basis of a combination of sorties and flying hours.[4] For airlifters, failures are 75 percent sortie driven and 25 percent flying-hour driven. The activity is prorated among the RSPs accordingly.

Thus, with the MRSPs getting more than half the total aircraft and flying hours, one would expect the IRSPs to get less than half, but there is another twist. Since the MOBs support the en route operations, the demands at a MOB include the demands generated by the local activity at the MOB *plus* all the demands that flow from the en route locations it supports. Thus, instead of getting less than half the total aircraft and flying hours, the IRSPs are computed as if they get all of the aircraft and flying hours.

This sounds like double counting, but it is not wrong. In any multi-echelon system, demands at a retail location can echo up through the supply chain, causing repeated demands at higher echelons. It is correct to count all those demands at all the locations.

Conclusions

To assess the impact of the new methodology, C-5, C-17, and C-141 RSPs were computed using both the old and new methods and the September 1998 D087 buy kit data. The new method increases the cost of the kits slightly and increases their range and depth significantly. The total RSP requirement rises from $530.1M to $560.7M, a 5.8 percent increase. To determine the cost impact on Air Force buy-and-repair requirements, changes in the RSP requirements were inserted into the central secondary item stratification. The new computation yields $10.4M in new buys and $8.6M in additional repairs.

To compare the resulting parts mixes, AMC analyzed the changes in the total MRSP requirement for those NSNs that caused mission incapable, awaiting parts incidents in 1998. An NSN with enough MRSP spares to put one unit in each segment is called *sufficient*. Insufficiency in a mission incapable causing NSN is a matter for concern, since segments without this part are a potential source of serious delays. The new computation yields significantly increased levels, specifically in many of those mission incapable-causing NSNs that are insufficient. Most of the insufficient NSNs become sufficient in the new computation. Conversely, only a handful of sufficient NSNs become insufficient.

To estimate the impact of the new RSP on readiness, the old and new kits were assessed using the new method. The new RSP, computed to reach a direct support objectives with the new method, achieves the target number of aircraft MC, while the old RSP yields a catastrophic number of NMCS aircraft (more than five times the allowed number in all cases). Clearly, AMC could not continue to operate as planned under these conditions. Heroic measures—expedited resupply, en route cannibalization,

and en route line replaceable unit repair—would be necessary to even approach the planned number of sorties.

Thus, the new AMC RSP computation method yields significant improvement in readiness at minimal cost. The Air Force is currently in the process of implementing the new method in the Weapon Systems Management Information System/ Requirements/Execution Availability Logistics Model requirements computation.

Notes

1. F. M. Slay, et al, *Optimizing Spares Support: The Aircraft Sustainability Model*, Logistics Management Institute Report AF501MR1, October 1996.
2. F. M. Slay and R. E. Burleson, *Computing Strategic Airlift Reparable Spares Packages*, Logistics Management Institute Report AF801R1, May 1999.
3. Department of the Air Force, *USAF War and Mobilization Plan, Volume 5 (WMP-5), Basic Planning Factors and Data*, Washington DC, HQ USAF/XOXOW, March 1993.
4. F. M. Slay, et al, "Predicting Demand For Wartime Spares," *Air Force Journal of Logistics*, Spring 1996, and F. M. Slay and C. C. Sherbrooke, "Predicting Wartime Demand for Aircraft Spares," Logistics Management Institute Report AF501MR2, April 1997.

F. Michael Slay and Robert E. Burleson are research fellows at LMI, and Senior Master Sergeant Jeffery D. Meyenburg is the superintendent of Weapon Systems Requirements in the Logistics Directorate, Supply Division, Headquarters Air Mobility Command.

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The Editorial Advisory Board selected "AEF Munitions Availability"—written by Lieutenant Colonel David K. Underwood and Captain John E. Bell—as the most significant article to appear in Volume XXIII, No. 4. Lieutenant Colonel Underwood was a student at the Air War College when this article was written. Captain Bell is a project manager in the Maintenance Division of the Air Force Logistics Management Agency.

Errata

Table 1 in Colonel William Stringer's letter to the editor as it appeared in the *Air Force Journal of Logistics*, Vol. XXIII, No. 4, page 1, was incorrect. The table to the right contains the correct information for series D and E data.

Series	F-15	F-16	C-5
A	3,910	3,727	6,548
B	3,940	3,536	2,668
C	3,159	13,435	2,528
D	2,931	13,045	
E	2,090		

Table 1. NSNs with F-15/F-16 Application Data

(Continued from page 3)

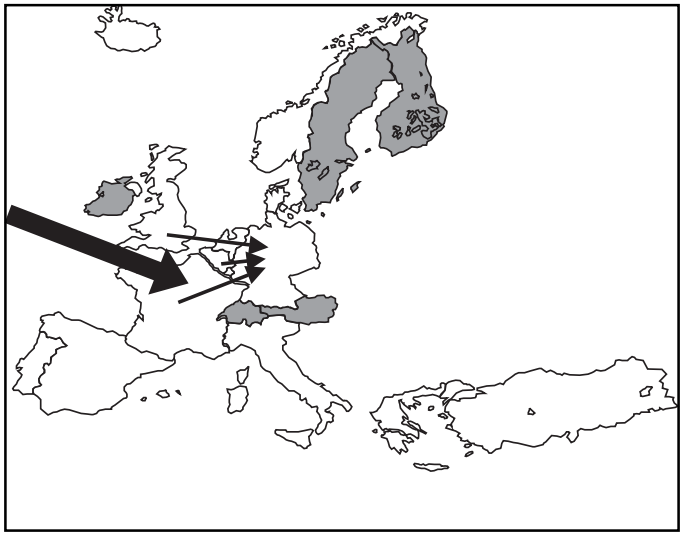

Figure 1. Before 1990, NATO operational logistics was focused on Central Europe. The lines of communication were short (with the exception of strategic reinforcements from the United States and Canada), and logistics was a national responsibility.

enforcement operations. It is important to know these types of operations can even involve the participation of non-NATO armed forces. A recent example was the conflict in the Balkans.

There is consensus amongst NATO nations that PSOs will be the type of operation that will become the most likely in the future.

Peace Dividend and Restructuring of Forces

The national concepts of operation of the NATO partners also reflect the new situation. In addition to national defence in the strictest sense of the word, the projection of military power to operational theatres in and beyond the Alliance's territory is of crucial importance. All NATO member countries by now consider operations in a multinational context as the rule. All things considered, the new disposition of security risks made it possible, even in light of the broader spectrum of responsibilities, to reduce and restructure drastically the military potential of all NATO member countries. This produced the expected peace dividend. The number of soldiers on active duty decreased by about 45 percent. The remaining forces were restructured to form combat-capable, fully manned, and fully equipped mobile reaction forces. These forces form the backbone for a direct military involvement option in crisis areas in near real time. Furthermore, increased skeletonisation of units takes into account the need for extended mobilisation periods to prepare for national or collective defence operations.

Logistics Implications of the New Strategic Concept

Logistically speaking, this means defence procurement planners must ensure the continuous adaptation of operational equipment to the changing responsibilities. Lighter and more mobile is the current motto. In view of the dramatic cuts in the equipment budgets (they have been halved since 1990), this goal can only be reached in the long term. The new strategic concept, however, also means reducing or mothballing major equipment, massive reductions in supplies, a decrease in the logistics capabilities of operational units, as well as a concentration and consolidation of logistics services in service centres, to include, if need be, even outsourcing of logistics tasks. Logisticians are required to support the routine peacetime operations of the armed forces across the whole spectrum of military missions, thus ensuring NATO's reaction forces can deploy for possible action without buildup. They also must prepare to support a practically unlimited number of operational options. These include the provision, as required by the situations, of suitable command and management structures and the capability for multinational cooperation or, preferably, integration.

In short, the future requirements that logisticians will have to meet have undergone fundamental changes. Practical experience gained by the nations in the course of a variety of NATO and coalition operations outside the alliance area during the 1990s, culminating in the Kosovo air campaign, clearly demonstrated the decisive importance of efficient and flexible, if not *customised*, logistics to successful operations.

The inclusion of peace support operations in NATO's spectrum of responsibilities makes logistics planning and combat service support considerably more difficult. Collective defence operations on NATO territory can be made the subject of contingency plans since the theatre of operations, concept of operations, assets, and nations involved, as well as the command and control structures, are known. Unlike measures regarding mobilisation, buildup, deployment, and sustainability with respect to a specific area of operations that planners are able to manage to a large extent, the conditions of peace support operations are fundamentally different. Key operational and logistics factors—such as mission, area of employment, and nations involved (defined by political leaders)—only become known on short notice. Bringing up reinforcements from the home country, which become available only after mobilisation, is not possible. Some nations, as a rule, reserve these reinforcements exclusively for national and collective defence.

In NATO, national and collective defence planning covers the entire Alliance territory (Figure 2). Peace support operations, even outside NATO territory, come on top. Additionally, the composition of a multinational formation is not necessarily determined by military needs or economic criteria. The desire of a nation to participate in an operation may also be interpreted as a political signal. A country simply wants to show its colours. As a result, elements—no matter the degree of smallness or military practicality—are assigned to a task force. The participation of 30 or more nations in one operation is not unusual, and all of them require logistical support.

Consequently, it is obvious that the old principle in which the logistics support of units operating as a single element of a multinational formation is a strictly national responsibility no longer makes sense. Logistics is in the process of becoming increasingly a coordinating, collective, and organisational management task for NATO.

Complex Planning Process

The mission, operational requirements, and composition of a task force, as well as the availability and efficiency of civilian

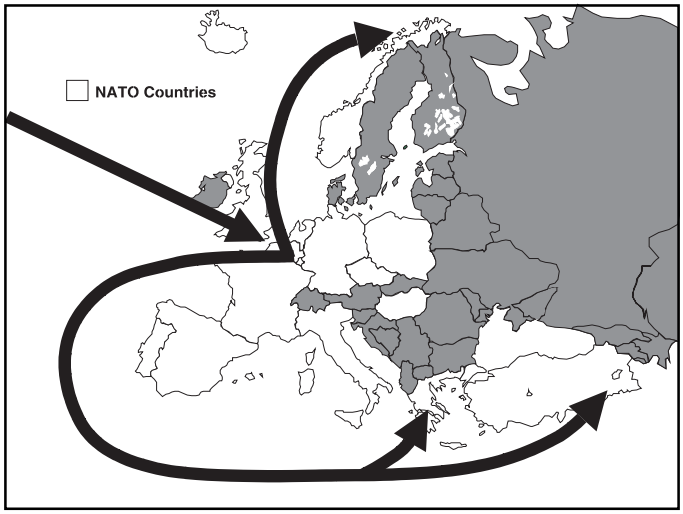

Figure 2. In NATO, national and collective defence planning covers the entire Alliance territory. Peace support operations, even outside NATO territory, come on top.

economic structures in the operations area, form the detailed basis for logistics planning. The overall multinational formation logistics support requirements are assessed against the background of the participating nations' logistics capabilities. A multitude of questions need to be answered.

- Which logistics services must be provided through military channels and which services can be provided by commercial contractors?
- Which services and supplies can be obtained locally through consolidated contracting (for example, accommodation, food, transport services, fuel, telecommunications)?
- How can the flow of necessary materiel from the homeland to the area of operations be optimised? How can the local distribution of materiel be organised efficiently?
- Which nations can provide logistics support for others?

On the whole, predicting the likely consumption of materiel in an operational area is a challenging and risky task. Relevant determining factors include intended operational intensity, as well as climatic and infrastructure conditions. The electronic equipment mean time between failure in extremely cold areas is completely different from that in hot and humid zones. Transports operated on unimproved surfaces are subject to considerably greater wear and tear than on smooth blacktop roads. Prognostic errors not only will entail expensive corrective action but also may carry operational risks. As a result, the necessary process of conceiving and preparing logistics plans should lead to a customised multinational command and control structure that ensures optimal logistics management of a campaign.

Transport as a Key Factor

The Alliance's new strategic concept assigns a critical role to transport as a power projection enabler. Strategic and theatre operational mobility is the overriding concern. Consequently, rapid deployment and redeployment of combat forces and ensuring their tactical mobility and combat readiness in the theatre of operations are important tasks. To compare and illustrate the importance of speed, during the first 30 days of Operation Desert Shield, the United States deployed 38,000 troops and approximately 150,000 short tons of equipment to the theatre of operations.

NATO's need for transport services is enormous. For example, one armoured division comprises approximately 15,000 troops and some 7,500 vehicles. The sole transport of vehicles and other major equipment requires about 30 medium-sized roll-on/roll-off ships, or when deploying a German Air Force ECR TORNADO squadron, approximately 1,000 tons of a wide variety of equipment and supplies have to be moved along with the unit. Depending on the situation, as many as 800 troops may be affected by the deployment.

The distances to be covered are also impressive. A NATO operation carried out in southeastern Turkey requires reinforcements from Central Europe to fly 3,000 kilometres (1,864 miles). The UN forces dispatched to Somalia had to travel more than 7,000 kilometres (4,350 miles). Additionally, it should be noted that, due to the very quantity of materiel to be transported, in both cases, the considerably longer and also more time-consuming transport by sea was the rule. To make the comparison, the sea route from Rotterdam to Turkey is about 3,300 nautical miles and the route from Rotterdam to Mogadiscio approximately 9,500 nautical miles. The available military transports that can cover operational demands of that size are absolutely not sufficient. NATO urgently needs to tackle that problem.

Reliable Logistics Support in the Area of Operations

There are two important aspects to operational area logistics support. The first is the units stationed in the area of operations need accommodation, messing, medical support, postal services, waste removal services, and so forth. The second, on the other hand, is materiel readiness and operational mobility or, to put it into simple terms, the fighting capability of these units in their area of employment. It must be guaranteed. This capability hinges on reliable logistics support in the area. The logistical prerequisite is an uninterrupted flow of materiel and supplies (fuel included) over long distances and maintained, as the case may be, in a threat environment and despite an inadequate or only rudimentary transport infrastructure. The other main logistics requirements are the creation of local repair facilities.

Military logisticians, particularly those of European NATO nations, are now faced with tasks they are not accustomed to; for example, the organisation and management of large-scale transhipment activities at seaports or airports, creation of a cold-storage system for food supplies, and extensive purification of water in an operational area, as soldiers operating in torrid zones need at least 6 litres (1.6 gallons) of water per day. Improvement of the local transport infrastructure in areas where deemed necessary has never been an unusual task for engineer troops or civilian contractors. This requirement will not go away. It includes the expansion and utilisation of existing airbases and seaports, all vital to success.

Experience has shown that logisticians of different nations operating in the same area compete for services and supplies on the local market. Whenever such a market exists, prices go up. Glaring examples of astronomical price hikes are fresh food supplies, accommodation, transport services and equipment, as well as a variety of other services. Container prices in Saudi

Arabia, for example, increased by a factor of 30 in the Gulf War. After these painful experiences, most are in agreement to consolidate all procurement actions henceforth.

To illustrate the magnitude of the task, an operational formation of 10,000 troops drawn from a wide variety of air force units needs 30 tons of food and 170 tons of ground petroleum products per day. Ammunition, spare parts, and other supplies come on top of this requirement.

Should each nation participating in a multinational task force maintain its own stovepipes to the employment area and establish its own command and control elements and logistics facilities, the resulting teeth-to-tail ratio—the ratio of operational formations to support troops in the area of operations—would be totally disproportionate and at the expense of operational and tactical capabilities. The overall formation size would be out of proportion to the operational mission. Mobility and flexibility would be degraded to the point of mutual obstruction. Finally, the large number of logistics facilities would constitute an unnecessary risk. Security forces that could be used for other tasks would have to be set aside to protect these facilities, or the people operating a facility would have to organise their own protection at the expense of efficient support.

Also, the economic aspect is remarkable. The Nordic-Polish Brigade (consisting of troops from the Scandinavian countries and Poland), which operated in Kosovo, organised a common logistics support organisation for its forces. The result was a 40 percent increase in efficiency.

In view of the lack of standardised equipment and/or other national particularities (for example, different standards of medical support), national stovepipes to an operations area are inevitable. However, it is imperative for operational reasons that these differences are reduced to a minimum, and it is just as advisable for economic reasons. There are many areas in which logistics tasks can be carried out in a theatre of operations as a consolidated and/or collective effort.

Limitations and Outsourcing

No nation is able to maintain logistics troops that can support the full range of possible operational challenges. This is neither practical nor affordable. The role of commercial contractors is, therefore, becoming increasingly important to the operational support of all NATO nations' armed forces.

The criterion for having military logistics capabilities in place is linked to the necessity for operational reasons. Military logistics must be limited to the core functions that are uniquely indispensable to military operations and, as a matter of principle, cannot be provided by the private sector. We call it the *operational minimum*. It should cover the direct support of units in the theatre of operations, as well as the maintenance and battle damage repair of weapon systems in operation. It also should apply to the provision of transport services and materiel handling in the event the existing transport infrastructure is inadequate or the services are needed in a threat environment. On the other hand, the transport to safe ports in neighbouring regions by commercial carriers gives absolutely no cause for concern and is even vital, considering the limited military resources.

The constant need for reducing operating expenses has caused all NATO nations to reexamine the predefined operational minimum for in-place military logistics capabilities and to weigh private sector outsourcing possibilities. The ideas and plans under discussion are downright spectacular. In the United Kingdom, scenarios are currently under consideration that recommend the civilianisation of in-flight refueling capabilities. The United Kingdom is also considering leasing C-17 strategic air transports, which would be made available for both civilian and military use.

The practical implementation of demanding strategic and operational plans is unthinkable without having extensive recourse to powerful private sector companies. Considering the scope of support required and the timeframe envisaged, it is of overriding importance in this context that transport regularly provides striking examples. It would have been impossible to conduct the Gulf War the way it was done, without making comprehensive use of civil resources to provide a broad spectrum of logistics support.

Third-party logistics provides on-call operational support of a predefined scope through the contracting of commercial companies to the military. It appears to be a growing business. The US company Brown & Root Services Corporation, for example, supports US Army units deployed to Bosnia. A detailed cost analysis carried out by US authorities clearly shows the greater cost-effectiveness of this service support in comparison with corresponding military services. Differences in service quality have not been noted.

The US Army's basis for this kind of support is a worldwide contract that provides for the on-call beddown and support of up to 20,000 troops in five field camps at different locations. An extension of the support packages under the contract is optional. The spectrum ranges from general logistics support, such as providing food and transport, to engineering services, operation of communication facilities, and medical support. Even highly specialised management functions in the operations area no longer have to be performed by the military. NATO also has tested this concept with local contracts in support of intelligence forces being managed by the NATO Maintenance and Supply Agency.

NATO and Logistics

This short glance at logistics planning, transport, theatre logistics support, and existing limitations should underline a necessity for NATO's enhanced involvement in multinational logistics issues. There is absolutely no point to, on the one hand, from the operations side, significantly improve interoperability and integration of forces and, on the other hand, ignore logistics aspects. One thing seems to be quite clear, Who else, other than the Alliance itself, could take over responsibility for the planning and execution of logistics support to multinational operations?

What did NATO do about that in the last decade? Under the proviso of the new strategy, in principle, all NATO nations approved revised *Principles and Policies for Logistics* (MC 319/1). The fundamental statement here is that nations and respective NATO commanders do have a common responsibility for logistics. It reflects a complete turnaround in the understanding of logistics, which in the past was a purely national responsibility.

Consequently, NATO produced a number of basic documents on multinational logistics. Amongst them is the *Allied Joint Logistic Doctrine* (AJP4), which functions as a general practical guideline for logistics management within NATO. *The Multinational Joint Logistics Centre-Concept* focuses primarily on the broad variety of logistics coordination functions in a PSO

operation. Additionally, there are logistics doctrines for land, naval, and air forces.

Despite the fact that a lot of work has been done on the concept and doctrinal side, their practical impact is not impressive. The newly defined common responsibility for logistics in day-to-day business remains vague. The authority of a NATO commander to establish requirements or conduct inspections could hardly be looked upon as an increase of real authority.

The commander of a NATO force, although formally endowed with rights regarding logistics—but only in a very limited way (to put it politely)—is enabled to assess the status of logistical readiness of the forces and their capability to support and sustain operations. There is no effective information flow between nations and NATO headquarters in existence that provides NATO with adequate logistics data. A sound organisational concept allocating the different NATO command levels defined and clearly delineated responsibilities, tasks, and tools for logistics management is not in existence.

In case of operations kicked off on short notice, NATO's logisticians—together with their colleagues from troop contributing nations—*reinvent the wheel* when establishing a mission-tailored logistics C2 structure. This seems to be necessary in the absence of reliable logistics C2 structures and procedures, preplanned manning rosters, and multinational logistics procedures. In this situation, troop-contributing nations try to remain on the safe side, establish their own solution, and accept the aforementioned disadvantages of too many stovepipes in a theatre of operations.

In their scepticism, the nations are right. NATO's ability to take over responsibility for logistics is still far from ideal.

Way Ahead

After having developed logistics concepts and doctrines, the time has now come to transfer them into practice. It needs to be said that there are plenty of ongoing projects on logistics planning, information systems, and procedures that definitely will, in the long run, improve multinational logistics led by NATO. However, ongoing activities, as in many multinational organisations, proceed slowly and cumbersomely. Moreover, the necessity to seek consensus amongst NATO nations is, unfortunately, very often used simply as an excuse for bad management.

NATO's *Defence Capability Initiative* (DCI), set up after the Washington Summit 1999, deals with several logistics points. The objective of DCI is to improve NATO's military capabilities and be more deployable, sustainable, survivable, and effective. In this context, logistics plays an important role.

Vision Needed

Nevertheless, NATO's understanding of multinational logistics remains a collection of single logistics items. There is no overarching vision of a future integrated logistics management system covering all functional areas of logistics and allocating specific responsibilities to each level of command, preparing to meet operational requirements in peacetime, crises, and war. In short, NATO still lacks sufficient logistics management!

Hopefully, DCI's outcome for logistics issues will finally:

- Establish a sound logistics structure with appropriate authority.
- Crest an effective, efficient controlling system, including a viable assessment tools.
- Foster a professional management system with clear-cut, achievable objectives for short, mid, and long term.

In fact, there is still a lot of practical work to be done. Until NATO has a reliable and efficient logistics organisation at its disposal, then and only then can NATO commanders be provided the *warm feeling* that their forces are logistically reliable and sustainable.

Colonel Peter Schmitz is the Chief, Logistics Division, Headquarters German Air Force Command in Cologne, Germany, and Major John Rausch is Chief, Movements Section and senior US logistician at HQ AIRNORTH (NATO) A4 Division at Ramstein Air Base, Germany.

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the financial risks to the Air Force. However, the present value analysis indicates that, in the long term, recurring costs outweigh investment costs, making the financial difference between the seven options negligible.

Most important, the consolidated intermediate repair structure will require new organizational processes. Unit commanders will have to relinquish some of their control over LANTIRN pods. They will also have to communicate very closely with the support centers and other bases serviced by the same regional facility. Performance metrics and incentive systems may also need to change to support a system focused on customer (warfighter) satisfaction, on-time delivery, and quality workmanship.

Conclusions

Analyses show that—given today's planning scenarios and deployment and transportation processes—the Air Force must invest in support equipment upgrades regardless of support structure. Furthermore, centralized support exclusively from CONUS facilities may reduce warfighter capabilities due to extended pipelines. Thus, it can be asserted that in assessing centralized repair alternatives, the Air Force should only consider networked FSL and CSL structures.

While the FSL structure introduces new risks to the Air Force, it also offers some distinct advantages over the current system. The most viable structure the analyses identified would use two FSLs and one CONUS facility. Figure 4 shows a notional implementation of such a structure with five prepositioned sets in each region and the peacetime manning indicated in the white bubbles.

This system requires that pods be shipped from FOLs to the centralized repair facilities. While this analysis was based on Defense Planning Guidance flying program expectations, other mission profiles (like Operation Noble Anvil) may change the resource requirements. However, since the options analysis focused on relative differences, the overall strategic outcomes would not change.

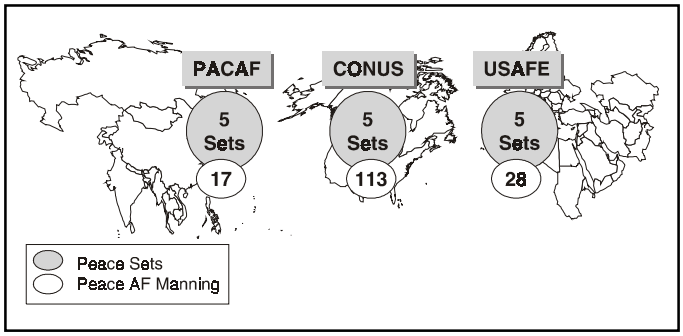

Figure 4. Notional Beddown of Equipment and People for a Regional Repair Structure

Based on the analysis, the Air Force should invest in the ADK upgrade and conduct a proof-of-concept experiment of the regional repair option. However, a centralized system will be sensitive to transportation times and may suffer from poor cross-organizational cooperation and communication. Viable locations to conduct this test include Aviano AB, Italy; Royal Air Force Lakenheath, United Kingdom; or another US Air Forces in Europe installation. This test offers an opportunity to assess transportation system capabilities (and shortfalls) in an international environment and with more stringent operating tempos than within the United States.

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Mathew Pausch is a career civil servant. At the time of writing, he was a student at the Air War College.

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Stephen Hays Rusell (Lt Col, USAF, Retired) is associate professor of Logistics Management, Goddard School of Business and Economics, Weber State University, Ogden, Utah. He is a graduate of the Air Force Institute of Technology School of Systems and Logistics (MS, 1974) and Arizona State University (PhD, 1978).

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historical demand to the future.[21] For ICIS to be a useful tool for the Air Force, it must interface with a depot workload planning tool like the reparability forecast model (RFM). The RFM uses a bill of materiel to forecast repair parts requirements to support a 6-month workload. The next logical step would be linking the expected wartime reparable item failures from the ASM with the workload planning tool in the RFM. This would, in turn, feed projected wartime depot surge requirements for repair parts to ICIS.

The ICIS model is clearly a step in the right direction by DLA in its attempt to take a more proactive role in supporting the warfighter. But like any model or simulation, the utility of the output is critically linked to the quality of the input data. For example, the Air Force recently considered ICIS output as an input to the annual other war reserve materiel computation for repair parts. It is also testing the linkage between ICIS and the ASM, with initial results due in the near future. While these collaborations promise significantly better sustainment assessment capabilities, data deficiencies will limit their effectiveness. Aircraft parts projections will be understated (due to API holes), and parts projections for nonaircraft systems will be ignored. Depot maintenance parts assessments also promise significant new assessment capabilities, but the effectiveness will be limited until the Air Force links the ASM, RFM, and ICIS. While the Air Force may not have the resources in the near term to address all the data deficiencies identified, it would be wise to address them in due time, beginning with repair parts deficiencies. A more robust Air Force input to the ICIS model would help DLA proactively manage its wartime sustainment for Air Force combat essential systems and equipment.

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19. The SRD is a data element on base-level issue requests used to document the applicable weapon system/equipment application. A maintainer replacing a part on a B-52H aircraft annotates the SRD for the B-52H on the issue request for all parts pertaining to the B-52H. SRDs, which are assigned and maintained by HQ AFMC, were established to track parts consumption and operations and maintenance costs for aircraft and equipment.
20. For example, one planner may annotate the deployment of 12 A-10 aircraft as *12 A/OA-10A*, while another annotates the same deployments as *A-10/0A-10(1)*. Programs like ICIS, which try to determine the weapon systems and quantities deploying, must be programmed to anticipate all possible ways a planner might annotate the TPFDD. In reality, ICIS occasionally *drops* deployment lines and identifies them separately on an exception list in the fuels assessment.
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Lieutenant Colonel Joseph M. Codispoti is a career supply officer. He is currently Chief, Warfighter Team, Headquarters, Air Force Supply/Fuels Policy and Procedures Division. At the time of writing, he was a student at the Air War College.

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included a series of MASS design studies emphasizing technology assessment, cost/affordability analysis, and the reliability/maintainability analysis of AGE. This early research resulted in a large knowledge base of existing problems and preliminary specifications for MASS machines. Phase II will bring this concept through an R&D cycle, culminating in the creation of a MASS prototype unit and field test/demonstrations in fiscal year 2000

Payoff. Introduction of modular support equipment will reduce the deployment footprint in a direct, objective way. Making support equipment smaller, multifunction, and modular allows for reduced numbers of ground support equipment items while maintaining flexibility. Maintenance modularity allows for reduced down time for repairs, increasing availability. At the same time, MASS machines will be more reliable and maintainable than current support equipment, resulting in reduced MASS ownership costs in manpower, spares, and training. Cost savings should span from initial acquisition through disposal.

Matthew Tracy, AFRL/HESS, DSN 785-8360, Comm (937) 255-8360, matthew.tracy@he.wpafb.af.mil