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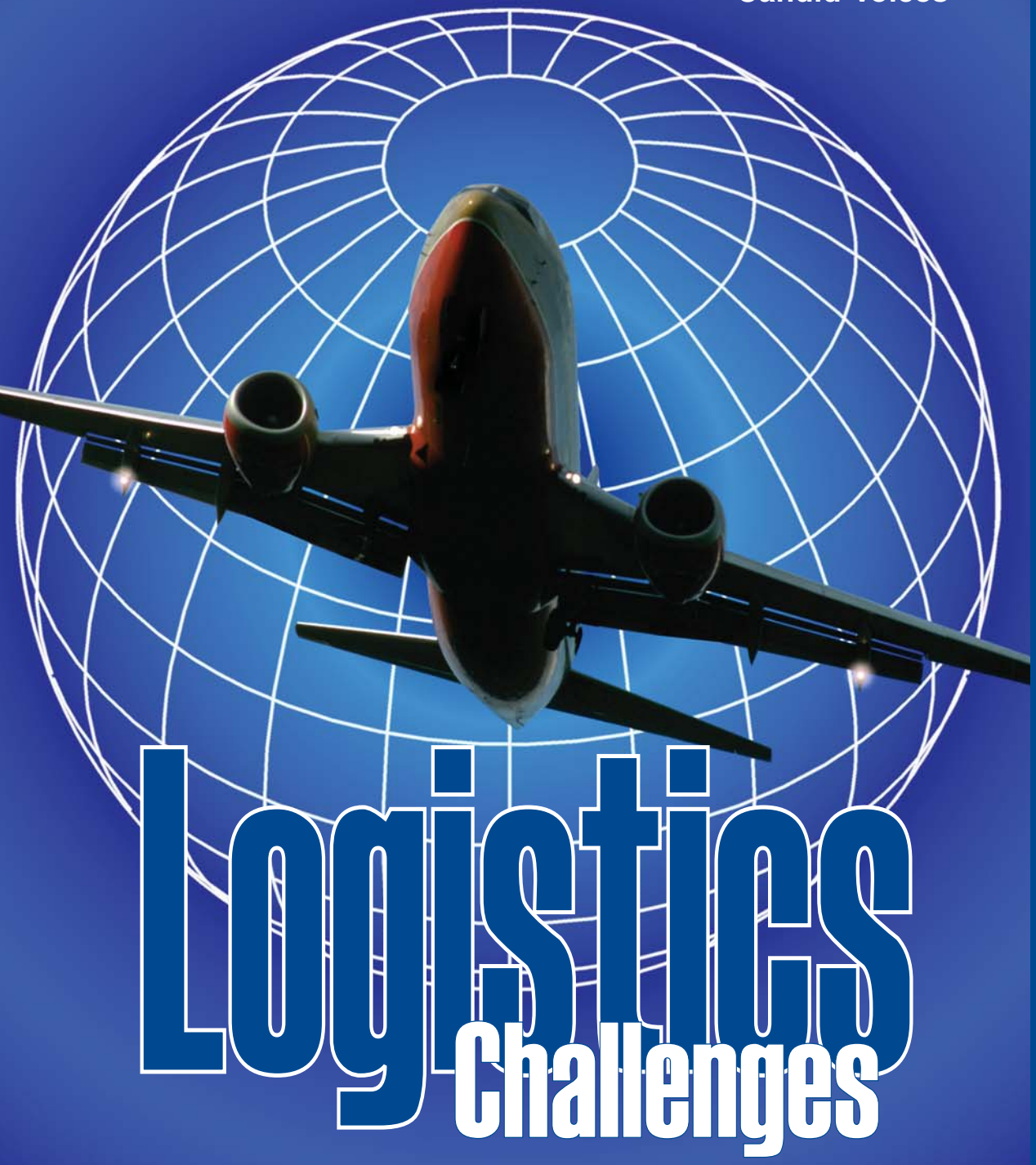

Logistics Challenges

Air Mobility Command: Improving Aircraft Maintenance Team Recovery Processes
Future Air Bases: Power Patches or Military Communities

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Special Feature

The Air Force budget is comprised of four main areas, all in desperate need of additional funding: personnel (force structure), readiness, infrastructure (sustainability), and procurement (modernization). Personnel costs (pay and benefits) have risen 57 percent over the last 10 years while personnel end strength decreased 8 percent. Operating (readiness) costs have increased 179 percent over the last 10 years, even though the aircraft inventory was reduced more than 2,500 airframes.

logistics Challenges

Air Mobility Command: Improving Aircraft Maintenance Team Recovery Processes
Future Air Bases: Power Patches or Military Communities

This edition of the Journal presents two featured articles: "Air Mobility Command: Improving Aircraft Maintenance Team Recovery Processes" and "Future Air Bases: Power Patches or Military Communities."

In "Air Mobility Command: Improving Aircraft Maintenance Team Recovery Processes," the author discusses Air Mobility Command's (AMC) strategic airlift role, identifies AMC's maintenance recovery team (MRT) process, analyzes AMC's historical MRT data for specific improvement opportunities, and where possible, recommends improvements that will lead to an increase in the efficiency of AMC's MRT process.

The second featured article examines the need to reengineer not only Air Force business processes but also future basing methods. The author makes the case that an approach is needed to free up substantial existing infrastructure assets (in excess of $200B) and unlock the potential value of Air Force installations for potential liquidation or exploitation. He also argues that such an approach must generate multiple efficiencies to reduce bills rather than continue to increase future costs that compete for limited budget funds. Future basing approaches must be revolutionary not incremental.

William Y. Rupp, Lieutenant Colonel, USAF

Air Mobility

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Special Feature

Introduction

The United States' (US) civilian and military leaders well recognize the need for speed in prosecuting military operations. The 2006 Quadrennial Defense Review places particular "emphasis on the ability to surge quickly to trouble spots across the globe."[1] This requirement is a testament to the position of America as the sole superpower, as well as a reflection of its willingness to engage around the world. Whether it's involved in a protracted military struggle, supporting other nations in pursuing democratic principles, or conducting humanitarian operations, the United States has the ability to quickly reach out and take the lead in world affairs. But speed is not the sole enabler of military power. In a 2001 speech, President George W. Bush noted that, "Military power is increasingly defined not by size and mass but by mobility and swiftness."[2]

The President's statement highlights that, in addition to bringing military capabilities swiftly to bear, the instruments themselves must be sufficiently mobile to make the transition from any starting location to any point of employment. Mobility of military assets is the responsibility of the United States Transportation Command (USTRANSCOM), whose stated mission is to "provide air, land and sea transportation for the Department of Defense (DoD), both in time of peace and time of war."[3] The Air Force plays a critical role in support of USTRANSCOM, defining rapid global mobility or, "the timely movement, positioning, and sustainment of military forces and capabilities through air and space, across the range of military operations," as a capability unique to the air service.[4] Air Mobility Command (AMC) and its airlift aircraft fill this role on behalf of the Air Force.

Given the significance of AMC's role in rapid global mobility—not just for the Air Force but for the entire DoD—the United States cannot afford to lose any of its strategic airlift capability. For research purposes, this article narrowly defines lost strategic airlift capability as any of the two aircraft types comprising AMC's strategic airlift fleet (namely the C-5 Galaxy and the C-17 Globemaster III) that are broken and away from their station of assignment. To repair these aircraft when broken within *the system*, AMC currently utilizes a dedicated system of command and control, people, parts, and equipment—some of which are prepositioned, and some of which are available on an as-needed basis. Known as the Maintenance Recovery Team (MRT) process, the system emphasizes identifying, troubleshooting, and fixing broken aircraft as quickly as possible, in order to maximize strategic airlift availability to DoD and other airlift customers.

With this in mind, this article will discuss AMC's strategic airlift role, identify AMC's MRT process, analyze

Article Highlights

Strategic airlift, now and for the foreseeable future, provides critical capabilities vital to our national interests. It is, therefore, incumbent upon the Air Force, and specifically Air Mobility Command, to work toward minimizing the amount of time our C-5s and C-17s remain broken within the airlift system.

While the current maintenance recovery team (MRT) process ensures airlifters broken away from home station are eventually repaired and put back into service (and arguably does so effectively), there is little evidence that much is done outside the normal manpower and parts placement systems to systematically analyze and improve the overall MRT process. In order to more effectively minimize strategic airlifter downtime, the Air Mobility Command (AMC) must implement analytical procedures specific to the MRT process itself, beginning with the sizing, sourcing, and tasking subprocesses. The current mechanism for reviewing and assessing historical data, the Global Decision Support System 2 (GDSS 2) database, as configured and utilized, is largely ineffective at meeting the analytical need.

In order to improve the MRT process, logistics personnel must first have access to sufficient and specific data enabling them to target areas for improvement. Currently, the only way to focus any analytical effort is to perform a painstaking, time-consuming review of each individual aircraft recovery record, a method so inefficient as to be essentially worthless. AMC must implement three AMC's historical MRT data for specific improvement opportunities, and where possible, recommend improvements leading to an increase in the efficiency of AMC's MRT process.

Background

Air Mobility Command

> The National Defense and Military Strategies call for rotating land forces in peacetime from the United States to Europe, Africa, the Middle East, and elsewhere for 4- to 5-month deployments to maintain that access and provide deterrence. Therefore, **strategic mobility is, as never before, a national imperative.**[5] [Emphasis in original.]

While strategic mobility has become the cornerstone of US global engagement, to be most effective in promoting peace and deterring aggression, mobility must also include swiftness. When the military speaks of rapid global mobility (with respect to cargo movement), the term is generally synonymous with strategic airlift. While it is true that the vast majority of DoD cargo moves by sea, it does not do so rapidly.[6] While sealift provides the preponderance of cargo movement, airlift offers the United States and its allies the speed and flexibility to move assets where needed in a timely manner. As the air arm of USTRANSCOM, AMC is the command of choice for moving cargo rapidly.[7]

The Air Force's cargo airlift mission is generally broken down into two main categories: intratheater and intertheater. Intratheater airlift, generally synonymous with tactical airlift, describes cargo movement within a theater of operations, and comprises such characteristics as relatively close range, smaller and lighter payloads to sustain units deployed within a theater, and the ability to operate on unimproved surfaces and utilize shorter lengths of runway.[8] Intratheater airlifters are generally controlled by their respective combatant commands to support the theater's cargo movement requirements. Despite the tremendous role intratheater airlift assets play in global mobility, the vast majority of requirements are logistically supported by and within their theater of assignment. This article will focus on maintenance recovery of intertheater airlift assets.

Intertheater airlift, synonymous with strategic airlift, refers to air movement of cargo between geographical theaters of operation and comprises such characteristics as size of the aircraft, range, and payload capacity. Because of the high demand and the need to prioritize use of these crucial assets, the National Command Authority apportions strategic airlift aircraft among the Services and other forces.[9]

The two strategic airlift aircraft operated by the US Air Force are the C-5 Galaxy and the C-17 Globemaster III. With regard to capacity, these are the only two aircraft in the inventory capable of transporting outsized cargo,[10] such as the Army's Abrams tank.[11] Differing from commercial aircraft with similar cargo capacity (such as the Boeing 747), C-5s and C-17s have air refueling capability and are designed to operate in ground conditions not normally conducive to commercial aircraft operations. When augmented with air refueling, strategic airlift aircraft provide practically unlimited global reach. It is the strategic airlifters' swiftness, mobility, and unique capabilities that make them key components of national security.

Central to any discussion on improving AMC's MRT process is understanding the two primary methods for strategic airlift cargo movement, the first being the hub and spoke concept, and

the second being direct delivery. In the hub and spoke concept, cargo is loaded on a strategic airlift asset at one of several aerial ports of embarkation and delivered to a centralized main operating location, or aerial ports of debarkation (APOD). The cargo is then distributed via intratheater assets to various forward operating bases (FOB) within the theater. The APODs are considered the hubs, the FOBs the spokes.[12] One advantage of hub and spoke operations is that, similar to commercial airlines, the aircraft operate in and out of dedicated locations, allowing for prepositioning of command and control, cargo handling equipment, and maintenance capabilities to support transiting aircraft.

When performing the second method of cargo movement, direct delivery, strategic airlifters overfly the APOD and deliver cargo straight to (or closer to) its final destination. A potential advantage to direct delivery is timeliness, with cargo arriving at its final destination significantly quicker than it would take to download, repackage, and deliver via intratheater means. However, due to the need to centralize and synergize efforts at cargo hubs, final destinations often do not retain the assets to fully support transiting strategic airlift assets, a distinct disadvantage.[13] For purposes of this article, this translates to an inability to effectively repair a broken aircraft. Before delving into specific discussions on more effectively supporting aircraft recovery efforts, this article must first identify AMC's current process for repairing strategic airlift aircraft broken in the system.

Global Air Mobility Support System

The Air Force attempts to minimize delays in its cargo delivery process through establishment and utilization of the Global Air Mobility Support System (GAMSS). GAMSS combines those functions essential to effective air cargo operations—command and control, aerial port, and maintenance—located in both the continental United States (CONUS) and outside the continental United States (OCONUS).[14] With respect to strategic air mobility, two contingency response wings, one at Travis Air Force Base (AFB) and one at McGuire AFB, constitute the bulk of the fixed active duty CONUS portion of GAMSS. Additionally, Air Reserve Component strategic airlift units located throughout the CONUS provide a significant amount of capability. AMC also operates key OCONUS locations as part of its fixed en route structure, all with varying degrees of aircraft maintenance capability.[15] See Figure 1 for the current GAMSS layout.

The en route locations serve two basic purposes with respect to strategic airlift. First, they act as APODs, often filling the role of the hub at which cargo is downloaded to be distributed to spokes throughout the rest of the theater. Second, and more importantly, they provide varying degrees of indigenous aircraft maintenance capability, with skilled technicians, tools, equipment, and parts to repair broken aircraft. Their existence ensures the continual flow of cargo from CONUS to OCONUS destinations—most importantly to downrange wartime locations—by minimizing the potential for cargo to be held up in the system or for aircraft to have to return to CONUS for maintenance repairs.

However, not all en route locations are equal in size and capability. En routes with higher numbers of transiting aircraft earn more manpower positions with a wider range of skill sets. Similarly, fiscal realities and parts availability necessarily limit the type and quantity of spares, with parts allocated to en route locations based on historic throughput and demand for individual components to effect repairs. Stations serving as regional hubs generally see more

Article Highlights

actions if it is to begin gathering the data to improve the aircraft recovery process. First, it must correct data input and access issues with currently existing data fields in GDSS 2. Second, in order to effectively target process improvement efforts, the Logistics Control Section, Tanker Airlift Control Center (XOCL) should work with system programmers to add specific data fields within GDSS 2 to account for the varied MRT subprocesses. Third, XOCL should develop and track basic time standards for the overall MRT process and its individual subprocesses. This will allow researchers to focus on those events having adverse impacts on aircraft recovery. While these recommendations are neither groundbreaking nor terribly exciting, they are necessary to begin the evaluation and improvement process.

Article Acronyms

AB – Air Base
AFB – Air Force Base
AMC – Air Mobility Command
APOD – Aerial Port of Debarkation
CONUS – Continental United States
DoD – Department of Defense
FCC – Flying Crew Chief
FOB – Forward Operating Base
GDSS 2 – Global Decision Support System 2
LOC ICAO – Location International Civil Aviation Organization (data field)
LRC – Logistics Readiness Center
LSC – Logistics Support Center
MAF – Mobility Air Forces
MILAIR – Military Aircraft
MOC – Maintenance Operations Center
MRT – Maintenance Recovery Team
OCONUS – Outside Continental United States
TACC – Tanker Airlift Control Center
US – United States
USTRANSCOM – United States Transportation Command
XOCL – Logistics Control Section, Tanker Airlift Control Center

Figure 1. AMC/TACC and MAF/LSC Global Air Mobility Support System Locations

transiting aircraft and, therefore, retain greater variety and quantity of supply items. Examples of regional strategic airlift hubs include Ramstein Air Base in Germany and Yokota Air Base in Japan, each with sufficient numbers of transient C-5s and C-17s to warrant forward deployment of such unique items as spare aircraft engines. Smaller en routes with less air traffic do not. As robust and effective as the GAMSS is, however, strategic airlift aircraft are often called upon to support mobility requirements outside the established system.

Part of the uniqueness of the Air Force's strategic airlift fleet is that the aircraft do not simply fly the same established routes day-in and day-out as do commercial passenger and cargo carriers. AMC is on call to support requests to carry cargo around the globe. Whether in support of DoD operations, State Department requirements, or helping free *Willy the Whale*,[16] C-5s and C-17s go to many locations around the world without organic aircraft maintenance capability. Making this even more of a challenge, unique aircraft systems and their associated maintenance requirements render support from non-US Air Force sources essentially nonexistent. In contrast, because Air Force aerial refueling aircraft are basically commercial derivatives (the KC-10 is the same basic airframe as the Boeing DC-10,[17] and the KC-135 is the same basic airframe as the Boeing 707[18]) support for those military aircraft is often available from commercial airline maintenance counterparts at non-AMC locations.

The need to utilize strategic airlifters worldwide and their unique capabilities in payload and *off-road* characteristics, combined with their airframe uniqueness in the world of aviation, makes them virtually unsupportable outside of AMC. Unfortunately, when the aircraft are broken they are not carrying out their cargo missions—enter the Tanker Airlift Control Center (TACC).

Tanker Airlift Control Center

The TACC is AMC's global air operations center, with responsibility for planning, scheduling, and tracking aircraft in support of strategic airlift and other AMC missions worldwide. The organization ensures centralized control of scarce strategic aircraft by validating customer airlift requirements, linking them with available airlift assets, and directing and tracking mission execution.[19] A significant aspect of tracking air mobility operations is identifying aircraft that are unable to perform their missions due to maintenance problems.

XOCL

Given the tremendous importance of strategic airlift to the DoD and other government agencies, centrally controlling the aircraft maintenance recovery function is a high priority for AMC. The Logistics Control section within the TACC, otherwise known as XOCL, is the command's focal point for sourcing and tasking the appropriate maintenance personnel, parts, and equipment needed to repair aircraft broken in the system while performing AMC missions. To most effectively manage maintenance recovery operations, XOCL oversees three primary components of the MRT process:

- Identify not mission capable aircraft
- Size, source, and task resources to effect repairs
- Oversee and effect repairs

As AMC's 24-hour command and control function, the TACC retains near real-time visibility of all aircraft performing missions for the command. "Successful and expedient recovery of [maintenance] delayed aircraft depends upon accurate and timely communication between field personnel and XOCL."[20] At fixed AMC locations, CONUS or OCONUS, the maintenance operations center (MOC) notifies XOCL of aircraft status and, if needed, identifies resources required to accomplish repairs. When broken at locations outside of GAMSS, responsibility for notifying XOCL falls to the mission aircrew.[21] While the aircraft commander retains overall responsibility, the crew's flight engineers and, in the case of the C-5, flying crew chief (FCC), provide general maintenance expertise while away from GAMSS locations.

Sizing the Requirement

Once notified of an aircraft requiring logistics support, XOCL begins to size, source, and task resources to effect repairs. Broken aircraft generally require three types of assistance—parts only, experienced maintenance personnel, or specialized tools or equipment—and support often requires a combination of the three. In sizing the required amount of support, XOCL works with the most knowledgeable person at the broken aircraft's location. GAMSS locations and forward deployed air bases are generally staffed with qualified maintenance technicians who are capable of troubleshooting aircraft malfunctions to the parts and equipment necessary to effect repairs. In those cases the MOC, or deployed equivalent, notifies XOCL with specific parts nomenclature, quantity, and other personnel or equipment items necessary to repair the broken aircraft. At all other locations without experienced maintenance technicians, the aircrew or FCC identifies the required resources. When the nature of a malfunction is such that neither the GAMSS location nor the aircrew or FCC can identify the solution, XOCL either solely or

in conjunction with personnel at the aircraft's location, communicates the nature of the problem to home station maintenance experts. Together they determine what is necessary to recover the broken aircraft.

Sourcing the Requirement

After sizing the requirement, XOCL then determines the source of parts, people, or equipment to most effectively accomplish repairs. When aircraft parts are required, XOCL works directly with the Mobility Air Forces (MAF) Logistics Support Center (LSC) to locate assets in the supply system.[22] The MAF LSC, collocated with XOCL at Scott Air Force Base, serves as AMC's centralized supply command and control function. With visibility over all aircraft parts in the AMC supply system, at XOCL's request the MAF LSC locates and directs shipment of parts based on recovery location and available transportation.

When maintenance technicians and equipment are required, XOCL generally sources them from one of the GAMSS locations with primary responsibility for the affected aircraft type. The en routes generally have sufficient resources to respond to MRT requests and, being forward deployed, they often offer the advantage of more timely support. However, the nature of the aircraft discrepancy is often such that the depth of experience required to troubleshoot and repair the broken aircraft must come from more knowledgeable home station technicians. Similarly, there may be insufficient specialized maintenance equipment resident in the en route system, necessitating that XOCL source the items from the better-equipped home stations. In every case, timeliness is a key consideration in sourcing an MRT.

Transportation

While it is understood that safety is always the overriding concern, the single most important factor in the MRT process is speed. As previously noted, the strategic airlift fleet is critical to the nation's defense. Aircraft broken in the system are not only unable to get their current cargo loads to the required destinations, they are also unavailable to provide timely support to future airlift taskings. XOCL works to mitigate the impact of broken aircraft by sourcing the fastest available support. Within reason, cost and other factors are considered, but priority is generally given to earliest possible recovery.[23] Given the need for speed, providing resources usually becomes a factor of available transportation.

Because resources and transportation often coincide at GAMSS locations, military aircraft (MILAIR) are a primary source of MRT support.[24] Using AMC's command and control database, the Global Decision Support System 2 (GDSS 2), XOCL identifies all existing and scheduled AMC flights into the broken aircraft's location, and then determines whether or not required resources can be collected and loaded on, or transported to meet up with, one of those aircraft. Depending on the mission priorities of both the broken aircraft and the potential support aircraft, the latter may be delayed or rescheduled to accommodate the MRT process. If currently scheduled AMC mission aircraft do not transit the broken aircraft's location or if they are not expeditious enough, XOCL pursues other means of supporting the MRT.

Due to the seemingly ubiquitous nature of commercial transportation, airlines and commercial cargo (such as FedEx or UPS) and passenger (such as United) carriers are often the most effective means to facilitate an MRT. XOCL is authorized to direct movement of recovery assets via these methods. Working with transportation management flight personnel at the sourced location, and in coordination with the aircrew and maintainers at the broken aircraft's location, XOCL coordinates passenger tickets on airlines, or parts and equipment shipment via commercial air or ground transportation, as required to expedite repairs.[25] There are, however, situations where commercial transportation is unable to meet MRT requirements. Recoveries with sizable logistics parts or equipment needs (for example, when an aircraft engine must be replaced), MRTs for items incompatible with commercial transport (explosives or other hazardous materials), or support requests to locations not serviced by commercial carriers must necessarily be facilitated via indigenous means.

A third option available to the TACC for supporting aircraft broken away from home station is to divert or schedule an AMC aircraft for the sole purpose of supporting the MRT. The advantages of using indigenous aircraft include sufficient capacity to transport large recovery packages, access to locations unserviceable by commercial means, control over such factors as sourcing and timing, and the ability to move cargo from the broken to the recovery aircraft in order to keep the mission moving. Disadvantages include the significant cost to operate an AMC aircraft, lost ability of the recovery asset to perform other missions, and the potential for the recovery aircraft to break while supporting the MRT. A careful risk or benefit assessment is always necessary when determining how to best recover strategic airlifters broken away from home station.

Analysis

Having identified the importance of timely and effective mobility of DoD and other US assets, how AMC contributes air mobility in support of USTRANSCOM, how the TACC oversees employment of C-5s and C-17s, and XOCL's significant role in keeping strategic airlifters moving through the system, this article will now analyze XOCL's process for identifying, tracking, and recovering these aircraft with an eye toward identifying potential improvements and efficiencies.

GDSS 2

AMC utilizes GDSS 2 as its centralized database for commanding and controlling aircraft. Implemented in 2004, the system provides unit- and headquarters-level managers with visibility over all MAF airlift and mobility missions from plan to task to execution.[26] As part of its integrated design, GDSS 2 includes a logistics application which allows XOCL personnel to track MRT data. Once notified by GAMSS or aircrew personnel of a C-5 or C-17 broken in the system, XOCL controllers track the aircraft by inputting into GDSS 2 specific associated factors, such as aircraft tail number, location, nature of the discrepancy, and others to include a running sequence of events detailing specific actions as they transpire from initial notification to final resolution (including the return of recovery personnel, parts, and equipment to their stations of origin). The flexibility of the system allows XOCL controllers to retain real-time visibility and to update each individual record across shift changes and over the course of several days or weeks of individual aircraft recovery operations.

More than just a system for tracking current operations, the logistics feature of GDSS 2 enables those with access to review historical aircraft recovery data, whether for purposes of recalling

Heading	Description
C-5 Tail Number	Aircraft tail number
GDSS Location	Where the aircraft broke according to GDSS 2
Actual Location	Where the aircraft actually broke according to the verbiage in the remarks section of each aircraft's historical record
Pacing Correct	Whether or not the GDSS 2 pacing data field contained correct data
Sourcing Tasked	Amount of time from when XOCL was notified of a discrepancy until XOCL tasked sourcing of recovery assets **Note: All time is in minutes**
Percent	Percentage of sourcing tasked time to overall downtime (Total time [GDSS])
Sourcing Complete	Amount of time from when XOCL tasked sourcing until sourcing was complete
Percent	Percentage of sourcing time to overall downtime (Total time [GDSS])
Trans Tasked	Amount of time from when sourcing was complete until XOCL tasked or identified transportation for the MRT
Percent	Percentage of Trans tasked time to overall downtime (Total time [GDSS])
Trans Arrived	Amount of time from when XOCL tasked/identified transportation until the MRT assets arrived at the actual location
Percent	Percentage of Trans arrived time to overall downtime (Total time [GDSS])
Mx Complete	Amount of time from when MRT assets arrived at the actual location until maintenance notified XOCL the aircraft was fixed
Percent	Percentage of Mx complete time to overall downtime (Total time [GDSS])
Total Time	Amount of time from when XOCL was notified of the first maintenance discrepancy until maintenance notified XOCL the aircraft was fixed (reflects actual downtime according to each Master Record remarks section)
Total Time (GDSS)	Amount of time from BREAK DTG to FIX DTG according to GDSS II LOGISTICS SUPPORT TOOL HISTORICAL TASKINGS data run for Jul 07 (erroneously reflects downtime)

Table 1. GDSS Report Headings and Definitions

specific issues or to facilitate analysis for process improvement. AMC appears to utilize GDSS 2 relatively infrequently in the latter capacity, at least with respect to identifying improvements specific to the MRT process. Several reasons may explain this lack of utilization.

First, the command has an existing process for determining maintenance and supply requirements for both home stations and for the en route system. Manpower and maintenance skill sets are apportioned based on aircraft workload (number of aircraft assigned to home stations and number of aircraft transiting en route locations). In other words, maintainers are stationed where the aircraft normally go. MRTs, on the other hand, are theoretically developed to support aircraft broken at locations outside the GAMSS, which are by definition, places where AMC does not anticipate the need for permanent or long-term support. While it is true a significant number of MRTs support requirements at GAMSS locations, their maintenance manpower requirements have already been factored in and risk accepted for those instances when specific skill sets have either been limited or have not been assigned. One example is fuel systems maintenance capability in the en route system. Of the AMC en route locations in Europe, only one (Ramstein Air Base) has permanently assigned fuels maintenance technicians qualified to work on C-5s and C-17s.[27] AMC banks on the infrequency of fuels-related discrepancies and accepts the risk that any aircraft that develop them will either relocate to Ramstein AB for repairs or that an MRT will be required. Given the less than permanent nature of MRTs, one does not expect historical GDSS 2 data related to aircraft recoveries to be particularly useful in determining permanent manpower basing requirements.

Similarly, AMC distributes aircraft parts based on demand data. The parts that break the most are, over time, positioned where demand has historically been the greatest. The supply system does not generally recognize demand for non-GAMSS locales, because the parts to fix aircraft at these locations are ordered from GAMSS bases, often from the broken aircraft's home station. Because the parts ordered to support MRTs *do* register for the GAMSS ordering locations, they are recognized and incorporated into the overall supply system requirements chain. In other words, AMC uniformly adjusts GAMSS supply levels for all parts ordered through the supply system irrespective of whether or not they were ordered as MRT support. Therefore, one does not expect historical GDSS 2 data to be particularly useful in determining permanent spare parts allocation.

A second reason AMC appears to use historical logistics data from GDSS 2 for process improvement relatively infrequently, is that the XOCL, TACC, and A4 (Logistics, Installations, and Mission Support) functions evaluate and adjust processes and procedures real-time. Because each aircraft XOCL supports is followed from inception to completion, anomalies to perceived norms are briefed, questioned, and dealt with as they occur. For example, when people, parts, or equipment are not ready to go on time and miss scheduled support rides, managers at appropriate levels engage to determine potential culpability, accountability, and procedural improvements to prevent future recurrence. Unfortunately, while targeted solutions to specific problems are potentially effective for the individuals, units, circumstances, and times in question, they do not necessarily prevent similar problems from occurring at other locations at other times. This is not to say AMC does not implement broad and enduring MRT process improvements based on individual situations; rather, it is to say that in the absence of a structured analytical approach to MRTs, AMC may be missing opportunities to improve the overall recovery process and potentially decrease maintenance downtime for the nation's strategic airlift assets.

As noted previously, utilizing historical MRT data from GDSS 2 may not be particularly useful for determining permanent

manpower and spare parts requirements, but it may, in fact, prove useful for analyzing past aircraft recovery efforts for potential improvements across the entire MRT process. One logical starting point, and the focus of the remainder of this article, is to analyze XOCL's interface with GDSS 2 and to determine the system's suitability for facilitating future efforts at improving the MRT process.

Analysis for July 2007

Although the TACC began using GDSS 2 in 2004, XOCL did not begin inputting data into the logistics portion of the database until June of 2007.[28] At the time data were extracted from the system for purposes of this analysis (August 2007), there were only 2 full months of historical MRT data: June and July 2007. Because June marked the data transition from GDSS to GDSS 2, that month's data were initially reviewed, but they were ultimately not factored in with this analysis because of the potential for inaccuracies associated with the transition to the new system. Additionally, given the unforeseen amounts of time and effort required to sort through 31 days worth of MRT records, the scope of this analysis was narrowed from the original intent. In July 2007 XOCL tracked 327 individual aircraft records: 129 C-17s, 88 C-5s, 55 KC-135s, 41 C-130s, 13 KC-10s, and 1 C-21.[29] The original intent of this article was to review MRT data for both of AMC's strategic airlifters; however, the monumental commitment involved made that proposition untenable. Therefore, this article's analysis focuses exclusively on the 88 C-5 MRT records for July 2007. (See Table 1 and Figure 2.)

Actual Supports versus Non-Supports

One of the first tasks was to segregate those MRT records with actual support data from those that were entered into GDSS 2 for tracking but were eventually resolved without XOCL action. As previously noted in the XOCL section of this article, GAMSS command and control functions (or the aircraft's crew if outside the GAMSS) are required to notify XOCL when aircraft are experiencing maintenance problems, regardless of whether or not support will be required. This requirement keeps the TACC

C-5 Tail Number	GDSS Location	Actual Location	Pacing Correct?	Sourcing Tasked	%	Sourcing Complete	%	Trans Tasked	%	Trans Arrived	%	Mx Complete	%	Total Time	Total Time (GDSS)
60021	KCEF	KDOV	N/A												
60014	KCEF	LERT	N	7	0.5%	13	0.8%	71	4.6%	1,283	83.1%	170	11.0%	1,544	1,542
70032	KSUU	KDOV	N/A												
00466	KSKF	KDOV	N/A												
00448	KSKF	LERT	N/A												
90008	KSWF	ETAR	N/A												
60014	KCEF	LERT	N	236		84		0		2,458		733			
				17		67		136		2,132		2,610			
				10		30		0		2,144		576			
				263	2.8%	181	1.9%	136	1.5%	6,734	72.1%	3,919	42.0%	9,339	16,890
70042	KSUU	RODN	N	6	0.4%	35	2.3%	0	0.0%	1,417	94.4%	43	2.9%	1,501	1,500
60020	KDOV	N/A	N/A												
90012	KSWF	KDOV	N/A												
50001	LERT	OKBK	N	82		34		21		917		114			
				0		0		22		1,340		114			
				3		20		26		3,495		259			
				85	1.4%	54	0.9%	69	1.1%	5,752	92.8%	487	7.9%	6,199	8,430
00466	KSKF	LERT	N	327	12.7%	3	0.1%	240	9.3%	765	29.8%	1,239	48.2%	2,571	2,550
60022	ETAR	LERT	N/A												
60023	KCEF	PGUA	N	140	5.3%	518	19.5%	61	2.3%	1,524	57.3%	417	15.7%	2,660	9,786
70043	KDOV	UNK	N	134	10.2%	0	0.0%	140	10.7%	966	73.8%	69	5.3%	1,309	2,664
60017	KCHS	KCHS	N	12	0.4%	17	0.6%	64	2.3%	2,268	82.7%	380	13.9%	2,741	2,718
60022	ETAR	LERT	N/A												
80225	KCEF	LERT	N/A												
70028	ETAR	KDOV	N/A												
60022	ETAR	UNK	N	11		58		436		1,349		1,019			
				103		67		0		0					
				8		101		315		1,797		352			
				122	2.2%	226	4.1%	751	13.8%	3,146	57.8%	1,371	25.2%	5,446	7,764
60012	LERT	PHIK	N	100		47		0		1,538		4,013			
				0		21		0		0					
				19		361		0		3,331		4,131			
				119	1.4%	429	5.0%	0	0.0%	4,869	56.4%	8,144	94.4%	8,627	8,592
90023	KSWF	LTAC	N	0	0.0%	31	0.5%	0	0.0%	5,474	92.8%	64	1.1%	5,901	5,904
80025	KCEF	LERT	N/A												

Figure 2. GDSS C-5 MRT Records for July 2007 (Part 1)

C-5 Tail Number	GDSS Location	Actual Location	Pacing Correct?	Sourcing Tasked	%	Sourcing Complete	%	Trans Tasked	%	Trans Arrived	%	Mx Complete	%	Total Time	Total Time (GDSS)
60018	KCEF	LERT	N/A												
60017	KCHS	KDOV	N/A												
50005	KDOV	KSUU	N/A												
50005	KDOV	KSUU	N/A												
50008	KSUU	UNK	N	7		22		37		1,039		45			
				462		0		0		?		?			
				469	19.5%	22	0.9%	37	1.5%	1,039	43.1%	45	1.9%	2,409	2,394
80219	KFFO	KDOV	N/A												
60019	KSUU	RJTY	N/A												
90023	KSWF	ETAR	N/A												
70029	KDOV	ORBI	N	315	18.6%	93	5.5%	2	0.1%	677	40.0%	614	36.3%	1,691	1,674
60019	KSUU	RJTY	N/A												
70032	KSUU	LERT	N/A												
90023	KSWF	ETAR	N/A												
00446	KSKF	ETAR	N/A												
70032	KSUU	LERT	N/A												
80219	KFFO	ETAR	N/A												
60018	KCEF	ORBI	N	429		44		223		448		4,373			
				541		548		0		0		0			
				0		56		90		611		3,871			
				22		0		0		1,517		1,829			
				0		52		0		1,757		0			
				0		113		0		0		0			
				992	17.9%	813	14.7%	313	5.7%	4,333	78.4%	10,073	182.3%	5,527	5,412
00465	KMEM	PGUA	N	15	0.5%	105	3.5%	0	0.0%	2,515	84.9%	267	9.0%	2,962	2,928
60014	KCEF	LERT	N	20	1.5%	28	2.0%	27	2.0%	910	66.6%	382	27.9%	1,367	1,338
50005	KDOV	PHIK	N/A												
50004	KDOV	LERT	N/A												
60023	KCEF	KCEF	N/A												
70039	KCEF	LERT	N/A												
50004	KDOV	KNKT	N	6	0.4%	56	4.0%	0	0.0%	593	42.2%	750	53.4%	1,405	1,374
40061	KDOV	LERT	N	1019		14		227		1,956		324			
				65		52		0		0		0			
				0		45		0		0		0			
				173		92		0		0		0			
				0		9		0		0		0			
				0		22		40		2,699		289			

Figure 2. GDSS C-5 MRT Records for July 2007 (Part 2)

informed of potential delays to current AMC missions and enables XOCL controllers to begin preparing for possible MRT support. It is important to note that tracking ultimately nonsupported aircraft is a necessary and potentially time consuming task, and it is only after an aircraft is repaired or determined able to continue without an MRT that it becomes in fact a nonsupport. Of the 88 C-5 records for July 2007, 54 (61 percent) were monitored without the need to generate an MRT. The remaining 34 (39 percent) were actually supported by XOCL. See Table 2 for a breakdown of the 34 C-5 actuals.

Given these statistics it is interesting to note three telling points. First, the fact that the majority of C-5 records were eventually identified as nonsupports (54 of 88) suggests that the GAMSS and those aircrews operating outside the system effectively communicate with XOCL in accordance with AMCI 21-108, *Logistics Support Operations*. In other words, field personnel aren't calling in only when they need support; they call in to ensure information flow. Second, while it is obviously difficult to draw conclusions given the limited data considered, it is interesting to note that more than half of C-5 supports went to locations within the AMC en route system designed to support these aircraft. One would expect a majority of supports to occur outside the GAMSS. Third, and related to the second point, the fact that more than 90 percent of C-5s supported required parts—to include 88 percent of recoveries affected within the GAMSS—poses potentially significant questions for further analysis within AMC's supply function. While interesting in and of themselves, and potential fodder for additional research, this article does not pursue these statistics any further but instead focuses analysis on the XOCL/GDSS 2 interface.

C-5 Tail Number	GDSS Location	Actual Location	Pacing Correct?	Sourcing Tasked	%	Sourcing Complete	%	Trans Tasked	%	Trans Arrived	%	Mx Complete	%	Total Time	Total Time (GDSS)
					19.7%	290	4.5%	267	4.2%	5,248	81.7%	1,363	21.2%	6,420	6,402
50001	LERT	LERT	N/A												
60018	KCEF	LERT	N/A												
70043	KDOV	LERT	N/A								1263				
60015	EGUN	KTIK	N	13	0.5%	106	3.8%	47	1.7%	2,618	92.8%	36	1.3%	2,820	2,814
70042	KSUU	LERT	N/A												
50002	KDOV	LERT	N/A												
80223	KSKF	PHIK	N/A												
50008	KSUU	LERT	N/A												
70031	KCEF	LERT	N/A												
00465	KMEM	PHIK	N/A												
60021	KCEF	LERT	N/A												
50001	LERT	LERT	N	156	4.3%	0	0.0%	226	6.3%	2,858	79.5%	357	9.9%	3,597	3,588
70042	KSUU	LEMO	N	45	4.0%	49	4.3%	0	0.0%	138	12.2%	899	79.5%	1,131	1,116
00465	KMEM	KSUU	N/A												
50008	KSUU	LERT	N/A												
60014	KCEF	LERT	N/A												
00460	KSWF	ETAR	N/A												
70027	ORBI	KDOV	N/A												
60019	KSUU	LERT	N	526		33		0		553		?			
				0		18		28		1,219		135			
				526	14.4%	51	1.4%	28	0.8%	1,772	48.5%	135	3.7%	3,657	3,654
70027	ORBI	KDOV	N/A												
70031	KCEF	LERT	N	911		55		14		1,018					
				0		0		11		837		694			
				911	17.4%	55	1.0%	25	0.5%	1,855	35.4%	694	13.2%	5,240	5,220
50008	KSUU	LERT	N/A												
90012	KSWF	OKBK	N	80		0		162							
				0		143		0		1,522		1,025			
				80	2.9%	143	5.1%	162	5.8%	1,522	54.6%	1,025	36.8%	2,789	2,436
50002	KDOV	LERT	N/A												
70032	KSUU	OKBK	N	56		0		mrt already moving to support another acft							
				300		209		62	1.0%	5,701	87.9%	212	3.3%		
				356	5.5%	209	3.2%	62	1.0%	5,701	87.9%	212	3.3%	6,484	6,486
00460	KSWF	ETAR	N/A												
90005	KFFO	ETAR	N/A												
00467	KMEM	KXMR	N	275	22.9%	1	0.1%	0	0.0%	631	52.5%	235	19.6%	1,201	7,740

Figure 2. GDSS C-5 MRT Records for July 2007 (Part 3)

Requirement	GAMSS	Non-GAMSS	Overall
Actual Supports	18 (53%)	16 (47%)	34
Parts	16 (89%)	14 (88%)	30 (91%)
Manpower	5 (28%)	9 (56%)	14 (47%)
Equipment	3 (17%)	3 (19%)	6 (20%)

Table 2. Requirements Breakdown for 34 Actual C-5 Supports for July 2007

XOCL Input into GDSS 2

One of the challenges with analyzing GDSS 2 historical logistics data is, given both the current structure of the logistics database and XOCL's method of inputting information, it is difficult to identify specific trend data for process improvement. There are, for example, insufficient data fields available to begin to target procedural deficiencies for individual subprocesses; this article will later make recommendations in this regard. However, given the database's current framework, it is quickly evident that either the input into individual aircraft records is flawed, the GDSS 2 database itself has software deficiencies, or a combination of the two. Utilizing the GDSS 2 historical master record for each C-5 supported in July 2007, this article will now identify challenges with XOCL/GDSS 2 interface and will, in a later section, recommend solutions.

The first of the inconsistencies appears in the data field LOC ICAO (location International Civil Aviation Organization),[30] an entry intended to show at which CONUS or international location a specific aircraft broke. Of the 88 C-5 records for July 2007, only 4 (approximately 5 percent) reflected the correct support location.

C-5 Tail Number	GDSS Location	Actual Location	Pacing Correct?	Sourcing Tasked	%	Sourcing Complete	%	Trans Tasked	%	Trans Arrived	%	Mx Complete	%	Total Time	Total Time (GDSS)
00460	KSWF	ETAR	N	22	0.6%	18	0.5%	46	1.3%	714	19.9%	191	5.3%	3,590	3,570
00455	KSWF	ETAR	N/A												
00467	KMEM	UNK	N	9		41		19		1,497					
				60		0		0		920		217			
				69	2.5%	41	1.5%	19	0.7%	2,417	86.9%	217	7.8%	2,782	6,510
90025	KNQA	RODN	N	64	3.3%	127	6.5%	0	0.0%	1,563	80.6%	223	11.5%	1,939	1932
60011	KDOV	LERT	N	23	0.5%	974	20.2%	14	0.3%	2,075	43.1%	1,728	35.9%	4,814	4,818
90018	KWRB	PGUA	N	5	0.3%	37	2.6%	13	0.9%	891	62.2%	486	33.9%	1,432	78,996
70037	KCEF	LERT	N	99	3.0%	106	3.2%	0	0.0%	2,334	71.4%	835	25.6%	3,268	900
60019	KSUU	LERT	N/A												
90012	KSWF	LERT	N/A												
70028	ETAR	LEMO	N	4	0.4%	352	38.6%	0	0.0%	692	75.8%	224	24.5%	913	846
60022	ETAR	LERT	N	117	11.9%	35	3.6%	70	7.1%	639	65.1%	121	12.3%	982	954
00467	KMEM	KNUQ	N/A												
70045	KDOV	KPOB	N/A												

Shaded areas represent aircraft tracked in GDSS II, but ultimately resolved as non-supports.

= less than 60 minutes difference between GDSS II and this analysis

= greater than 60 minutes difference between GDSS II and this analysis

Figure 2. GDSS C-5 MRT Records for July 2007 (Part 4)

This analysis was conducted by comparing the ICAO found in the LOC ICAO field with the verbiage contained in the LRC REMARKS section (input by XOCL controllers) of the 88 individual historical records. It should be noted that while in 5 of the 88 records the actual aircraft location could not be accurately determined, it was clear from the context of the remarks section that the LOC ICAO field was not accurate. Given that XOCL controllers utilize GDSS 2 ICAO information for all active records on a daily basis to make support decisions and to provide status updates, it is likely the field was properly populated when the record was active and that the problem with the historical records lies not with XOCL, but rather within the historical portion of the GDSS 2 database itself. The presence of incorrect information in the historical LOC ICAO field is, nonetheless, significant. In looking for trends associated with the MRT process, it will be extremely important to determine where the aircraft have broken and what support, if any, was sent to which location.

The second inconsistency appears in the PACING data field. In the case of multiple aircraft discrepancies, this field is designed to identify which one is causing the aircraft to be grounded and awaiting an MRT or, when multiple grounding items exist, which one is driving the most extensive projected repair time. Additionally, when XOCL is supporting a grounding discrepancy, at GAMSS or aircrew request, XOCL often simultaneously tracks and supports otherwise flyable discrepancies for the same aircraft with the intention of preventing them from degenerating into grounding conditions. In other words, the intent is to fix a problematic but flyable discrepancy while the aircraft is already grounded vice waiting for it to possibly break further down the road. In both cases, flagging the correct pacing item will enable analysts to focus future research on the major items contributing to the MRT requirement. Of the 88 C-5 records, none correctly identified a pacing maintenance discrepancy, despite the fact that 26 records (30 percent) actually contained multiple aircraft discrepancies. The only way to determine the correct pacing item is to read through the LRC REMARKS section of each individual record.

A third inconsistency appears in the DISCREPANCY data field itself, which identifies the actual maintenance problem (or problems) generating the need for an MRT. Of the 88 C-5 records, 18 (20 percent) contained DISCREPANCY data fields where the discrepancy verbiage had been replaced by the word "CLOSE." It is unclear whether this is the result of a GDSS 2 software glitch or if XOCL controllers purposely amend records to reflect that a discrepancy has been corrected. For historical purposes this field should retain the actual discrepancy verbiage; otherwise, a future analysis requirement may necessitate sorting through the LRC REMARKS section to determine the maintenance problem. While in individual cases this may not prove to be too onerous a task, in some cases the actual discrepancy is not reflected in the remarks section at all.

The fourth and final XOCL/GDSS 2 interface challenge identified as part of this analysis is the GDSS 2 accounting of total time broken for supported aircraft. Researchers with GDSS 2 access can utilize the Logistics Support Tool feature to pull up broad synopses of historical MRT taskings. These synopses are useful in that they package pertinent information by time frame and by data field, eliminating the often lengthy LRC REMARKS section and allowing for greater ease of use (assuming, of course, that individual record remarks are not required as part of the research). One of the advantages of this tool is it identifies the total amount of time each supported aircraft was broken in the system, extremely useful data in a business where downtime for maintenance equates to lost potential revenue or, more importantly, delays in getting cargo to the warfighter. The challenge in this case is that the TIME BROKE field does not always reflect the aircraft's correct total not mission capable time. GDSS 2 calculates total time broken using two other data fields on the same report—BREAK DTG (the approximate date and time GAMSS or aircrew personnel notified XOCL of a particular discrepancy) and FIX DTG (the date and time maintenance

personnel notified XOCL the aircraft was repaired or flyable)—both input by XOCL. This analysis has determined that while BREAK DTG information in GDSS 2 is reliable, data in the FIX DTG field often does not match the time reflected in the LRC REMARKS section. Of the 34 actual C-5 recoveries, 11 (32 percent) reflected FIX DTG times that differed from the LRC REMARKS section by 1 hour or greater. This resulted in GDSS 2 reflecting total C-5 time broke (for July 2007) as 153.8 days versus 79.7 days according to the more reliable LRC REMARKS section. Two potential reasons for the disparity are GDSS 2 software issues or inaccurate XOCL input (either neglecting to input completion data or incorrectly loading the time all related MRT personnel, parts, or equipment were returned to home station vice the time the aircraft was actually repaired). This issue is significant and must be addressed if GDSS 2 data is to be used for MRT process improvement.

Other Findings

In addition to the XOCL/GDSS 2 interface findings noted above, the July 2007 C-5 data yielded several other findings that should serve as additional basis for future MRT process improvement. (As a note of caution, multiple supports in Figure 2 may have simultaneous actions resulting in a combined percentage greater than 100; non-multiple supports are purely sequential by definition and the collective averages approximate 98 percent to 100 percent of their total support times.)

- The average C-5 MRT takes approximately 2.3 days.
- On average, the transportation tasking portion of the MRT process takes the least time, 85 minutes, with XOCL identifying available rides in less than 3 percent of the total process time.
- On average, the entire size, source, and task portions of the MRT process constitute approximately 13 percent of the total time, which equates to approximately 7.4 hours per record.
- On average, 68 percent of the total MRT process, or 1.6 days per record, is spent awaiting transportation of MRT assets from the sourced location to the broken aircraft's location. This requirement takes more than twice as long as the next most time consuming part of the process and should, therefore, be a primary target of future analysis. Specific areas for future analysis should include mode of transport (airline, MILAIR, and commercial cargo carrier), sourced base preparation procedures, carrier delivery procedures, and receiving base procedures.
- On average, 33 percent of the total MRT process, or 18.3 hours, is spent fixing a broken aircraft once MRT assets arrive. When multiple supports are not required for the same aircraft, the percentage decreases to 20 percent (approximately 7.4 hours per record) of the total MRT process. Specific areas for future analysis should include procedures to get MRT assets from delivery location to the broken aircraft, MRT qualifications, and troubleshooting procedures. (See specific recommendation that follows, Deploy Multiple MRT Teams.)

Recommendations

LOC ICAO Data Field

Correct the deficiency with the LOC ICAO data field in the GDSS 2 historical logistics support database. While identifying the correct LOC ICAO from the LRC REMARKS section of a single record may not be terribly onerous, to identify all MRT supports to a specific location by combing through individual records would not only be impractical in today's age of information, it would be virtually impossible. The ability to accurately identify XOCL supports by location will enable analysts to potentially target specific locales for process improvement. For example, comparing overall aircraft maintenance trends with MRT supports to certain *desirable* locations (Australia, Hawaii, or Germany in September) may result in a targeted decrease in aircraft not mission capable time. Similarly, a large or unusual number of MRTs to the same location to support cut or worn tires may help identify issues with a local runway, taxiway, or parking ramp. Finally, significant numbers of supports to a given location may point to a need to add or increase the number of flying crew chiefs (or other maintenance personnel) assigned to support a particular airlift mission.

PACING Data Field

Correct the deficiency with the PACING data field, either via software update or, if simply a procedural problem, ensure XOCL controllers properly input the required data. Identifying the grounding discrepancy or, in case of multiples, the driving one, will help focus future analytical efforts. Additionally, recommend programmers include an option to identify sequential pacing items within the same record. This will accommodate circumstances when a subsequent grounding discrepancy becomes the new pacing item once the original pacing item is repaired.

DISCREPANCY Data Field

Correct the deficiency with the DISCREPANCY data field, either via software update or through XOCL data input procedures. Identifying the actual discrepancy will help focus future analytical efforts and avoid the potential for researchers to have to read through the LRC REMARKS section of individual support records.

FIX DTG Data Field

Correct the deficiency with the FIX DTG data field, either via software update or through XOCL data input procedures. TIME BROKE is a significant metric for mission and logistics support planning, as well as an indicator for XOCL process improvement. The alternative to accurate GDSS 2 data, sorting through individual support record remarks, should make fixing this data entry a high priority.

Create Additional GDSS Data Fields

If AMC is to utilize GDSS 2 data to evaluate and improve the MRT process, it must first adjust the database and XOCL data input procedures to quickly and reliably capture and produce the necessary information. In addition to the current data field suggestions above, AMC should consider software upgrades to include new fields for data extraction and analysis. The ultimate purpose of these fields is to help analysts systematically evaluate and focus on potential subprocess anomalies, especially if paired with metrics for each of the subprocesses. See Table 3 for recommended additional data fields.

Deploy Multiple MRT Teams

With respect to maintenance time to repair an aircraft once MRT assets have arrived, another area for evaluation is work and rest cycles and the number of technicians or teams sent to repair an

aircraft. In some instances the time from MRT asset arrival until aircraft fixed is significantly lengthened by maintainer rest requirements. Obviously, work and rest cycles are a necessity and should not be violated; rather, it may be that given a known multishift recovery operation; XOCL should consider sending sufficient personnel to work around the clock (two teams on 12-hour shifts). This would likely be done only on a case-by-case basis, such as supporting high visibility mission maintenance recovery operations, when a multishift operation is determined to be feasible and effective, and when manpower availability will accommodate. The potential payoff, however, would be approximately 12 hours saved for a 24-hour job, approximately 36 hours saved for a 48-hour job, and so forth.

Develop Time Standards for MRT Process or Subprocesses

Establishing time standards for each of the subprocesses (to include those identified in Table 3), as well as an overall MRT time line, is key to process improvement. Granted, although the same basic processes apply to all MRTs, the individual circumstances such as location and nature of repair, make it difficult to draw conclusions by comparing and contrasting individual supports. However, establishing basic standards for the overall process and subprocesses will help evaluators target specific portions of specific recoveries for analysis. XOCL controllers should develop a baseline against which to compare future subprocess time lines, with possible consideration given to establishing separate standards for different categories of support, such as support to CONUS, OCONUS, GAMSS, and non-GAMSS locations outside the US. As a starting point, the average times for non-multiple supports identified in Figure 2 may be used to develop standards for C-5 MRTs. Standards for some of the proposed data fields in Table 3 will require additional analysis to determine appropriate time lines, preferably facilitated by the GDSS 2 software upgrades recommended previously. Different MDSs may require separate standards to account for variances in parts and technician availability and current support methods such as C-17 contracted logistics support. Although more detailed standards will more effectively target improvement areas, even a single set of standards for all MRTs will likely facilitate some degree of process improvement. In the absence of a standardized approach to measuring and identifying process deficiencies, MRT process improvement will continue to be situational at best.

Data Field	Rationale
Sourcing Tasked	Identifies time XOCL tasked unit to source MRT assets; targets XOCL process
Sourcing Completed	Identifies time XOCL received asset sourcing from unit; targets unit process time
MRT Assets Mobilized	Identifies time sourced unit has assets ready to transport; targets unit process
Transportation Tasked	Identifies when XOCL identified actual support ride; targets XOCL process
MRT on Hand	Identifies when MRT assets are available or delivered to maintenance; targets unit process

Table 3. Recommended Additional GDSS 2 Data Fields

Conclusion

The US government places tremendous significance on global engagement. Whether it's military action to deter aggression, humanitarian assistance to troubled areas, or supplying US embassies and other deployed personnel around the world, rapid and agile mobility plays a key role in meeting America's security objectives. That means strategic airlift, now and for the foreseeable future, provides critical capabilities vital to our national interests. It is, therefore, incumbent upon the Air Force and specifically Air Mobility Command to work toward minimizing the amount of time our C-5s and C-17s remain broken within the system as they carry out their global airlift mission. This effort begins with the TACC and its logistics control function, the XOCL.

Unfortunately, while the current MRT process ensures airlifters broken away from home station are eventually repaired and put back into service (and arguably does so effectively), there is little evidence that much is done outside the normal manpower and parts placement systems to systematically analyze and improve the overall MRT process. As noted earlier in this article, this is not to say that AMC does not make efforts to improve real-time on a case-by-case basis; rather, it suggests that in order to more effectively minimize strategic airlifter downtime, the command must implement analytical procedures specific to the MRT process itself, beginning with the XOCL's sizing, sourcing, and tasking subprocesses. The current mechanism for reviewing and assessing historical data, the GDSS 2 database, as currently configured and utilized, is largely ineffective at meeting the analytical need.

In order to improve the MRT process, logistics personnel must first have access to sufficient and specific data enabling them to target areas for improvement. Currently, the only way to focus any analytical effort is to perform a painstaking, time-consuming review of each individual aircraft recovery record, a method so inefficient as to be essentially worthless. Therefore, the journey toward MRT process improvement begins with the data accumulation and evaluation mechanisms themselves. As proposed in the recommendations section of this article, AMC must implement three actions if it is to begin gathering the data to improve the aircraft recovery process. First, it must correct data input and access issues with currently existing data fields in GDSS 2. Corrections will likely include XOCL reviewing and improving procedures to ensure maintenance controllers input clear, concise, and accurate data, as well as software fixes to GDSS 2 to ensure the data is accurately transferred from active to historical records. Second, in order to effectively target process improvement efforts, XOCL should work with system programmers to add specific data fields within GDSS 2 to account for the varied MRT subprocesses. Third, XOCL should develop and track basic time standards for the overall MRT process and its individual subprocesses, that will enable researchers to focus on those events having adverse impacts on aircraft recovery. While these recommendations are neither groundbreaking nor terribly exciting, they are necessary to begin the evaluation and improvement process.

Strategic airlift is absolutely key to the timely movement and sustainment of US and allied military forces and therefore, key to the nation's security. The members of XOCL perform a tremendous service in helping to keep C-5s and C-17s flying and delivering cargo around the world; however, the current MRT process, as effective as it is, can likely be improved upon with increased attention and analysis. By implementing the actions recommended in this article, AMC can take steps to build upon its past and present successes to ensure an even more effective process for minimizing strategic airlift downtime due to maintenance. In doing so, it will not only help the command move cargo, it will also improve the overall effectiveness of our Air Force, our Department of Defense, and our nation as a whole.

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I said to myself, I have things in my head that are not like what anyone has taught me—shapes and ideas so near to me—so natural to my way of being and thinking that it hasn't occurred to me to put them down. I decided to start anew, to strip away what I had been taught.

—Georgia O'Keeffe

Planning is everything—plans are nothing.

—Field Marshal Helmuth von Moltke

If I had to sum up in a word what makes a good manager, I'd say decisiveness. You can use the fanciest computers to gather the numbers, but in the end you have to set a timetable and act.

—Lido Anthony (Lee) Iacocca

If opportunity doesn't knock, build a door.

—Milton Berle

Introduction

Special Feature

Reality struck hard on 24 September 2007 when Secretary of the Air Force Michael Wynne publicly announced that the 40,000 personnel reduction taken by the Air Force to pay for new airplanes was not reaping the rewards envisioned—stated bluntly, "It isn't working." The purpose of the drawdown in Air Force personnel strength to 316,000 by fiscal year 2009 was to free up money to modernize the Air Force's aging aircraft fleet—average age of 24 years, 14 percent of which is either grounded or possesses mission-limiting restrictions. This type of drawdown, a method commonly used in private industry, is used to liquidate assets to gain the resources needed to recapitalize the company's asset base. However, the funds generated by the drawdown were only sufficient to alter the slope of the aging curve so that the average age was 26.5 years by the end of the current five-year defense plan.[1]

Further, the drawdown generated insufficient savings throughout the out-years to significantly alter the aging curve. Air Force leaders state they need an additional $20B per year to meet aircraft fleet recapitalization needs.[2] Additional drawdown of forces is not realistic and the Air Force Strategic Plans and Programs Division is already taking action for the next Quadrennial Defense Review to add back eight combat-ready wing equivalents and return Air Force end strength to 330,000 in order to meet future requirements for providing global strategic deterrence.[3]

What remains unclear is whether Congress will provide any additional funds to meet recapitalization requirements. Likewise, there is no indication from Congress that money will be appropriated to support the now needed upsizing of Air Force end strength to 330,000, or whether that cost will be borne by the Air Force out of its future budgets. As a result, the Air Force is looking for all means to achieve the needed savings for recapitalization.

The Air Force's current fascination with Air Force Smart Operations for the 21st Century (AFSO21) may help it to do more with less via better management of resources and improved efficiencies—reviewing existing processes and attempting to make them more efficient. In fact, process reengineering has identified some savings in Air Force depot and industrial processes, but not nearly enough to meet the savings needed.

The Air Force budget is comprised of four main areas, all in need of additional funding: personnel (force structure), readiness, infrastructure (sustainability), and procurement (modernization).[4] Personnel costs (pay and benefits) have risen 57 percent over the last 10 years while personnel end strength has decreased by 8 percent. Operating (readiness) costs have increased 179 percent over the last 10 years, even though the aircraft inventory was reduced by some 2,500 airframes. The Air Force baseline budget, however, has not increased commensurate with these rising costs of operation. Figure 1 depicts defense spending as a percentage of gross domestic product (GDP) since Air Force establishment and the trend indicates there will likely be little change in the future.[5] Although there has been debate, a convincing case has not yet been made to secure an increase in defense spending.

Jeffery A. Vinger, PE, Colonel, USAF

Future Air Bases

Power Patches or Military Communities?

A revolutionary approach is needed by the Air Force to reengineer not only its business processes but also its current and future basing methods.

Article Highlights

The Air Force should join with other Services to implement an ideal base study, as conducted in the 1960s, to examine future requirements for a Joint basing structure given changing technologies, potential threats, climate changes, and changing support missions.

Colonel Jeffery A. Vinger in "Future Air Bases: Power Patches or Military Communities" examines what airbases of the future might look like.

The Air Force recently elected to reduce end strength by 40,000 personnel in a private industry approach to liquidate assets to generate needed capital to recapitalize and modernize its core operating systems—aircraft that are rapidly aging. Air Force leadership believes it requires an additional $20B annually to recapitalize its fleet. While Congress shows little inclination to provide the additional funding, analysis of the Air Force budget shows little flexibility to shift sufficient funding from other areas to meet recapitalization needs. Further drawdown of personnel is no longer an option as current Air Force planning indicates a need for increased authorizations to meet future mission requirements and actions are underway to increase end strength from 316,000 to 330,000. This makes the infrastructure area of the budget with its focus on military construction, base realignment and closure (BRAC), family housing, and operations and maintenance the only potential budget area with any flexibility. Unfortunately, this segment of the budget comprises only $5B of the current Air Force budget.

Base realignment was thought to be a method by which to generate future savings, but the approach of simply transferring assets to local communities while constructing new facilities to

Given that the Air Force cannot further reduce end strength (personnel budget) and flying mission operations (readiness budget) must continue, an approach which aggressively examines the only piece of the budget from which savings may be found—infrastructure—is needed. The current infrastructure portion of the budget totals only $5B, and simply transferring the bulk of these funds to other budget areas will not solve the recapitalization problem. Therefore, a more revolutionary approach is needed that strategically leverages the existing infrastructure budget to generate future savings for recapitalization, while at the same time unlocking the potential value of Air Force infrastructure assets.

Given that the Air Force's current infrastructure plant is valued at over $200B, this is an asset base that could be used in various ways to generate the resources needed for recapitalization.[7] The funding used to support infrastructure assets (military construction, family housing, base realignment and closure [BRAC], and operations and maintenance accounts) is available in the short term to create change and generate efficiencies for current and future savings. Over the long term, the Air Force needs a strategy to generate savings from the infrastructure base that can be used to reduce outlays within specific areas—readiness that includes utility accounts and supporting contract accounts.

Throughout the past two decades, amidst budget cuts, personnel reductions, and base closures, the Air Force has been called on continuously to support Department of Defense (DoD) demands for power projection around the globe. While some senior leaders have expressed serious concern for the operations tempo, there seems to be no end in sight to the complex challenges facing our world and strategic national security interests. To remain a viable weapon of choice, the Air Force must transform, making difficult choices for organizing, training, and equipping air, space, and cyberspace forces.[8]

> We're at a critical juncture—a transition period that will shape the Air Force and our nation's security for generations to come. By focusing on our main priorities—winning the global war on terror, developing airmen, and recapitalizing and modernizing the Total Force—we are prepared to face the challenges of today and the uncertainties of tomorrow… Meeting these challenges will require bold new initiatives.[9]

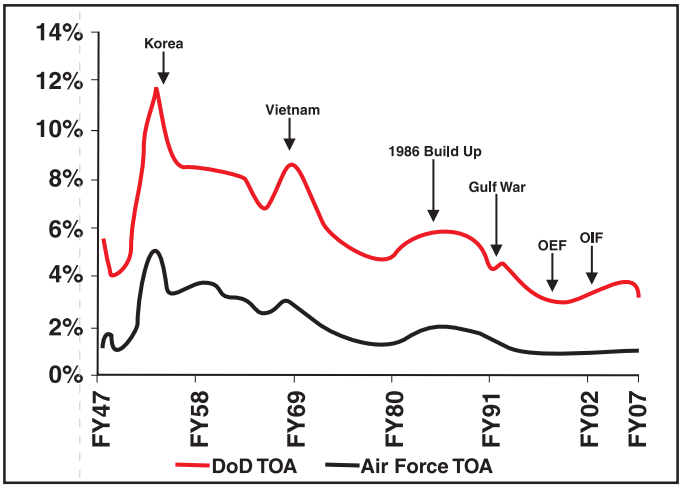

Figure 1. GDP Spending on Defense[6]

Discussion

Article Focus

The intent of this article is to focus on the Air Force's priority of recapitalizing and modernizing the Total Force. This article assumes the Air Force is making the most of its infrastructure budget to create efficiencies over the short term to include focusing investment on more energy efficient technologies, facilities, design standards, and utility reducing systems.[10] This article will focus on long-term changes that can generate efficiencies from which savings can be generated from the infrastructure base. Given this position, it is believed that the footprint of the Air Force can and will be dramatically reduced in the future, providing tremendous efficiencies in the number, look, and operations of continental United States (CONUS) air bases. As such, the Air Force basing structure may hold the greatest potential for generating resources needed to support the recapitalization and modernization needed to further Air Force transformation.

A revolutionary approach is needed by the Air Force to reengineer not just its business processes, but also its future basing methods. An approach is needed to both free up substantial existing infrastructure assets (value in excess of $200B) and unlock the potential value of Air Force installations for potential liquidation or exploitation. Such an approach must also generate multiple efficiencies to reduce bills, rather than continue to increase future costs that compete for limited budget funds.

History

Past approaches to basing have been incremental rather than revolutionary. This is evidenced with a review of the current inventory of installations. Currently, 20 percent of CONUS Air Force installations existed well before World War II.[11] For example, Francis E. Warren Air Force Base (AFB), Wyoming and Offutt AFB, Nebraska are locations decided upon as western outposts during the American Indian wars. In most cases, we continue to invest heavily in maintaining and operating the ancient infrastructure at such bases. Also, 94 percent of existing CONUS Air Force installations were active War Department installations or Army airfields during World War II. Others, like Malmstrom AFB, Montana and Beale AFB, California, are remnants of bases thought to be only temporarily established to support lend-lease ferrying operations to the Soviet Union or prisoner of war internment during World War II.[12] The majority of our current bases were simply the result of inheritance from the Army following World War II, as politically directed by Congress, whether they met the needs of the Air Force or not, with incremental changes over the decades to continue to maintain, operate, and modernize some of the same existing infrastructure. Only 6 percent of our current airbases were actually the result of any actual strategic, analytical planning processes.[13] Some former Strategic Air Command (SAC) bases (Minot AFB, North Dakota and Grand Forks, South Dakota) were consciously located based on technology of the time to be within interceptor range of Soviet bombers. Likewise, Schriever AFB, Colorado was established in the 1980s to provide command and control of space-based assets.[14] As seen by the few installations added to the Air Force inventory, the major justification for these bases focused on the technological aspects of the weapons systems needed to reside at those installations.

Methodology

Future technology may leave these past basing strategies as well as many of the resulting current installations obsolete. Likewise,

Article Highlights

realign assets to other locations chewed away at any potential savings, preventing long-term savings from materializing. Colonel Vinger proposes a revolutionary approach to reengineer a segment of Air Force business processes. Future basing methods need to free up and unlock the value of some assets for liquidation and generate efficiencies that reduce budget layouts rather than continue to increase future budgets. Past approaches to basing have been incremental rather than revolutionary. Many current Air Force bases are locations decided upon from the result of the Indian wars, while the locations of other bases are simply the result of inheritance from the Army following World War II. Only a handful of our current stateside airbases were the result of any actual strategic planning process. Today's technology and future technology may leave these past basing strategies even more obsolete. Vinger believes the current BRAC process merely locks in future incrementalism. In an effort to determine a potential revolutionary approach, he assumes a clean slate and assesses three very broad categories to see if we can learn anything that may be useful in influencing future BRAC considerations. These three areas are basing aligned with Homeland Security, military basing aligned with the Total Force structure, and military basing aligned for Joint missions. The article concludes by assessing the benefits of each option.

Article Acronyms

AFB – Air Force base
AFSO 21 – Air Force Smart Operations for the 21st Century
BRAC – Base Realignment and Closure
CBO – Congressional Budget Office
CONUS – Continental United States
DHS – Department of Homeland Security
DoD – Department of Defense
GDP – Gross Domestic Product
SAC – Strategic Air Command
UAV – Unmanned Aerial Vehicle

potential future threats to these bases such as encroachment, force protection issues, and even climate change are serious concerns warranting consideration in assessing future basing strategies. Current processes for modernizing airbases for the future such as military construction and BRAC realignment continue to perpetuate and lock in future incrementalism. In an effort to determine a potential revolutionary approach, this article assumes a blank sheet of paper unfettered by current and historical constraints of base geometry, geology, infrastructure, location, or politics. It will examine three very broad categories to see if we can learn anything that may be useful in metering into future military construction and BRAC process considerations. The three broad areas reviewed by this article include military basing aligned with:

- Homeland security concerns
- The Total Force structure
- Joint operations

This article will present various ideas for consideration in matching or combining mission capabilities to establish major installations under the three broad areas mentioned. Finally, this article reviews the benefits of the potential options assessed, drawing general conclusions on future basing strategies the Air Force might consider for maximizing efficiencies for future operations. It then discusses recommendations for proposed future basing strategies.

Optimizing Air Base Installations

This section of the article assesses three different actions that may provide tremendous opportunity for the Air Force to relook at its current force structure and supporting infrastructure, capitalizing on economies and efficiencies for the future. It discusses how future Air Force supporting infrastructure might be molded to enhance support to homeland security efforts. It reviews the potential for efficiencies and savings by tying a baseline supporting infrastructure with future Total Force initiatives. Finally, it makes a case for efficiencies created utilizing a baseline supporting infrastructure with a program of Joint basing or consolidation, combining multiple activities to fully utilize the available space of our military installations.

Molding into Homeland Security

The creation of the Department of Homeland Security (DHS) was the largest restructuring of federal agencies since the 1947 National Security Act establishing the Air Force.[15] Section 202 of Title 6, United States Code makes the DHS responsible for securing the borders, territorial waters, ports, terminals, waterways, and air, land, and sea transportation systems of the United States and preventing the entry of terrorists and the instruments of terrorism into the United States. According to the *National Strategy for Homeland Security*, two ways in which the DoD contributes to homeland security are domestic missions of homeland defense and civil support. While DoD trains and equips its forces for homeland defense, it does not do the same for the civil support mission, instead relying on dual-capable forces for civil support activities. According to the *Strategy for Homeland Defense and Civil Support*, the National Guard also trains and equips for warfighting missions while being tasked with being a state's military responder to emergencies.[16] Securing the homeland is the DoD's top priority and is listed as the first strategic objective in the current *National Defense Strategy*.

The damage inflicted by Hurricane Katrina was huge and the likelihood of similar catastrophic natural disasters occurring again is inevitable. There are other scenarios that could provide similar catastrophic disasters such as chemical, biological, radiological, nuclear or high-yield explosion attacks. In these disasters it is highly probable that local and state capabilities will be overwhelmed and the states will require federal assistance. DoD's responsibility is to provide support to DHS, when directed by the President or when requested by the Secretary of DHS and approved by the Secretary of Defense.[17]

In addition to disasters, the DoD may be called upon to provide other forms of domestic support. Recently, the President directed the use of National Guard personnel to temporarily support the border patrol in protecting the nation's borders. This measure was intended to be an immediate, short-term measure to reduce cross-border violence, prevent entry of possible terrorists, combat trafficking in persons and illegal narcotics, and stemming the flow of illegal immigrants. There may be additional requirements in the future for Guard, Reserve, and active duty personnel and installations should there be changes made in the Posse Comitatus Act.[18]

The Posse Comitatus Act currently prohibits federal military personnel and units of the National Guard (while under federal authority) from acting in a law enforcement capacity within the United States, except where expressly authorized by the Constitution or Congress.[19] While there are currently no plans to deploy additional active duty personnel to the border, DHS informed Congress that there may, in the future, be some skills and capabilities found in active duty units that can be employed to gain and maintain increased security along the border. The future use of Air Force aerial surveillance, unmanned aerial vehicles (UAVs), command, control, communications, computers, intelligence, surveillance, and reconnaissance, transport, logistics, and engineering capabilities would be useful to the DHS border security mission. Tying future basing initiatives to provide better support to this critical DHS mission could generate efficiencies for the Air Force as well as the DoD as a whole.

Currently the DoD does not budget and program for civil support missions, viewing these missions as derivative of its wartime mission.[20] However, it is a likely assumption that Congress will increase spending for homeland security to some degree for some time into the future given the continued threat of terrorism. However, constrained funding even for homeland security, and between competing departments, will drive a future strategy of consolidating available assets to provide an interoperable system of intelligence, surveillance, and reconnaissance supporting a rapid response force capability, rather than dispersing large forces along the expansive borders of the United States. Future Air Force technologies including UAVs, unmanned combat aerial vehicles, and cyberspace capabilities will greatly enhance support to this consolidated mission, providing the intelligence data needed to identify potential threats to United States territory. Air Force assets in space and in the air will identify and track suspect traffic approaching the United States. Likewise, the same assets will be used to monitor border violations, track, and coordinate rapid interdiction response.

The operation and information gathering mission of these air and space assets can be achieved from combined operations at a single key consolidated airbase, with the information output then dispersed widely to information users. The use of future air assets will, however, require locating them at airbases closer to the locales affected. Border and coastal surveillance will require airbases (primary and alternate recovery support) within range of the expansive territories involved in order to provide the persistent imagery, surveillance, and reconnaissance needed . As an example, the North Dakota Air National Guard recently flew its first MQ-1 Predator remotely piloted aircraft from Fargo, North Dakota. The data collected by this unit (and others like it) can be consolidated centrally, interpreted, and dispersed to the appropriate DHS agency for action.[21]

The March 2007 Commission on the National Guard and Reserve found that the National Guard has assumed increased responsibilities for homeland related missions since 9-11, a trend that will continue in the future. Domestically, members have been deployed to support an increased security presence at state airports and other transportation hubs, especially during the holiday seasons or other times of elevated force protection conditions. Likewise, members have volunteered and been mobilized in large numbers to support the continuing efforts in Operation Enduring Freedom and Operation Iraqi Freedom. The Commission found that these increased responsibilities include newly created missions for the National Guard, both domestically and overseas, for which the current force structure is not sufficiently flexible enough to handle adequately. In light of the existing need for force structure change, the DoD should accomplish an aggressive review of the Guard's force structure and identify opportunities to push additional missions into the Guard, especially those key to responding and supporting the DHS mission for domestic defense and civil response.[22]

Given DHS reliance on National Guard and Reserve support, opportunities may exist for the transfer of air assets to these components to be operated and maintained at widely dispersed Air Guard and Reserve bases and local airports. With this approach, the infrastructure needed for these operating locations need only consist of core supporting infrastructure to support the air assets.

Future Air Force cyberspace systems will need to integrate information collected from a wide range of sources and share that information by linking across: federal, state, and local agencies; the private sector; and international partners. The Air Force will coordinate with interagency and intergovernmental partners to cooperate closely in the execution of homeland defense and civil support missions. To best support the homeland security mission, Air Force infrastructure will need to ensure interoperability. Many urban communities are obtaining federal grants to establish regional command and control centers, or *fusion centers*, to consolidate and coordinate civil emergency support operations.[23] The Air Force could benefit greatly by offering available space to incorporate these regional centers on federal property to facilitate the joint operability of local authorities with military defense operations. To become eligible for grant money, local communities must abide by federal rules for establishing state plans that, aside from standardizing responder equipment and capabilities, also provide for continuity of local government operations in the event of an emergency. Local airbases could provide the needed space for establishing these secure alternative operating facilities in return for fees for future operations and maintenance that can be provided through the comprehensive grant formula matrix being developed by the DHS in partnership with states and local communities. Los Angeles and Las Vegas are two examples of major urban areas in which these fusion centers will operate continuously—both cities possess major Air Force installations that could play host. The most efficient baseline supporting infrastructure is that which comprises the minimum core facilities, utilities, and airbase systems needed to ensure the Air Force is capable of meeting its mission to deliver sovereign options for the defense of the United States and its global interests.

Tying into Total Force Initiative

Numerous efforts are underway to assess potential actions to make the Air Force's Total Force more seamless. The Total Force Initiative may be akin to a chapter out of Army history in which Army General Creighton Abrams established the Total Force Policy as a result of the lessons of Vietnam.[24] At that time, it was General Abrams' intent to circumscribe the freedom of action permitted to the President to opt for war. By placing critical functions into the Reserves, without which the conduct of major campaigns was all but impossible, he made the active Army operationally dependent on the call-up or mobilization of the Reserves.[25] Like the Army, the Air Force has a significant part of its combat capabilities in the Guard to include 30 percent of personnel end strength, 33 percent of fighter squadrons, 12 percent of bomber aircraft, 45 percent of tankers, 49 percent of theater airlift, and 100 percent of air defense capability. Support units include air traffic control, combat communications, civil engineering, weather, medical, and aerial port capabilities. National Guard units are highly dispersed, existing in more than 88 flying units and 579 mission support units located in 54 states and territories of the United States. They can be mobilized quickly and deployed where needed. This size and composition is derived principally from the Total Force Policy of the 1970s, conceived as a means to meet global commitments while saving money in personnel accounts.[26]

As with past policy, the Air Force can further capitalize on Total Force initiatives to produce a smaller, more capable Air Force composed of regular, Guard and Reserve components by recapitalizing the force and changing organizational constructs. Former Chief of Staff of the Air Force (CSAF) General T. Michael Moseley's efforts to further Total Force integration will, in the coming years, provide substantial savings through shared leveraging of Air Force resources with the overall intent of increasing combat capabilities. By assigning active associates or Reserve units with Air National Guard units, these units are allowed to share responsibility for limited weapon systems. The associate unit concept has been around since 1968, successfully supporting strategic airlift operations. Associate units fly the same missions, fly the same aircraft, maintain the same aircraft, and support the same mission under the operational control of the active duty commander, but are still under the administrative control of the Air Force Reserves. Likewise, consolidating commissioning programs, training, and military education programs for active, Reserve, and Guard personnel creates efficiencies, bonding, and total integration of forces. At the same time, the Air Force's total footprint will shrink along with its required infrastructure assets and duplicative manpower activities.[27]

Figure 2 depicts 138 initiatives currently identified for action by the Air Force that will partner active duty, National Guard, and Reserve Air Force units. These initiatives allow fuller integration and sharing of future weapon systems, combining of future operations, training of the Guard and Reserve on the newest technologies and systems to increase the Air Force's reachback capabilities. They also will allow National Guard and Reserve members to directly support operations from their home airbase. Such initiatives leverage limited manpower and free active duty Air Force members for expeditionary deployments. Likewise, establishing Guard and Reserve units as associate units will allow sharing of assets rather than procuring additional assets to stand up separate units and continually resourcing them to maintain the same combat ready status.[29]

The Air Force, National Guard Bureau, and Air National Guard are working closely with the adjutant generals of all states and territories to resolve issues regarding time lines, manpower and resources, emerging mission potential locations, and new organizational constructs to increasingly integrate active duty, Air National Guard, and Air Force Reserve components. As this effort matures, the Air Force's combat capability and peacetime efficiency will increase.

In the past, one of the primary barriers to accessing and utilizing the Air National Guard in overseas missions was that the Air National Guard's traditional manning structure was more suited to the demands of a Cold War environment rather than the contingency demands of today. One option available to allow the Air National Guard to meet more demanding taskings, for longer periods of time and with less impact on the traditional Guard force, is to increase the number of active duty Air Force personnel in Air National Guard units. An example of such an arrangement is the 124th Fighter Group and the B-1 unit at McConnell AFB. The addition of active duty personnel allows these units to be capable of performing no-notice, long-duration taskings as well as crisis response. It stands to reason other Gurard units would also experience these same benefits with an increase in the number of active duty personnel assigned.[30]

The establishment of associated units either pulls National Guard and Reserve personnel to active duty units for training and operations (classic associate or ARC associate) or pushes active duty personnel out to Air National Guard or Reserve Air Force units to provide training and integration (active associate). In the latter case, active duty members will live and work in what is being termed *community basing arrangements*.[31] One of the advantages of the Reserve and Guard components is that they are community based, meaning most of the personnel assigned to these units are generally sourced from within a 50-mile radius of the unit's home base. As such, the majority of these units are located near large metropolitan areas. Another advantage is that this work force, having always been community based, has always depended on the local community for its needs and will continue to do so into the future. The benefit of leveraging manpower from the Guard and Reserves through future Total Force initiatives is increased flexibility of the active duty force—allowing greater mobility as well as future personnel reductions to generate additional funding for recapitalization, or simply to balance the budget for ever-increasing personnel costs. Increasing Guard and Reserve forces will push out the overall retirement bill for budgeting purposes. As funding for these future Total Force initiatives comes directly from the air budget, state adjutant generals, especially those with missions becoming less relevant to the warfighter or to the Air Force's air and space expeditionary force concept, are readily volunteering to accept new associated missions. Future infrastructure requirements could be drastically reduced for those associated missions pushed toward community basing operations since only core infrastructure would be needed to support those missions or systems. Likewise, for associated missions drawn toward active duty installations, the leveraging of manpower should allow further reductions in active duty personnel and a further reduction in community and communal support infrastructure as active bases could benefit by mirroring the community basing concept of Air National Guard units.

Fusing into Joint Basing Initiatives

The 2005 BRAC plan included a mandate to consolidate 25 DoD installations into 12 Joint bases in an effort to generate efficiencies and savings by reducing the duplication of effort and capitalizing on economies of scale in the management and support of combined-use installations. The concept of bundling management of facilities, infrastructure, and services is a successful business concept used extensively worldwide. The 2005 BRAC Joint Basing Initiative is expected to generate $212M in annual savings. The concept of joint basing supports the DoD's vision for all Services to operate in an efficient businesslike manner, emphasizing timely, reliable, and relevant management information for decisionmaking and regular clean audit opinions. The common delivery of installation support assists the Services in making informed risk-based decisions to program resources for installation support by allowing them to report to Congress, with confidence, where money is being spent, the cost of doing business, and the return on DoD investments. Common standards for all Services is the ultimate goal. The warfighter should receive the same standard of service, regardless of the color of the uniform.[32]

As of July 2007, the Air Force has taken a *slow-it-down* approach, prodding the Secretary of Defense to accept a concept of testing the Joint basing concept in only a couple of situations to see if it works and to develop solutions for problems before considering other bases for conversion at a later time, if at all.[33] Most Air Force apprehension centers on the loss of control by wing commanders. Under the Joint concept, the wing commander would no longer run the installation and his or her unit would be a tenant on the base with a Joint installation commander. Some fear, under this concept, that combat leaders will be replaced by managers focused only on the business principles needed to manage installation support services, but lacking a battlefield warrior ethos. Both the Navy and Army, for some time, have had organizations working very much like those envisioned in the Joint concept. The Navy Installations Command guides operations, administration, and support for all Navy shore installation support to the fleet, fighter, and families worldwide. This structure reduces infrastructure management layers, regionalizes many support operations, conserves resources, establishes enterprise-wide standards, and improves facility infrastructure. It is not the ship commander's responsibility to operate the shore base when he or she is in port. Similarly, the Army Installation Management Agency manages Army posts to support readiness and mission execution, providing facilities and services, optimizing resources, and sustaining and enhancing the

well-being of the military community. Like the Navy, the Army accomplishes support through regional offices with garrison commanders at each installation responsible solely for the management of the installation and supporting the multiple tenants located thereon. Both the Army and Navy structure allows the warfighter to concentrate on the warfighting mission and not on managing the installation.

Some elements of Air Force leadership have been concerned that the other Services are known to defer base maintenance from time to time to fund other mission priorities. Such actions may impact the quality of life at the Air Force installations, which unlike the other Services, are the Air Force's fighting platforms. That said, the Air Force has also been known to defer base maintenance as well. In fact, base operations is consistently under funded in the hopes of making up the deficit with year-end fallout money. For fiscal year 2007, the base operations account was funded at only 64 percent.[34] Likewise, claiming Air Force bases as fighting platforms is not much of an argument as the weapon systems at these bases (excluding the B-2 at Whiteman Air Force Base and the strategic nuclear deterrence mission) must be forward deployed to fighting platforms in a theater of operations. Additionally, Air Force installation wing commanders seldom, if at all, deploy with their assets to the theater. With few exceptions, they remain behind to manage the installation while their assets fall-in on established forward installations with standing warfighting wing commanders. This current arrangement already makes the *wing* commander in essence a *garrison* commander, managing the base while the forces are deployed. Restructuring airbases to the Joint installation concept with wing commanders and their units as flyaway tenants should be achievable. Hard line statements that the Air Force will not lower its standards, nor compromise its warfighting capabilities, will likely result in civilian leadership dictating the Joint standards be complied with by all Services. Similarly, readiness at any cost may no longer be a viable option in the limited funding atmosphere of the future. Joint basing can offer tremendous efficiencies in consolidation of support service missions. Consideration should be given to extending consolidation efforts even further in order to fully utilize the space and assets available at a smaller number of installations, thus allowing further reduction of infrastructure inventory.

Consolidation or realignment of Air Force or other Service missions has the potential to combine numerous activities to include multiple wings or Joint missions at the same base. This will allow more efficient use of the space available at these installations and a reduction of excess capital assets. In the 1960s the Air Force established *super-wings* in SAC, but these were actually the result of partial consolidation of just strategic bomber and tanker assets.[35] In the 1990s the Air Mobility Command established *composite wings*. These wings were the result of a partial consolidation of mobility airlift airframes and tanker assets.[36] A concept of *super consolidation* should not be limited to only missions of common major commands. Historically, there are numerous examples of multi-command missions having been collocated at airbases. In the 1960s, there were many combined use installations. Seymour Johnson Air Force Base was a tri-command installation hosting a tactical fighter wing, a strategic bombardment wing, and an air defense division.[37] Today, there

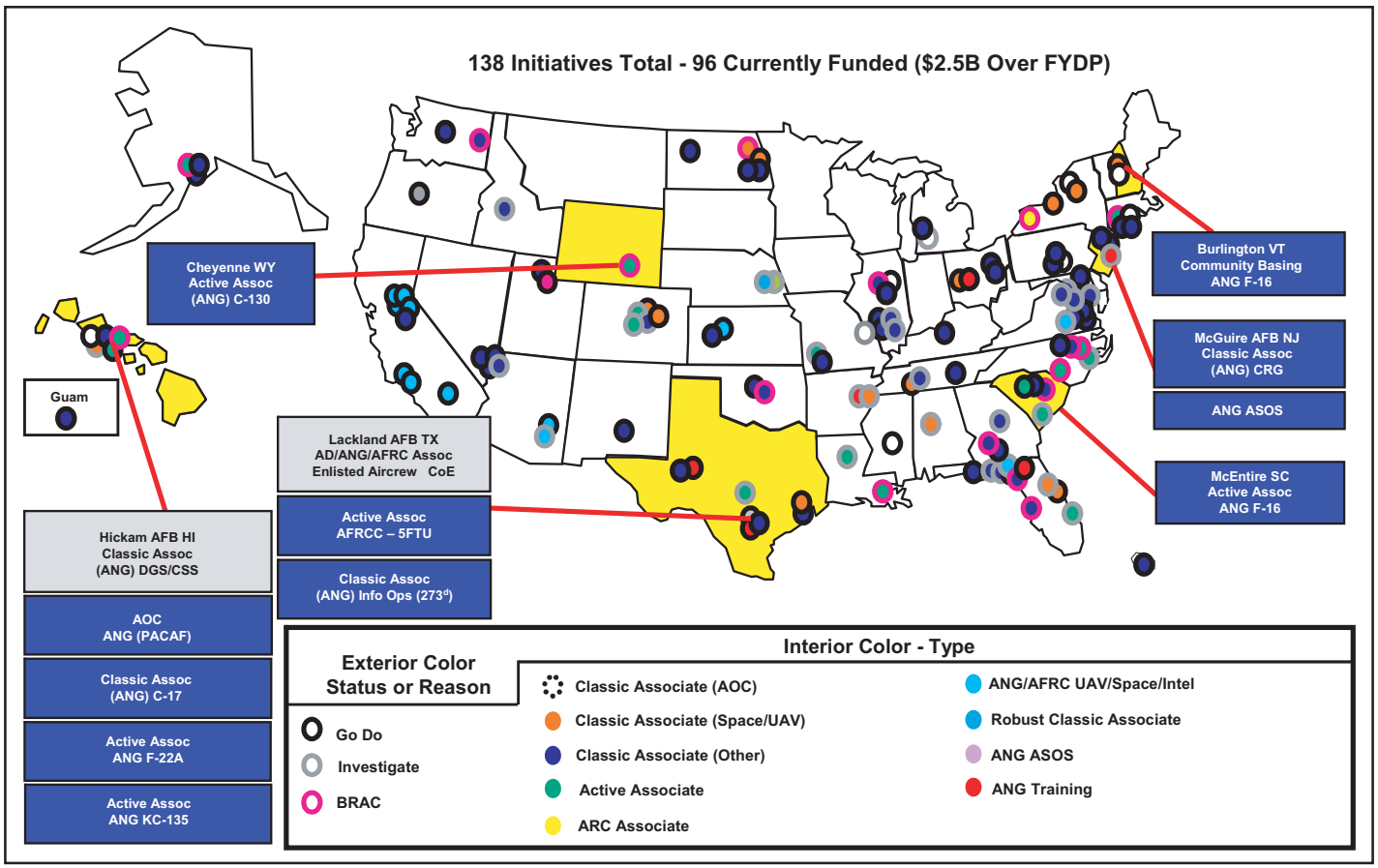

Figure 2. Total Force Initiatives[28]

are fewer examples of combined command installations, but cases do exist such as Minot Air Force Base sharing two command missions—Air Combat Command and Space Command. Likewise, cases exist today in theaters where Joint warfighting missions are consolidated and operate from the same forward operating base. Historically, the Air Force has moved units and consolidated functions in an effort to reduce operating costs, surrender capital investment, and achieve efficiencies. Likewise, the Air Force has consolidated missions for the purpose of reducing the number of commands (such as Air Defense Command to Tactical Air Command and then Tactical Air Command and SAC to Air Combat Command). There may be great benefit and efficiencies to be gained by assessing the super consolidation of multiple missions on enduring Air Force bases.

True savings will be achieved by the reduction of duplicative management and support of superfluous infrastructure. However, a counter argument might question the space available on potential enduring installations. A review of the 1998 BRAC Report by the Congressional Budget Office determined that DoD installations, on average, have more than 20 percent excess capacity when comparing the size of bases with the force and workload present.[38] In some cases, however, this argument might justify a new basing choice altogether to better meet Joint mission needs, physical space needs, future climate changes, or force protection needs. In some cases, the Air Force might need to relook at its true infrastructure needs. The most efficient baseline supporting infrastructure needed would be those core facilities, utilities, and systems critical to ensuring mission accomplishment. In mirroring a community basing concept, the core systems, facilities, and utilities are those directly impacting operational support, mission support, and personnel support systems. Operational support systems include flight line and runway systems, fuel systems, ramp space, and operations and planning centers. Mission support systems include munitions and weapons storage, hangars, maintenance backshops, logistics warehouses, and armory space. Additional infrastructure needs would include personnel support systems such as expeditionary personnel and equipment processing centers, training centers, fitness centers, and administrative space.

Assuming this position implies all other infrastructure to be superfluous, inefficient, and an added expense to the limited Air Force budget of the future. During World War II and the Korean War period, the Air Force was building for a specific objective—winning a global war, and family separations were accepted and understood. Given that, not much was spent on quality of life or communal facilities. Following the Korean War, the Air Force was building a force based on the strategic concept of deterring future wars without a foreseeable termination. As such, maintaining and retaining a quality force required more attention to providing for the families of that force. Communal facilities such as barracks, messes, housing, chapels, exchanges, theaters, clubs, and libraries began to show up in construction programs. Even in those early days of the Air Force it was assumed by Congress that military personnel would obtain their support needs from the surrounding communities; however, various surveys and reports to Congress provided sordid stories of local profiteers taking advantage of military personnel and their families. As a result, Congress was pressed to fund for more and better quality of life accommodations vital to "the comfort of the personnel."[39]

Given the budget issues discussed and continually increasing costs, the Air Force could benefit greatly by revisiting its method of *taking care of people*. Continuing to maintain the quality of life as we have for the last 60 years may not be fiscally possible over the next 60 years. In today's world of several Wal-Marts in every town and a gas station on every corner, the Air Force's only argument to maintain extensive quality of life facilities on each installation is that the low prices they offer are a cost-effective alternative to providing additional cash compensation to Service members. The CBO charges this argument is not credible when the costs that the system imposes are taken into account. The argument overlooks a $2B a year congressional subsidy that could easily disappear, forcing the Air Force to make difficult quality of life decisions in the future.[40] A more efficient and economical benefit may be to authorize national tax-free purchases, or more simply, income tax rebates for military personnel and their families, rather than manage subsidized retail sales establishments. Likewise, family housing has been touted as a means for retention of quality personnel since the establishment of the Air Force; however, less than a third of active duty military members actually live in on-base housing. According to a GAO report, based on RAND study data, 72 percent of military personnel would prefer civilian housing and it recommended the Air Force consider decreasing housing in the future to encourage military members to live off base.[41] It is assumed that current trends toward increasing pay, housing allowances, and decreased out-of-pocket expenses will further decrease the desire for on-base housing, leading to decreased needs for quality of life community facilities or other communal facilities. As such, now may be the right time to assess the future needs for costly retail, community, and communal infrastructure. Decreases in personnel support requirements will reduce the infrastructure footprint, greatly reduce utility costs, and generate open space for alternate uses on future airbases.

Findings and Conclusions

> Any base complex constructed to accommodate present-day equipment must be tested for applicability against future developments. The threat of being forced to adapt or prostitute future developments in equipment and strategy to take advantage of costly complexes which could not be abandoned in view of adverse public opinion must always be considered in determining the course of action to be followed. Thus, technological developments are a critical factor in the location of bases.[42]

Findings

Air Force relevance in the future depends on continuous technological modernization of capabilities in the realms of air, space, cyberspace, and other potential realms. Future funding for recapitalization and modernization should provide decisionmakers the ability to project power directly from airbases within the United States, thus avoiding costly forward presence. Modernization of weapon systems will create obsolescence in current infrastructure systems and even the airbases themselves due to limiting factors. The decisive factor in determining the location and continuation of an airbase is its suitability for its military mission. Establishing air bases with an eye to the technological developments in the foreseeable future would

seem common sense. However, according to Air Force historian Howard B. Seim Jr, in World War II air bases were constructed to B-17 standards while the B-29 was being test flown and the B-36 was on the drawing boards.[43] Similarly, we are designing the future bomber, tanker, strike fighter, and unmanned vehicles for operation on our World War II airbases. The Air Force needs to take more aggressive actions concerning efforts underway within the DHS, Total Force initiatives, and Joint basing to produce a smaller, more capable Air Force composed of regular, Guard, and Reserve airmen—recapitalizing the force and changing organizational constructs. The Air Force can capitalize on the unique organizational frameworks offered by these initiatives, thus enabling a more efficient and effective use of Air Force assets.

Potential Benefits

The areas discussed in this article provide valid avenues for the Air Force to examine its current force structure and supporting infrastructure and to find ways to capitalize on economies and efficiencies for the future. Molding force structure and supporting infrastructure to enhance support to homeland security and Total Force initiatives together has numerous benefits. With the emergence of securing the US homeland following the attacks of 9-11, there is a strong belief that developing a stronger, more robust, and more capable force to protect the United States is needed. This protection will likely manifest itself with increases to National Guard units throughout the country interlinked by the DHS.[44]

Other foreign countries are investing aggressively to secure their expansive borders using the high technology benefits of UAVs. An ABC TV *Asia Focus* segment interview with Air War College professor Dr Adam Cobb (fall of 2007) illustrated how Australia was testing the use of UAVs to patrol its border given the persistent capabilities of these systems.[45] The 119th Wing of the North Dakota Air National Guard recently converted from flying F-16s to a new mission flying UAVs. This conversion should be the first of many mission changes for the Air National Guard, pushing new technology and critical missions from the active duty force and making the Air National Guard a highly capable and ready force to support overseas missions as well as the domestic mission of homeland security and disaster response.[46] The adjutant generals of every state will become tremendous allies in the Air Force's efforts to modernize its force, particularly when members of Congress seek to protect constituencies in their home districts. To the greatest extent possible, the Air Force should push missions into the National Guard, taking advantage of the potential to obtain funding for modernization and acquisition of weapon systems such as UAVs that serve a dual role of border surveillance, while training the future total force needed to conduct missions abroad. In a RAND Corporation study, the CBO reported that a Guard unit is 60 to 70 percent cheaper to maintain than its active duty counterpart.[47] Transfer of more missions to the Air National Guard will generate substantial savings.

Joint basing and the overall consolidation of multiple activities to fully utilize the available space of our military installations will provide tremendous opportunities to bundle management of facilities, infrastructure, and services, and is a proven successful business concept used worldwide. The 12 Joint basing initiatives identified for testing in the 2005 BRAC action are expected to generate a $212M annual savings. As with past manning cuts, these manpower savings may or may not materialize, but not included in this estimate is the expected savings in economies of scale for bundling of contracts and services, nor the savings for further reductions of redundant supporting communal services. Aside from building closer relationships with other Services, the Air Force needs to embrace and capitalize on future Joint basing initiatives to further realign and consolidate more of its own missions. The Air Force could benefit from a full assessment of the methods used by the Navy and Army to manage their installations with a mostly civilianized, contract, and regional work force.

Potential Pitfalls

Of the choices facing the Air Force, two pose the most risk. Failing to raise the funds needed to modernize the Air Force's aging fleet will draw out or even slow down the rate of modernization, forcing the Air Force to accept the risk of aging aircraft. As of the writing of this article, 60 percent of the current fleet of F-15s (452 aircraft) was grounded by possible fleet-wide airworthiness problems due to defects in the metal holding the fuselage together.[48] These mission impacting episodes will become more frequent with more and more aging weapon systems. Failure to modernize will jeopardize the relevancy of the Air Force and the Air Force mission vis-a-vis the other Services.

The second choice of gutting the Air Force community by removing quality of life or communal support facilities and infrastructure will be a life-altering change for many. It may be argued that the Air Force community of profession is characterized by the way it treats its personnel, and that these communal support facilities act to bind its members with a sense of identity. It may also be argued that these assets are needed to establish and maintain this identity, so as to allow Air Force members to distinguish themselves from civilians and society. Stanley Finer, in discussing the differences of military and society noted:

> … it differs in function from the society that surrounds it and this function requires that it be separated and segregated … distinguishing it from the civilian masses … it requires separate housing, in purely military quarters and barracks … separate code of morals and manners from that of the civilian population.[49]

For years, this separation was deemed necessary to identify Air Force members as professionals and part of a distinct professional community. This distinction grows ever more costly in nonmonetary benefits to members and retirees in the form of infrastructure and subsidized amenities. Although a notable feature to be a member of a microcosm sheltered from society at large, the military risks being perceived by society as alien, negative, and differently distinctive, leading to a downward spiral of suspicion and distrust from the society of which it is nonetheless an integral part.[50]

Recommendations

Though hated by many in his day, there is a sense of irony today in the words of former Secretary of Defense Robert S. McNamara who emphasized cutting waste and improving efficiency by closing 40 airbases during his tenure from 1961 to 1968:

> Technological progress causes obsolescence not only in weapon systems, but also in the often highly specialized facilities constructed for their deployment and maintenance. Just as we continually measure our weapon system developments and procurement programs against the ever-changing yardstick of military need, so too must we review our worldwide complex of installations in light of our present and future requirements. Facilities and installations, which fail this test of true need, only encumber the national security effort and waste resources.[51]

The Air Force must vigorously voice its concerns for the ever-growing cost of continuing to maintain unnecessary infrastructure, highlighting the threat to national security vis-a-vis the diversion of vital funding from critical mission enabling systems of the future. The Air Force should take a lesson from the Army's post World War II actions in which it simply mothballed many of its excess installations, not closing them, but making deals with local communities to rent space in return for operation and maintenance costs and guaranteed future use should national security situations require it.[52] In so doing, the Air Force can fully utilize the space available at its enduring installations by further consolidating major commands, headquarters, wings, and supporting units. This consolidation will lead to numerous efficiencies in supporting personnel overhead, supporting facilities, supporting equipment, supporting infrastructure, and supporting utility requirements. Likewise, the Air Force may benefit financially from leasing or sale of excess property, facilities, utilities, and other infrastructure at market rates.

To take advantage of DHS and Total Force initiatives the Air Force needs to work with adjutant generals of each state to strategically review what missions can and should be pushed into the National Guard, allowing accomplishment of the homeland defense mission while at the same time building, equipping, and training the force that will also be called on to support future missions abroad.

The Air Force must embrace Joint Basing initiatives and seek additional opportunities. The current test consolidation of facilities is only a start. The Air Force needs to assess fully the potential and advantages of collocating and consolidating those Joint missions that would benefit greatly from the closer Joint operations and training opportunities for units expected to support each other in wartime. It should join with the other Services to implement an ideal base study, as conducted in the 1960s, to examine future requirements for a Joint basing structure given changing technologies, potential threats, climate changes, and changing support missions.[53] Such a study should be accomplished through the establishment of a Joint and interagency center that could nurture the expertise necessary to generate ideas, develop strategies, and set in motion the actions needed to reach future goals. This pool of expertise can organize teams to travel to each installation to provide assessment and guidance to improve resource management, budgeting, planning, training, and personnel and manpower. Too often we strike out with tactical attempts to train the entire force for what are truly strategic initiatives, delaying execution, diffusing expertise, and failing to take strategic advantage of seeing the bigger picture and potentially bigger economies and benefits as a whole. The Air Force will need to develop and nurture change expertise throughout the Air Force. To ensure a balanced and grounded understanding of what are truly corporate business matters, the Air Force should expand opportunities for formal education in business and business administration.

As always, personal interest and involvement of senior Air Force leaders will be required to bring about the massive institutional changes needed to make the hard choices necessary in consolidating or transferring missions. Making change a priority in speeches, policy guidance, and programmatic decisions will convince institutional Air Force, other Services, and political leaders of the benefits and efficiencies to be gained by cooperating in future efforts to combine operations in beneficial ways.

Additional Considerations

The current migration of funds from the infrastructure area of the budget to fund recapitalization and modernization of Air Force aircraft is being accomplished at an acceptance of great risk to the operations and maintenance of our existing infrastructure. As a result, periodic or recurring maintenance is being deferred. Base operations and maintenance for fiscal year 2008 is currently being funded at 64 percent. This deferment will result in future and more frequent failures of systems and interruptions of service or missions requiring emergency response, repair, or replacement at potentially greater costs. Continued under-funding will make future Air Force infrastructure questionable in its ability to support the high-tech systems being developed for Air Force operations of the future. As the DoD undergoes a future shift in its budgetary, training, and operational priorities from a focus on major nation state wars to smaller and possibly longer interactions with rogue states and international terrorist organizations, the Air Force will need to make hard choices. These choices will determine the continued relevancy of the Air Force as a whole, its core mission, and ultimately whether accomplishing that mission is more important than maintaining the military community as it exists today.

What airbases may look like in the future depends on the tough decisions needed to be made today by our senior military, civilian, and congressional leaders. This article provides recommendations driven by the assumption of continued budgetary constraints that seriously limit the basing options toward anything other than lean, agile, power projection from a smaller active force focused on long-range strike capabilities. This smaller active force will be highly consolidated and jointly based with other Services on bases, providing the minimum of communal infrastructure and greatly dependant on a widely dispersed total force to conduct future military operations abroad.

It is evident that future changes to basing options must be driven through continued BRAC rounds. The criteria used in BRAC rounds generally focuses on determining which bases to leave open based on continued military value, cost, and expected return on investment. This article suggests that BRAC criteria should also look at where the right place to put these military units may be and what is the best way to combine military units to best affect and utilize DHS, Total Force, and Joint basing as the major variables of consideration.

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He who will not apply new remedies must expect new evils; for time is the greatest innovator.

—Viscount Francis Bacon

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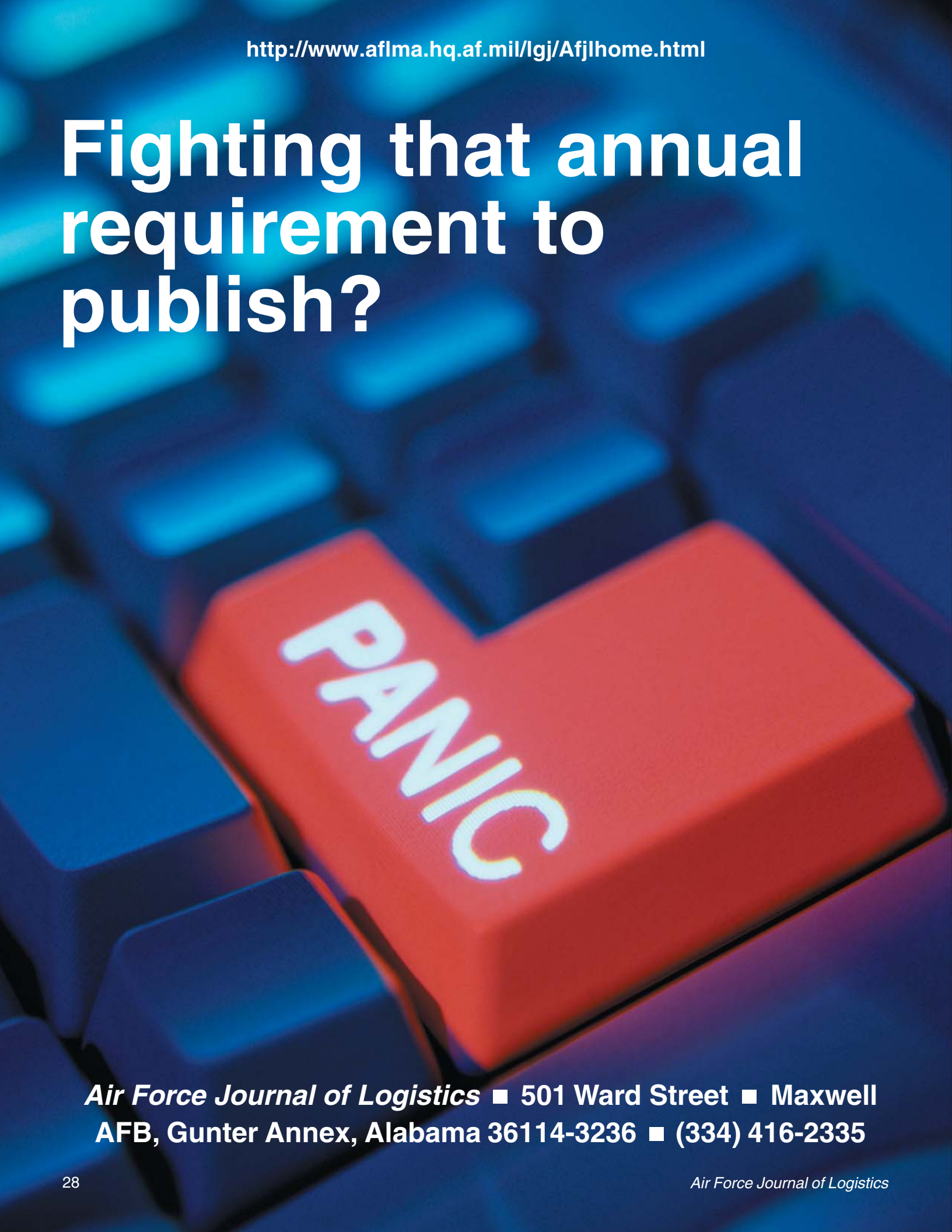

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contemporary issues

Capturing Risk in Solution Prioritization
Defense Budgeting Challenges: Uncertainty and Unpredictability
Generating Opportunity from Uncertainty

Contemporary Issues in this edition presents three articles: "Capturing Risk in Solution Prioritization," "Defense Budgeting Challenges: Uncertainty and Unpredictability" and "Generating Opportunity from Uncertainty."

In "Capturing Risk in Solution Prioritization" Jennifer G. Walston, PhD, USAF, presents a simple method to quantify risk so that it can be included as an additional objective in a multi-objective solution prioritization problem. She makes the case that the ability to capture risk in the prioritization method may provide a more complete picture for decisionmakers and could be useful in future studies.

Lieutenant Colonel James D. Peccia III, USAF, in "Defense Budgeting Challenges: Uncertainty and Unpredictability" examines current and future budgeting challenges. He argues that the Defense Department needs to readdress its funding strategy based on the Gross Domestic Product (GDP). Defense spending as a percentage of the GDP is a useful metric in comparative analysis; however, strategy and politics will determine future defense budgets, not a percentage of GDP. Allowing this funding strategy to dominate budget discussion permeates the belief that the Defense Department has no better strategy to defend its half trillion-dollar defense budget. He concludes it does not need to be this way. It is within the Department's expertise to build, defend, and articulate a better capabilities-based strategy.

In the concluding article, Lieutenant Colonel David R. King, PhD, USAF, looks at generating opportunity from uncertainty in decisionmaking. According to King, decisions are made despite uncertainty—even taking no action is a decision. Better decisions are likely to be made under conditions where an organization can tolerate and manage greater amounts of uncertainty. As a result, the impact of uncertainty on organizations is more complex than has generally been recognized. Leaders can make their organization's tolerance for uncertainty more robust. While its introduction may be unpleasant, uncertainty likely leads to a closer examination of the environment and an organization's role in it. This should contribute to expanding an organization's ability to make decisions based on identified potential outcomes; and improved decisionmaking from better information should contribute to higher performance. Doing better than competitors depends on higher tolerance of ambiguity from learning and capability development that ensures better information than its rivals on a range of topics. As such, leaders should ensure their organization avoids specializing in too few areas.

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Capturing Risk in Solution Prioritization

Jennifer G. Walston, PhD, Major, USAF

Introduction

The intent of the Chief of Staff of the Air Force-directed Comprehensive Assessment of Nuclear Sustainment (CANS) was to identify and provide solutions for any systemic problems within the nuclear sustainment enterprise. During the study, strategic-level findings were prioritized using a multi-objective optimization approach. As with any system, there is risk associated with maintaining the status quo when problems are identified. However, as it was assumed that the risk associated with not addressing the strategic-level findings was sufficiently high such that all findings would eventually be addressed, this risk was not included in the prioritization problem formulation. This is not to say that risk was not considered at all, but rather that the consideration of risk was limited to that of the solutions themselves—risk that the solution may have unintended consequences that actually make the problem worse. Though sufficient and appropriate for the initial study, the inclusion of risk in the prioritization formulation may provide a more complete picture for decisionmakers. The remainder of this article presents a generic methodology to incorporate a measure of risk into a multi-objective solution prioritization problem like the one in the CANS study. Such a methodology may be useful in follow-on efforts of CANS. (For a detailed description of the CANS methodology, see the previous *Air Force Journal of Logistics* article entitled "Using AFSO21: The Problem is Big, Time is Short, and Visibility is Enormous."[1])

Original Problem Formulation

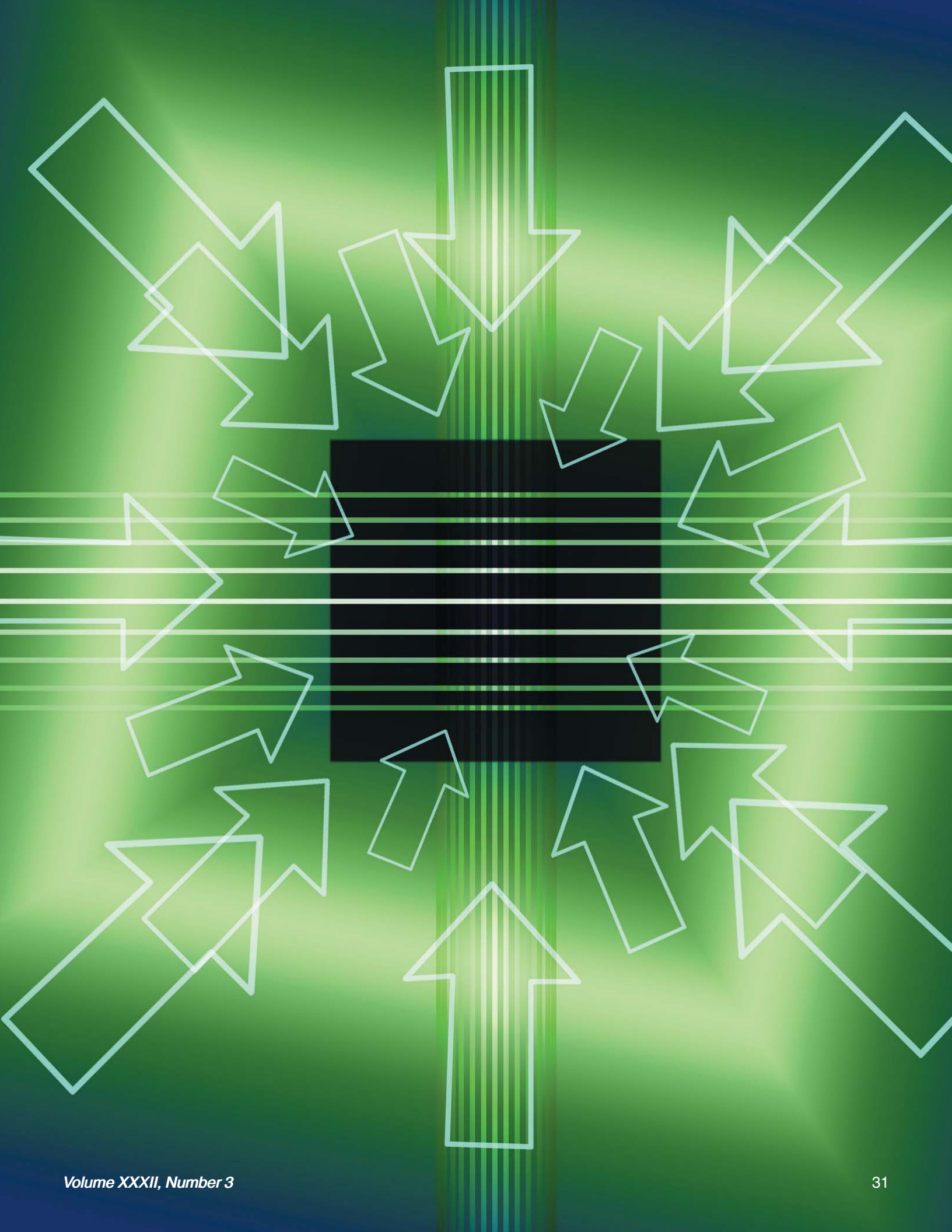
The original prioritization portion of CANS attempted to prioritize strategic level findings of the study. To accomplish this, subject matter experts (SME) scored the impact of each strategic level finding, if solved, on the five key mission areas (see Figure 1). The result was then formulated as the following multi-objective optimization problem:

$$\max F(x)$$

subject to

$$x \in \Omega = \{x \in \{0,1\}^n : g_i(x) \leq 0,\ i = 1,2,...,M\}$$

where $F : \Omega \rightarrow R^J$. In this formulation, the five key mission areas represent the competing objectives and the selection of particular strategic findings for resolution represents the decision variables. The resulting problem was then solved using a weighted-sum-of-the-objective-functions (WSOTOF) method[2] in which weights were determined by surveying senior Air Force leaders.



	Training	Policy	Culture	Resources	OS/Control
Finding 1	1	3	1	1	9
Finding 2	1	3	1	9	1
Finding 3	9	1	9	1	1
Finding 4	3	9	1	3	9
Finding 5	3	1	9	3	9
Finding 6	3	1	3	1	1
Finding 7	9	9	9	3	1
Finding 8	1	1	3	1	9
Finding 9	3	3	1	9	1
Finding 10	1	9	3	1	9

Figure 1. Impact of Solving Strategic-Level Findings on the Five Key Mission Areas

Modeling Risk

Risk analysis[3] and mitigation related to performance, cost, and schedule can be modeled or approximately quantified for each finding using a modified version of the Develop and Sustain Warfighting Systems (D&SWS) core process working group[3] Active Risk Management (ARM) process model as follows: SMEs use brainstorming to identify and explicitly define potential consequences associated with not correcting the strategic level findings. The SMEs then score the identified consequences, via a Delphi voting method, using life cycle risk management likelihood and severity ratings (a numerical score from 1 to 5) as defined in the D&SWS ARM process model[4] and shown in Figure 2. These scores then provide a quantifiable measure of risk to be included in the prioritization.

Addition of Risk in the Problem Formulation

Consider the following formulation. Let

$$F(x) = \sum_{j=1}^{J} w_j f_j(x) + w_{J+1}\, \xi\,(x)$$

where $f_j: \Omega \rightarrow \mathrm{R}$, $j = 1, 2,...,J$ are the impact on the original key mission areas and $\xi(x)$ represents the risk associated with finding x.

Article Acronyms

AFSO 21 – Air Force Smart Operations for the 21st Century
ARM – Active Risk Management
CANS – Comprehensive Assessment of Nuclear Sustainment
D&SWS – Develop and Sustain Warfighting System
SME – Subject Matter Experts

The question then becomes: What function $\xi(x)$ best describes the risk determined and quantified using the ARM process model?

The risk scores can be divided into three areas (see Figure 2). The green squares represent a safe area where there is little likelihood of a risk occurring and low impact to the system if it does. The yellow and red squares represent medium- and high-risk areas, respectively. The function chosen to represent the risk in the prioritization formulation should be similarly scaled (be smaller for risks in the green area, somewhat larger for those in the yellow area, and larger again for those in the red area). As shown superimposed over Figure 2, a simple product of the severity and likelihood ratings would meet this criterion.

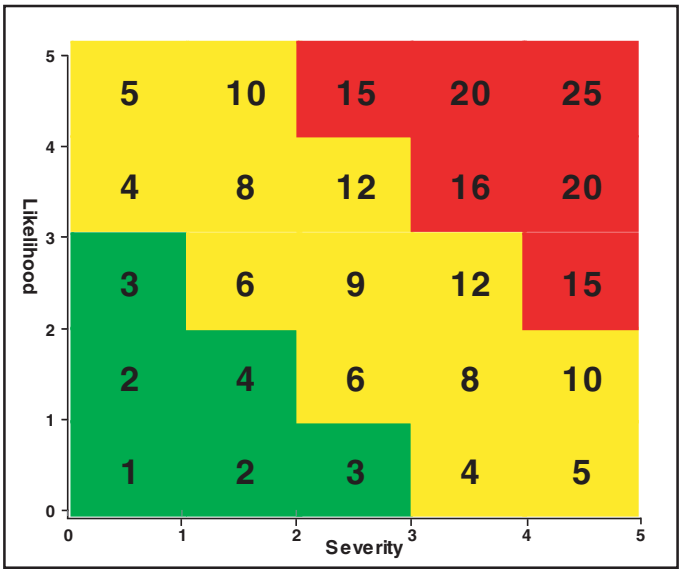


Figure 2. Risk Function Diagram

Therefore, consider the inclusion of the aforementioned risk function as follows. Let

$$\xi(x) = \max_{i=0}^{I_x} \xi_i(x)$$

where the function $\xi : \Omega \rightarrow R$ is a measure of the risk associated with consequence i of not addressing finding x, Ix is the total number of identified consequences associated with not addressing finding x and $\xi_i(x)$ = (Severity x Likelihood). Thus, the final formulation then becomes

$$\max \mathrm{F}(x)$$

subject to

$$x \in \Omega = \{x \in \{0,1\}^n : g_i(x) \leq 0,\ i = 1,2,...,\mathrm{M}\},$$

where $F(x) = \sum_{j=1}^{J} w_j f_j(x) + w_{J+1} \max_{i=0}^{I_x} \xi_i(x)$

Conclusion

This article presents a simple method to quantify risk so that it can be included as an additional objective in a multi-objective solution prioritization problem like the one in the CANS study. The ability to capture risk in the prioritization method may

provide a more complete picture for decisionmakers and could be useful in future studies.

Notes

1. J. Walston, "Using AFSO21: The Problem is Big, Time is Short, and Visibility is Enormous," *Air Force Journal of Logistics*, XXXII, No 2, 56.
2. M. Ehrgott, *Multicriteria Optimization,* second edition, Berlin, Germany: Springer, 2005.
3. J. Jackson and M. Hailston, "D&SWS Life Cycle Risk Management (LCRM) Update," briefing, D&SWS Core Process Working Group, 27 June 2008.
4. J. Kindinger and J. Darby, "Risk Factor Analysis—A New Qualitative Risk Management Tool," *Proceedings of the Project Management Institute Annual Seminars & Symposium*, Houston TX, 7-16 September 2000.

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Defense Budgeting Challenges: Uncertainty and Unpredictability

James D. Peccia III, Lieutenant Colonel, USAF

Introduction

Of all enemies to public liberty war is, perhaps, the most to be dreaded because it comprises and develops the germ of every other. War is the parent of armies; from these proceed debts and taxes … known instruments for bringing the many under the domination of the few … no nation could preserve its freedom in the midst of continual warfare.

—James Madison, Political Observations, 1795[1]

Does the Department of Defense have adequate funding to meet its requirements? Does it have what it needs to defend the interests of the United States (US)? Does the defense budget need to increase, or can the Department accomplish the *National Military Strategy* with less? Finally, what threats are driving defense budgets today and what type of military force is required?

On the surface, these questions seem easy to answer, but in reality, they are quite difficult. They are difficult because of the uncertain and unpredictable environment in which today's Department of Defense operates. The comfort days of the Cold War, where the United States required a large conventional force to deter a major state actor, are long gone. Currently, no strong nation state threatens the United States. Will this remain true in the future, or will an emerging power, such as China, grow to threaten US interests and those of its allies? Will the United States continue to face irregular warfare threats from weak or failed states, terrorists, or other nonstate actors? Will the successes of current terrorist groups embolden others to do the same, and what kind of military force is required to meet these uncertainties? While these questions will ultimately drive current and future defense budgets, they are only part of the equation.

It has been 19 years since the end of the Cold War and 7 years since 9-11, yet Congress, the President, and the Department of Defense are still struggling to redefine an acceptable military strategy and force structure to defeat current and future threats. In the absence of this new definition, the Defense Department continues to maintain its large conventional force, transforming only *at the margins* to meet irregular threats. Unfortunately, many of the military's conventional legacy weapon systems are becoming obsolete and need modernizing. However, when Congress is appropriating $450B to $500B for *peacetime* defense requirements, plus another $100B to $200B per year to execute the Global War on Terror (GWOT)—or more accurately, missions in Iraq and Afghanistan—it is difficult to appropriate additional resources for modernization. Will existing defense resources be enough to train, equip, and prosecute the GWOT and modernize an aging force? If not, what is the right amount?


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Defense leaders are currently struggling with these questions, but there are no easy answers.

Many defense experts, such as Baker Spring from the Heritage Foundation, say the Defense Department needs additional funding to modernize its weapon systems. In a March 2007 article, Spring stated, "the Administration's budget from Fiscal Year (FY) 2009 through FY 2012 reflects a roughly $400B defense funding gap in budget authority."[2] While most experts seem to shy away from quantifying specific shortfalls, they seem willing to make historical comparisons. The most recent effort compares defense budgets to the US gross domestic product (GDP). For example, as a percentage of GDP, the FY 2008 defense budget is well below historic *wartime* averages. Including GWOT funding, the Department expects its FY 2008 defense budget to be a little over 4 percent of GDP.[3] Compared to peak budgets in World War II (WWII), which equated to 36.3 percent of GDP; the Korean War, which equated to 11.7 percent of GDP; Vietnam, which equated to 8.9 percent of GDP; and the Gulf War, which equated to 4.6 percent of GDP, this percentage is low.[4]

The Defense Department seems to be adopting this GDP argument and using it as their niche to acquire additional modernization dollars. However, in an era of uncertainty and unpredictability, the GDP argument will not be sufficient to garner additional resources, because it does not adequately explain what these resources will accomplish in terms of strategy.

To increase budgets in this era, the Defense Department needs to understand the positive and negative factors facing it in future budget battles. Until it has an understanding of these factors, and can develop a strategy around them, the Department will not be successful. This article addresses many of these factors, such as how the US military spending compares to world military spending, the GDP argument in depth, other fiscal challenges facing the US government, the effects of the current defense strategy, and the role of politics. After researching this topic, it is my belief that solely pursuing an argument based on GDP will not get the Department of Defense where it needs to be. Defense spending as a percentage of the gross domestic product is a useful metric in comparative analysis; however, strategy and politics will determine future defense budgets, not a percentage of GDP.

Article Acronyms

DAWG – Deputy Advisory Working Gorup
FY – Fiscal Year
FYDP – Future Years Defense Program
GDP – Gross Domestic Product
GWOT – Global War on Terror
OMB – Office of Management and Budget
OSD – Office of the Secretary of Defense
PB – President's Budget
PBD – Program Budget Decision
PPBE – Planning, Programming, Budgeting, and Execution
QDR – Quadrennial Defense Review
US – United States
WWII – World War II

US Defense Spending Versus the World: A Background

In order to put the size of the US defense budget into perspective, it is useful to provide background on how it compares to the rest of the world. In terms of capabilities, depth, and raw conventional power, the United States military dominates the world. This also holds true for the size of the United States defense budget. In FY 2005, the international community spent approximately $1T on military expenditures, or 2.5 percent of the world's GDP.[5] While FY 2008 US military budget figures are known, the latest figures for international spending is FY 2005, so it is used in this comparison. The US peacetime budget (minus GWOT funding) was $420.7B, or roughly 43 percent of the world's total. Table 1 shows the other top 27 nations and their percentage of the world's military expenditures. As this chart illustrates, the United States enjoys a substantial advantage in the size of its military budget. In a 25 February 2007 article, "Arms Trade: World Military Spending," Anup Shah captured the essence of these differences in the following comparisons:[6]

- The US defense spending is 7 times greater than the second leading country, China, which spent approximately $62.5B on defense in 2005.
- The US spent 29 times more than the six *rogue* states of Cuba, Iran, Libya, North Korea, Sudan, and Syria, which collectively spent $14.7B in 2005. This almost equals the amount the US spends in Iraq and Afghanistan every 6 weeks.
- The US defense budget is larger than the GDP of Cuba, Iran, Libya, North Korea, Sudan, and Syria.[7]
- If an analyst were to combine the defense budgets of the six rogue states with that of Russia and China, they would collectively total $139B, which is approximately 30 percent of the US defense budget. It is also less than the US funded for GWOT in FY 2007 and 2008.
- Finally, the combined defense budgets of the US and its allies (NATO, Australia, Canada, Israel, Japan, and South Korea) account for almost 66 percent of the world's total military spending.

Country	Dollars ($B)	% of Total	Country	Dollars ($B)	% of Total
United States	420.7	43.0	Turkey	9.8	1.0
China	62.5	6.0	Israel	9.7	1.0
Russia	61.9	6.0	Netherlands	9.7	1.0
United Kingdom	51.1	5.0	Spain	8.8	1.0
Japan	44.7	4.0	Taiwan	8.3	1.0
France	41.6	4.0	Indonesia	7.6	1.0
Germany	30.2	3.0	Myanmar	6.9	1.0
India	22.0	2.0	Ukraine	6.0	1.0
Saudi Arabia	21.3	2.0	Singapore	5.6	1.0
South Korea	20.7	2.0	Sweden	5.6	1.0
Italy	17.2	2.0	North Korea	5.5	1.0
Australia	13.2	1.0	Poland	5.2	0.5
Brazil	13.1	1.0	Iran	4.9	1.0
Canada	10.9	1.0	Pakistan	3.7	0.5

Table 1. International Military Spending

Without question, the United States enjoys a substantial advantage in the size of its defense budget. However, this nation also

has a large, technologically advanced Army, Navy, Air Force, Marine Corps, and several defense agencies, that require substantial funding for personnel, day-to-day operations, construction, and investment in future weapon systems. Just because the United States has the largest defense budget in the world does not necessarily mean the Department of Defense is satisfied with its current level of funding—or at least that is what the Secretary of Defense is saying.

On 6 February 2007, the Secretary of Defense Robert M. Gates submitted an FY 2007 Emergency Supplemental Appropriation request for $93.4B, an FY 2008 President's Budget request for $481.4B, and an FY 2008 Global War on Terrorism request for $141.7B to Congress.[8] During his testimony, the Secretary stated:

> I believe it is important to consider these budget requests in some historical context as there has been, understandably, some element of sticker shock at their combined price tags—more than $700B in total. But consider that at 4 percent of America's gross domestic product, the amount of money the United States is expected to spend on defense this year is actually a smaller percentage of GDP than the Cold War, Vietnam, or Korea.[9]

His statement is correct.

As a percentage of GDP, defense budgets have steadily decreased since the end of WWII (see Figure 1).

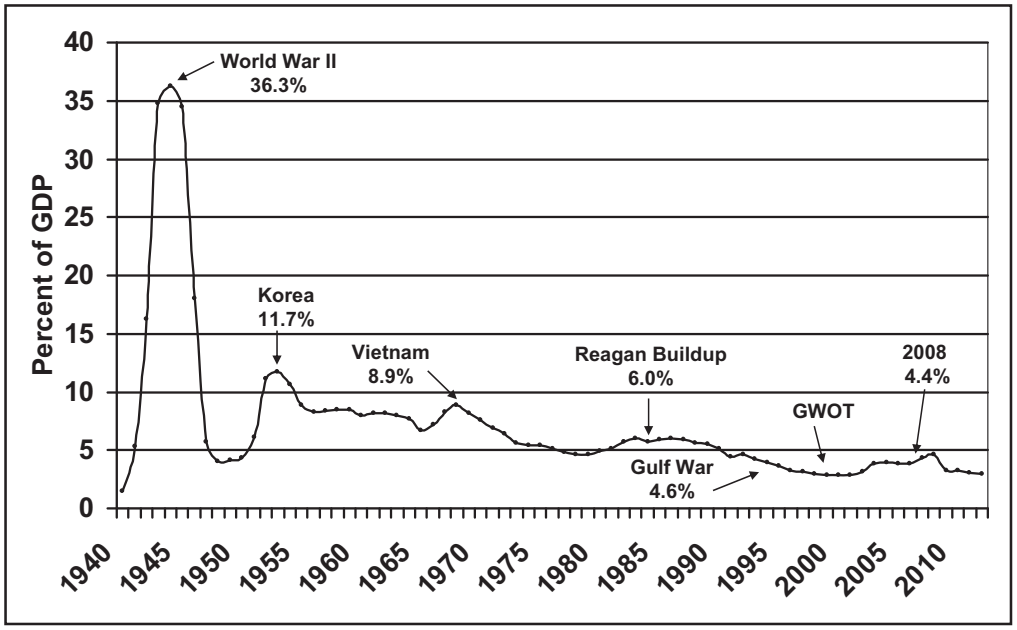


Figure 1. Defense Budget as a Percent of GDP[10]

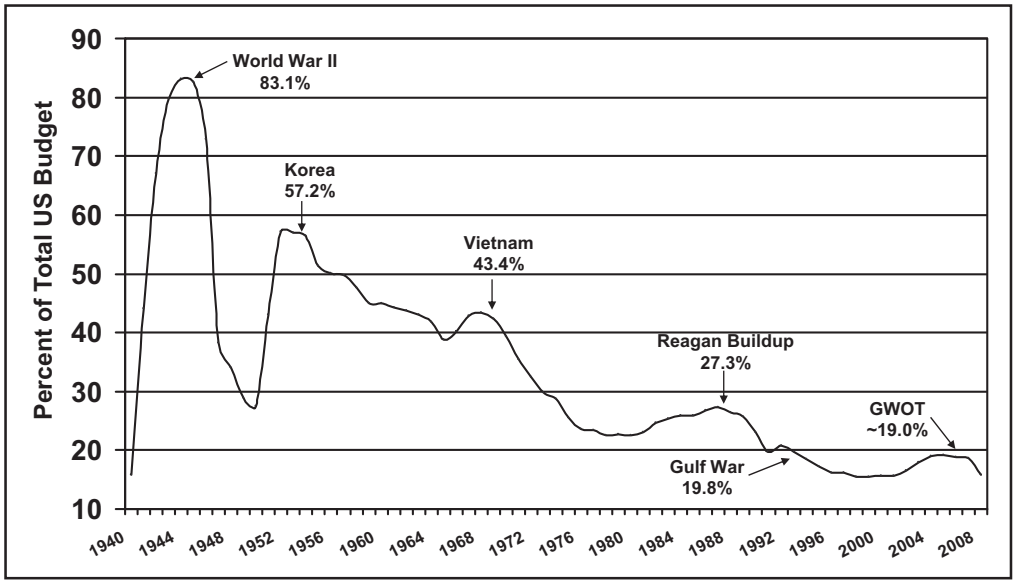


Figure 2. Department of Defense Budget as a Percent of Total US Budget[13]

There are a couple of obvious reasons for this. First, technology has allowed the size of the Defense Department to decrease from 12.1M active duty personnel at the height of WWII to 1.4M active duty personnel today.[11] Second, the size of the economy (for example, the GDP), has steadily increased from $221.4B at the peak of WWII to an estimated $14.5T by the end of 2008.[12] However, the defense budget has also decreased as a percent of the total US budget since WWII as illustrated in Figure 2.

What should stick out for defense analysts is the fact that defense budgets have immediately declined after every war or military conflict since the 1940s. Much of this, of course, is expected. Once hostilities stop, the cost of funding them should also stop. The discouraging fact for the Department of Defense is the budget percentage—with the exception of military wars and conflicts— has not stopped going down since WWII and the potential for another *peace dividend* once hostilities stop in Iraq and Afghanistan is looming in the future.

Despite the sizeable advantage of US defense budgets over the rest of the world, and despite the historical trends of peace dividends at the end of hostilities, many military analysts and Washington DC think tanks believe it is time for defense budgets—as a percentage of GDP—to go back up to mirror historical averages. So far, Congress has not accepted this GDP argument for additional topline. The question is why. It appears the reason is self-evident—GDP does not define defense requirements.

The Gross Domestic Product Argument

Commit to spend at least 4 percent of GDP on our national security. By any historical standard, this is a modest level. Yet it's sufficient to provide an adequate military and not unduly burden the economy.

—Mike Franc, Heritage Foundation, 2007

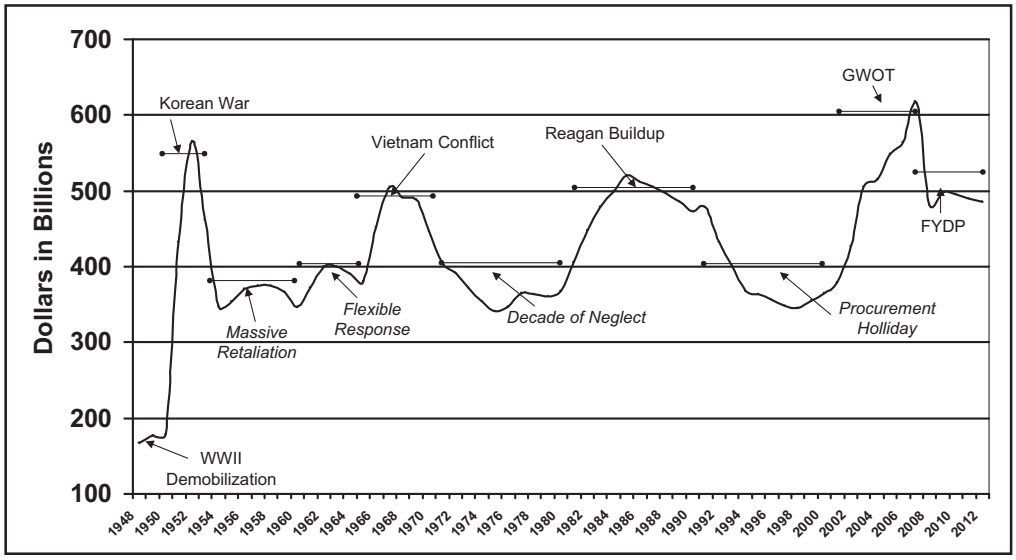


Figure 3. DoD Budget History: 1948 to 2008 (Constant Year 2008 Dollars)[14]

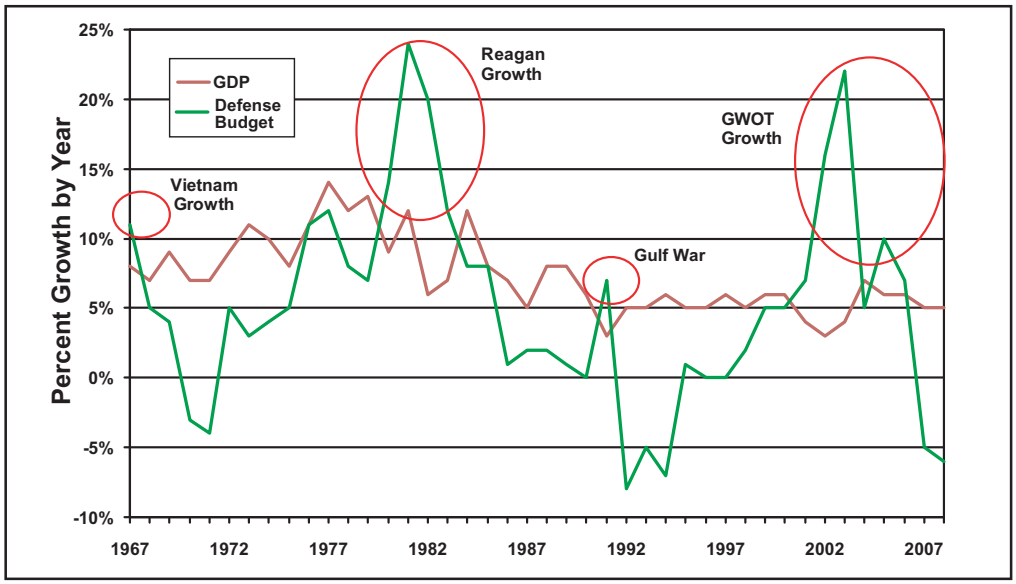


Figure 4. Comparison Between Yearly Growth in GDP and DoD Budgets[21]

As the cost of the GWOT continues to rise, the Department of Defense is under increased pressure to explain the need for such large budgets. Figure 3 highlights the defense budget in real terms—or adjusted for inflation in FY 2008 dollars—since the late 1940s.

While the defense budget has steadily gone up since 2001, these additional dollars supported GWOT efforts—they did not provided investment relief from the *procurement holidays* of the 1990s. Unfortunately for the Defense Department, the GWOT came at the exact time when it needed to modernize legacy weapon systems to the new KC-X, combat search and rescue helicopter, new space systems for early warning and communications, F-35 Joint Strike Fighter, next generation bomber, future combat systems, littoral combat ships, and much more. Acquiring resources to execute the GWOT and modernize at the same time is proving difficult.

In an effort to deflect some of the negative attention away from the fact that in constant 2008 dollars defense spending has never been higher (see Figure 3), and at the same time make an argument for additional funding, the Defense Department is using a funding strategy based on GDP. More specifically, the Defense Department is saying the US military is costing Americans less today—around 4 percent of GDP—than it ever has in history, which averaged between 6 and 10 percent. Therefore, Congress can *afford* to appropriate the Defense Department additional funds to modernize its forces. This fact was *suggested* by the Secretary of Defense and the Chiefs of Staff of the Air Force and Army during their FY 2008 posture hearings. While the Department deserves an *A* for effort, this GDP strategy is unlikely to be effective.

For starters, the GDP measures the market value of all goods and services produced during a particular period by individuals, businesses, and the government in the United States.[15] It is a universal standard among nations to measure the strength and value of their economy. It also serves as a metric for defense budgets as well as many other governmental programs, but the adequacy of these programs should not be based on a standard percentage of GDP, as some military and think tank experts suggest.

Debunking the GDP Myth

Senior defense leaders have repeatedly stated, as a percentage of GDP, defense budgets are too low. In December 2007, the Army Chief of Staff recommended the defense budget be sized at 6 percent of GDP, which would increase the defense budget to more than $900B annually.[16] Think tank experts Mike Franc and Baker Spring of the Heritage Foundation both believe defense spending should be at least 4 percent of GDP stating, "by historical standards this is a modest level … yet it is sufficient to provide an adequate military and not unduly burden the economy."[17] However, there are many problems with establishing these types of standards.

First, they are arbitrary and dependent on the thoughts and beliefs of those who create them, and therefore easily dismissed by others. In the 1950s, Congress established a budget standard of $15B for the Defense Department and it was a proven disaster.[18] This established limit gave no incentive for the Services to operate efficiently; instead, the goal was to spend the $15B regardless of need. The Korean conflict also proved that established spending limits are not achievable, because additional resources were required to prosecute the war. Once this $15B spending limit was broken, Congress found it impossible to bring post-conflict

spending back to the $15B mark, even after the military downsized its forces.[19] By the end of the 1950s, Congress had learned a valuable lesson—it is not possible to impose a funding standard on the Department of Defense.

Second, defense analysts need to be cautious when correlating historical GDP expenditures to current defense budgets. Yesterday's military is not today's military. Today, the Defense Department is smaller, it is technologically advanced, more capable, more educated, more joint, more lethal, and can employ more precise weapon systems and munitions around the globe than at any other time in history. These combinations make today's military much more efficient, so comparing the cost of the current military force with historical forces is really comparing *apples to oranges*. When looking at defense budgets as a percentage of GDP, it is also important for analysts to review both sides of the equation. Christopher Hellman, a senior research analyst for the Center for Defense Information, who heads the Project on Military Spending, aptly points this out. He said it is true defense budgets as a percentage of GDP are low, but this statistic is also misleading. Hellman stated, "Since September 11, 2001, annual defense spending—minus GWOT funding—has grown by 34 percent … the only reason the percentage of GDP is smaller is because the United States economy has grown even faster at 44 percent over the same period."[20]

Third, establishing a funding standard based on GDP focuses military requirements on incorrect criteria, such as spending, and not other criteria learned from history, such as threat levels. For example, realists would argue it is sometimes best to handle *lesser threats* with *lesser means*. If Congress bases defense budgets on a standard percentage of GDP, and the GDP continues to increase each year, so will defense budgets and therefore military capabilities. Continuing to expand military capabilities at a disproportionate rate to the rest of the world may have unintended consequences, such as inviting other emerging powers, like China, to do the same. Inviting emerging superpowers into an arms race is not in the best interests of this nation. There is simply no need to force our nation into a negative self-fulfilling prophecy.

Fourth, when it comes to funding, Congress does not like to establish standards of this nature. Standards tend to limit congressional flexibility and can affect their oversight responsibilities for the appropriation process. In addition, it is extremely difficult for Congress to stick to the budget standards it creates, such as a balanced annual budget. Expecting them to honor any defense standard is not realistic. Those in the Defense Department also need to keep in mind the one true power Congress has over the military is its ability to control the purse strings. Establishing a defense budget based on a standard percentage of GDP is contrary to what the authorization and appropriation committees will allow.

Finally, GDP measures the strength of an economy. GDP does not determine how much should be spent now, nor does it explain, predict, or measure future military requirements—world threats, military strategy, and politics will do that. This is true for the past and will be true in the future because the two are mutually exclusive of each other. Figure 4 is a simple chart which graphs the percentage of increase from one year to the next for both the GDP and defense budgets.

As this figure shows, there does not appear to be any relationship between GDP increases and increases to the defense budgets, especially during the last 20 years. What is clear, however, is major increases in defense budgets occurred during military conflicts and major decreases from year to year occurred during post-conflict periods.

As the Defense Department searches for a strategy to increase funding, a quote from Warner Schilling serves as a reminder of the difficulties it will face. In 1962 he said,

> The major limit on the size of the defense budget is not how much the economy can stand, but how much the people can be persuaded to support. To recognize that the limit is political in character, that it turns on the desire and ability of the administration and Congress to undertake the necessary tasks of persuasion, is to accent the element of choice and to change a seemingly determinate problem into an open one.[22]

His statement is as true today as it was 46 years ago. He seems to understand the limitation of defense budgets is not necessarily the economy, but rather taxpayers and politicians.

Based on this, sizing defense budgets from a percentage of GDP is not a credible strategy. It does not clarify the requirement or need, it is arbitrary by nature, it is not defendable, and it perpetuates the fallacy there is one right amount for defense budgets. As history has shown (see Figure 1), there is not one right amount for defense. If a percentage of GDP is not an effective funding strategy, what is? Fortunately, history has provided an answer—strategy and politics—both will entail an uphill climb, especially in light of the fiscal realities the United States will face in the future.

Fiscal Realities and the Challenges Facing the United States

The "Status Quo" is not an option. We face large and growing structural deficits largely due to known demographic trends and rising health care costs. The way forward is fundamental reexamination and transformation.

—The Honorable David M. Walker, Comptroller General of the United States, January 2007

The European Union and the United States have the largest GDP (purchasing power parity) in the world at just over $13T each (see Table 2). However, having the largest economy of any world

Country	Dollars	% of Total
World	**65,960,000,000,000**	
European Union	13,080,000,000,000	20
United States	13,060,000,000,000	20
China	10,210,000,000,000	15
Japan	4,218,000,000,000	6
India	4,164,000,000,000	6
Germany	2,632,000,000,000	4
United Kingdom	1,928,000,000,000	3
France	1,902,000,000,000	3
Italy	1,756,000,000,000	3
Russia	1,746,000,000,000	3
Brazil	1,655,000,000,000	3
South Korea	1,196,000,000,000	2
Canada	1,181,000,000,000	2
Mexico	1,149,000,000,000	2

Table 2. GDP (Purchasing Power Parity)[23]

nation does not insulate the United States—or the Defense Department—from fiscal realities. For the Defense Department, these challenges come in two forms, external and internal factors.

Mandatory versus Discretionary Spending

External factors are out of the control of the Defense Department, but they do affect defense budgets. The battle between mandatory and discretionary spending is perhaps the best example of this. As Figure 5 illustrates, mandatory spending, comprised mainly of Medicare, Medicaid, Social Security, and interest on the national debt, is taking up a larger portion of the United States budget with each passing year. As a comparison, in 1962, mandatory spending comprised 31 percent of the total budget and defense spending comprised 43.8 percent. By 2007, these percentages dramatically changed. Mandatory spending is now 55.6 percent while defense spending dropped to 18.6 percent.[24]

In terms of GDP, mandatory spending is currently 8 percent, but is expected to double to 16 percent by 2050.[26] The only way to slow mandatory spending in the near future is to reform these programs. Of course, this is a separate political challenge, one that is unlikely to be decided upon in the near future. Therefore, if the administration is going to balance the US budget by 2012,[27] as President Bush briefed on 1 January 2007, mandatory spending increases will require additional tax revenues, or reductions in discretionary programs—and defense spending is more than 50 percent of the discretionary total. In order to fund future *must-pay* mandatory requirements, it is likely Congress or the Office of Management and Budget (OMB) will use defense programs as a funding source. This could put a damper on any additional funding for modernization. This is an external challenge the Defense Department needs to prepare for and adjust accordingly.

There is another funding source available—national debt. However, as discussed in the next section, political leaders have used this source too often, and the current size of the national debt is starting to put a strain on the economy. The strain from debt is another external factor that may negatively affect defense programs.

The United States National Debt

The US national debt is an estimated $9.8T, and OMB estimates it will reach $11.5T by 2012.[28] Figure 6 provides a historical picture and trend line for the national debt.

As the chart indicates, the last four administrations greatly increased this nation's debt. By the end of President Reagan's 8-year term, the national debt reached $2.9T, which effectively doubled the debt from the previous 200-plus year history. Following President Reagan, the combined 12-year period of the *Bush I* and Clinton administrations (1989-2001) again doubled the amount of national debt, bringing the total to $5.8T. By the end of *Bush II's* term, OMB estimates the national debt will again double reaching a staggering $10.1T by 2009, and will continue to increase to $11.5T by 2012. To put this into perspective, this amount of debt will equate to 65 percent of this nation's projected $17.8T GDP. Interest payments alone will be 8.8 percent of the estimated $3.2T national budget;[30] and will equal 1.8 percent of this nation's GDP—the entire defense budget is estimated to be only 3.1 percent of GDP by 2012.[31] Like the other areas of increased mandatory spending, as the national debt and interest payments rise, they will likely impact available funds for the Defense Department.

While increasing mandatory costs paints a gloomy picture for the Defense Department, perhaps the most damaging external factor is right around the corner—a *peace dividend*.

Peace Dividend

Peace dividends, or reductions in defense budgets after conflicts, are not new. The Defense Department has experienced them after every major war or conflict since WWII (see Figure 1). It is too optimistic for the Department to assume a peace dividend will not occur after troops redeploy back to the United States from Afghanistan and Iraq, even when the GWOT continues. This is especially true when one considers the increase in defense budgets since FY 2000 (see Figure 3). Considering inflation, between FYs 2000 and 2007, defense budgets increased 69 percent.[32] This includes supplemental dollars, but even without them, defense budgets increased substantially. This increase did not go unnoticed. The OMB addressed it as the Defense Department was finalizing its FY 2006 President's Budget (PB) submission. In late December, OMB reduced the defense budget by $60B dollars through the Future Years Defense Program (FYDP). The Office of the Secretary of Defense, Comptroller, later bargained this amount down to $30B, but it still had a dramatic effect. This effect was documented in the infamous Program Budget Decision (PBD) 753.[33]

To pay the $30B FYDP reduction, PBD 753 laid out a plan reducing Service programs by $1.2B to $8.5B annually.[34] For example, among the Air Force casualties the PBD terminated F-22A fighter production after FY 2008, capping the aircraft at 183 from its previously programmed quantity of 381.[35] It also terminated the C-130J production line after FY 2006. For the Navy, PBD 753 reduced its planned procurement of the DD(X) destroyer from two to one per year; cut its planned submarine procurement from three subs every 2 years to one per year; and delayed its funding for a new aircraft carrier by 1 year.[36] These lists are not all encompassing for any of the Services, but sufficient to point out the impact these types of decisions can have on modernization programs.

In addition to OMB, other Washington DC political leaders and think tanks are discussing ways to trim down defense budgets. During the FY 2008 budget hearings, James P. McGovern, a representative from Massachusetts, recommended a 30 percent reduction in defense dollars.[37] The Institute for Policy Studies believed $56B could be trimmed off the FY 2008 budget by reducing or terminating programs like the F-22A, F-35, C-130J, V-22, Virginia-class submarines, future combat systems, missile defense systems, nuclear systems, research and development, and deployed Air Force and Navy forces to name a few.[38] In reality, congressional budget committees did not accept these recommendations; however, once hostilities cease in Iraq and Afghanistan, history has proven these types of discussions gain steam and programs like the ones mentioned above are vulnerable to potential peace dividends.

While external factors, such as increased costs associated with mandatory spending programs, the national debt, and future peace dividends may affect future budgets, the Defense Department can do little to control them. However, the Department can control many internal factors influencing its budgets as discussed in the following sections.

Military Personnel Costs

As budget pressures increase, it is imperative the Defense Department utilizes its scarce financial resources in the most

efficient manner possible. In doing so, the Department should first zero in on two internal factors; military personnel costs and decisions, and its process of establishing funding priorities. To free up resources and ultimately succeed in its modernization efforts, the Defense Department needs to make tough decisions in both areas.

In FY 2007, military personnel costs (adjusted to FY 2008 constant dollars) represented 23 percent of the defense budget. Between FYs 2000 and 2007, military personnel costs increased by $23B or 23.6 percent. During the same period, active duty end strength actually came down slightly, by 49,000 members or 3 percent.[39] On the surface, it looks like personnel costs are out of control; however, in fairness they are not. Much of this increase directly relates to the GWOT. For example, the President activated many Guard and reserve units to augment the active duty force in GWOT operations. While activated, the Defense Department pays these units from the active duty personnel accounts at a full-time rate, which is a much higher rate than their normal Guard and Reserve drill pay. Therefore, it is normal to see military personnel costs go up at a time of conflict or war. The good news is supplemental appropriations are paying for most of these GWOT-related personnel costs, so baseline budgets are not greatly affected.

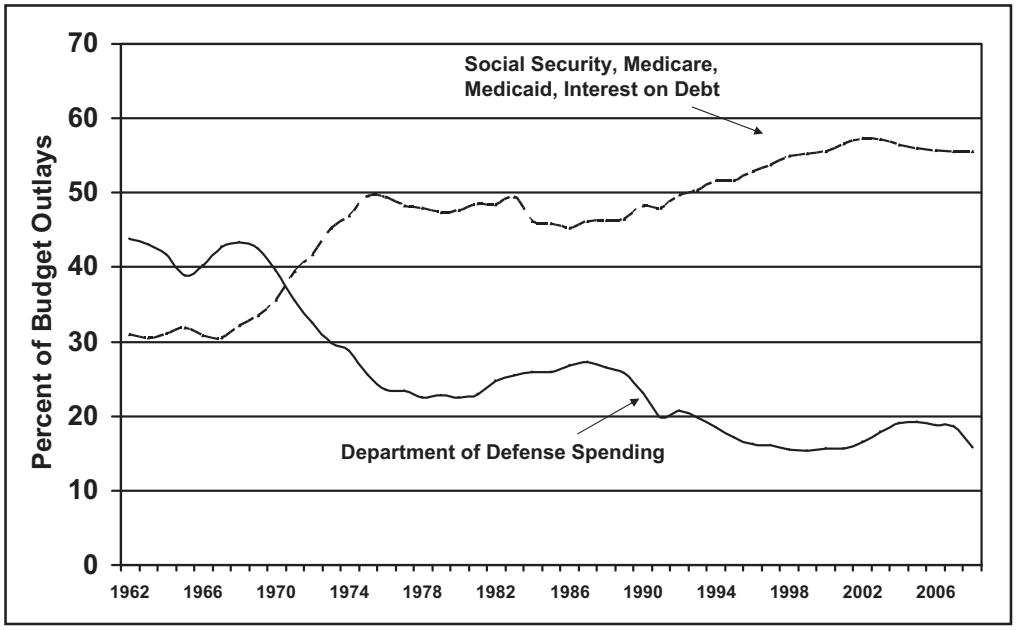


Figure 5. DoD and Mandatory Spending as a Percentage of US Budget[25]

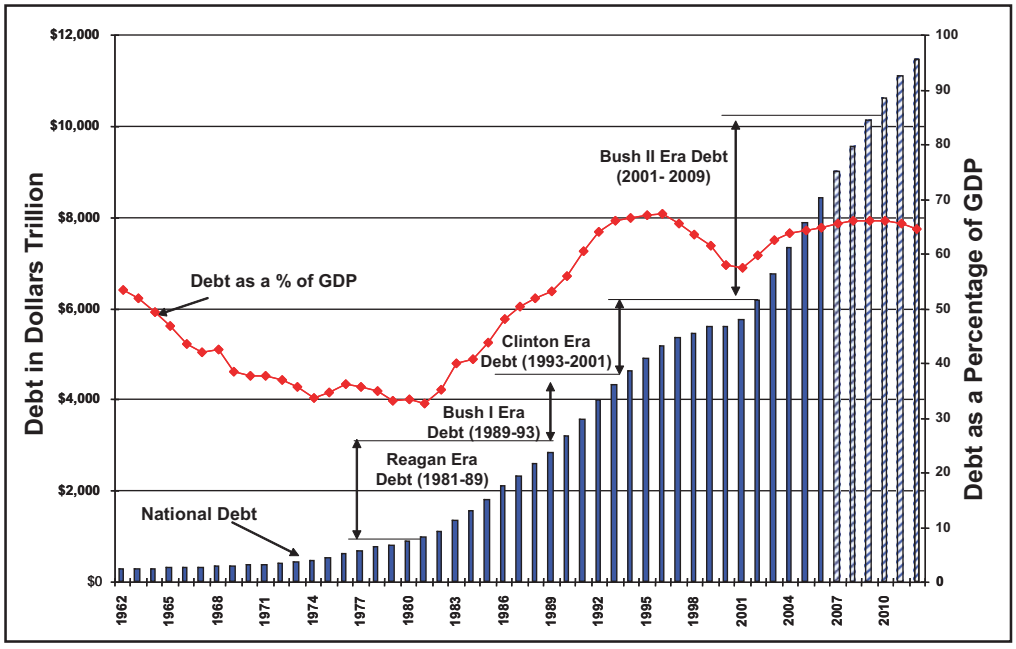


Figure 6. US National Debt[29]

Unfortunately, while the Defense Department was busy drawing down active duty end strengths to free up resources for modernization efforts, GWOT requirements are now forcing the Department to increase the force. The President called for an increase of 92,000 members to be in place by 2012. The Defense Department saluted smartly and its FY 2008, President's Budget submission included $12.1B to pay the salaries for 12,000 of these members.[40] The OMB will offset most of these costs with additional topline, but the remainder will require sourcing from modernization and other investment accounts, which is not what the Department wants to do. The internal question the Defense Department needs to address is whether it can afford to keep these members after hostilities cease and it begins redeploying units out of Iraq and Afghanistan.

Of course, the issues discussed above are not the only reasons for increased military personnel costs. A *Congressional Report for Congress*, written by Stephen Daggett listed seven other reasons for increased military personnel costs since FY 2000. They are as follows:[41]

- Six years of pay raises of half a percent above the Employment Cost Index, and economy-wide measure of wage costs.
- Three rounds of pay table reform that gave much larger pay raises in middle grades to improve retention of skilled personnel.
- A multi-year plan to eliminate differences in on-base and off-base housing costs.
- Approval of a phased-in plan to allow military retirees with a veteran's disability rating of 50 percent or greater to receive both retired pay and Veteran's Administration disability benefits.

- A program known as *TRICARE for Life* under which military retirees age 65 and older will have access to defense provided health care in addition to Medicare.
- Repeal of the 1986 *Redux* retirement program which gave lower pensions to those recruited after that time.
- Repeal of a measure that lowered benefits to survivors of military retirees once they qualified for social security benefits at age 62.

While Congress, not the Defense Department, initiated many of these programs, the effect is the same: they are expensive to sustain, the Defense Department must pay the bill, and they take away budget flexibility. In January 2005, Dr Chu, the Undersecretary of Defense for Personnel and Readiness stated, "The amounts have gotten to the point where they are hurtful. They are taking away from the nation's ability to defend itself."[42] So what will the Defense Department do about it? That is the tough decision it faces. Can the Department afford to keep these programs in place? If not, is it willing to fight Congress for control over them?

Bonus Programs

The Defense Department, immediately after troops redeploy out of Iraq and Afghanistan, needs to address bonus programs. Since the war in Iraq began, bonuses have increased sevenfold. In FY 2003 the bonus program totaled $174M and in FY 2008 they reached the $1B mark.[43] Bonus programs range from a high of $150,000, for selected special operations personnel to a low of $10,000, for some types of ground troops. In an all-volunteer force, during a time of war, bonuses serve a valuable purpose—they keep volunteers in the active, Reserve, and Guard forces. However, when hostilities cease and troops redeploy, the Defense Department needs to reevaluate these programs and make a tough decision. The Department pays bonuses out of its baseline programs, not supplemental dollars, and these scarce resources may be put to better us in the modernization accounts. These kinds of decisions are hard to make and not popular, but they are within the control of senior defense leaders and must be addressed.

Funding Priorities

Perhaps the most dangerous time for investment and modernization programs is during the Pentagon's program and budget review period. Once the Services submit their proposals to the Office of Secretary of Defense (OSD), parochial requirements—from those without funding—begin to appear from every crevice of the 60-year-old building. This might be a bit dramatic, but not from the Service's perspective. After 12 months of blood, sweat, and tears, much of what the Services programmed for begins to unravel at the expense of other defense priorities. This is not new, and all the players in the Pentagon know this is part of the budget building process, but it does come at a cost.

For example, during the FY 2007 Program and Budget Review process, the OSD comptroller delivered a $13.2B FY 2007, $65B Future Years Defense Program bill to the Services to pay for other defense bills and priorities. These bills covered increases in fuel costs, the cost of inflation, Quadrennial Defense Review (QDR) initiatives, some parochial initiatives, and many others. Spread between the Services, these bills had a dramatic effect on their programs. For the Air Force, the effect on its modernization programs were so great General Mosely decided it was necessary to *transform* the Air Force to keep its modernization programs on track. He largely accomplished this through the reduction of 40,000 Air Force billets. This decision was documented in the other infamous Program Budget Decision, 720. For the Army, these reductions were so severe, that during the next year's program and budgeting process, it could not find the resources to balance the FY 2008 Program Objective Memorandum, so it did not submit one. This threw the Pentagon's budget cycle out of whack for several months.

The point of this discussion is not to cast disparaging remarks toward the Defense Department's resource allocation process, but rather to point out there is little flexibility left in defense budgets. If the Department is going to modernize within its topline—or a reduced topline after a peace dividend—considerable thought needs to be given toward the consequences and expense of reprioritizing established priorities. To the Department's credit, it recognized this and assembled a powerful group of OSD, Joint Staff, and Service leaders into a group called the Deputy Advisory Working Group (DAWG). The DAWG is responsible for weighing the cost and benefits of choices to determine the best outcome for the Department. The benefit of this process is that regardless of the outcome of a particular decision, the Defense Department has control over its destiny—or at least until it submits the budget to Congress.

So far, this article has discussed the defense budget, the Department's plan to use the GDP argument to secure additional resources from Congress, as well as some external and internal factors affecting defense budgets. However, the area Congress and taxpayers look at when judging the adequacy of the defense budget is strategy. When hostilities end in Iraq and Afghanistan, and the size of the current defense budget is challenged, a well-defined strategy will help defense leaders defend the topline. Without it—and at a time when taxpayers and Congress are looking for a peace dividend—the Department of Defense will have a tough time defending the world's largest defense budget.

Defense Strategy

The problem of selecting strategies and weapons systems today are quite unlike those that existed before WWII … before WWII, we did not plan on technology change, we merely adjusted to it, now we are forced to plan on it.

—Alain C. Enthovan and K. Wayne Smith, 1973

The *National Security Strategy*, *National Defense Strategy*, *National Military Strategy*, and QDR all played major roles in defining the defense strategy for the United States during the last several years. Regardless, many critics believe the United States has not had a viable defense strategy since the end of the Cold War. This is incorrect. The Defense Department has always had a strategy to defend the United States and its interests. What is missing from this equation is a large, looming, easily identifiable Cold War type threat—a threat that has the potential to single-handedly endanger this nation and all of its citizens. With a threat such as this, just about any defense strategy is acceptable. For instance, during the Cold War, the United States had five separate strategies: containment, massive retaliation, flexible response, mutually assured destruction, and mutually assured safety to defeat or deter the Soviet Union.[44] Without threats of this nature, strategy is difficult to create and defend.

The only threat more difficult to base a strategy on is a threat that does not necessarily require military power to ultimately defeat—such as the GWOT. While military power is obviously required for this type of threat, it may not be central to defeating it. The United States is discovering other instruments of power—such as diplomacy and economics—are just as effective in dealing with many irregular threats. This puts defense strategists in a bind. How does the Department develop a defense strategy to defeat irregular threats, as well as uncertain or unpredictable threats in the future? The Department of Defense has struggled with this since 11 September 2001.

The 2006 QDR transformed the defense strategy from a threats-based strategy to a more modern capabilities-based strategy.[45] Since the Defense Department does not possess a crystal ball and cannot see into the future, how can it determine what capabilities are required to meet future threats? It is difficult, but the Defense Department decided to transform ground capability, such as the Army and Marines, on the margins to make them more flexible in defeating emerging irregular threats. It also preserved the Air Force and naval capabilities along conventional lines, while adding some information, surveillance and reconnaissance, and special operations assets to satisfy current requirements. But back to the challenge—without an identifiable threat, this capabilities-based strategy is difficult to sell to Congress and the taxpayers. If the Defense Department wants to keep, and modernize, the foundation of a capabilities-based strategy, such as its conventional forces, it needs to do a better job of selling its new strategy.

In the 2006 QDR, the Defense Department laid out its capabilities-based strategy. The document supported the four 2004 National Defense Strategy goals of defeating terrorist networks, defending the homeland in depth, shaping the choices of countries at strategic crossroads, and preventing hostile states and nonstate actors from acquiring or using weapons for mass destruction. It also unveiled the *quad chart* (see Figure 7),[46] which graphically showed the Defense Department moving military capability away from traditional challenges toward irregular, catastrophic, and disruptive challenges. Again, the problem came in selling this strategy.

During the official release of the 2006 QDR, a senior defense leader stated the following at a press conference:

> It is important to remember that we exist in an age of uncertainty and unpredictability. We in the Defense Department feel fairly confident that our forces will be called on to be engaged somewhere in the world in the next decade where they're currently not engaged. But we have no idea whatsoever of where that might be, when that might be, or in what circumstance that they might be engaged.[47]

While this individual provided an honest portrayal of how the Defense Department built its strategy, it gives the appearance the Defense Department is spending $481.4B to build military capabilities for capabilities sake. The Department does not really know where it is headed so it will just continue to build up capability to meet any challenge. This is a bit cynical and oversimplified, but to better sell the defense strategy, perhaps it will be more influential to quote the 2006 National Security Strategy. In it, President Bush said the following:

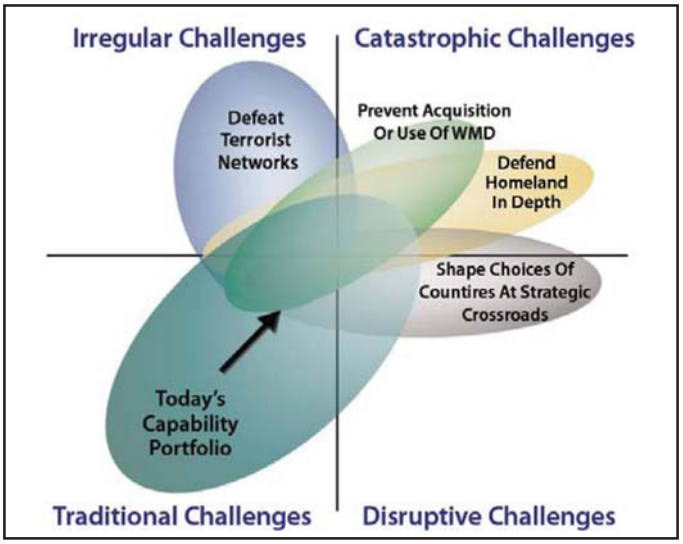
> This Administration has chosen the path of confidence. We choose leadership over isolationism, and the pursuit of free and fair trade and open markets over protectionism. We choose to deal with challenges now rather than leaving them for future generations. We fight our enemies abroad instead of waiting for them to arrive in our country. We seek to shape the world, not merely be shaped by it; to influence events for the better instead of being at their mercy.
>
> The path we have chosen is consistent with the great tradition of American foreign policy. Like the policies of Harry Truman and Ronald Reagan, our approach is idealistic about our national goals, and realistic about the means to achieve them.
>
> To follow this path, we must maintain and expand our national strength so we can deal with threats and challenges before they can damage our people or our interests. We must maintain a military without peer—yet our strength is not founded on force of arms alone.[48]

As the world's only superpower, the United States has chosen to lead, to support its allies and other nations as required, to defend democracy, and to support countries around the world who ask for assistance. This takes a robust Defense Department to achieve.

As the world's only superpower, the United States is in a position (the top) where emerging nations, such as China and Russia, want to be. With this comes the potential for conflict and again, a robust Defense Department is required to protect US interests and deter aggression.

As a nation, the United States needs to determine if holding the world's only superpower status is important or not, or will this nation simply be content with a strong economy. The European Union now collectively has the largest GDP in the world, but it does not possess sufficient military power to defend itself. [49] China has the second largest GDP of any single nation at $10.2B, but does not possess the military power to defend itself against a superpower like the United States.[50] However, the United States has the largest economy of any single nation and has the military power to defend itself against any country in the world. [51] This entitles the United States to its superpower status and from President Bush's comments above, he feels it is necessary to keep this status to influence (rather than be the victim of) world events.

If the Defense Department expects to acquire additional financial resources in a fiscally constrained environment, it needs to integrate and articulate these issues into its strategy. Defense leaders must also sell this strategy to the taxpayers and Congress.



Insert Figure 7. Shifting the Portfolio.

In the end, Congress will review the Defense Department's strategy and budget submission, and determine the appropriate amount for the nation's defense. Because politics is perhaps the most influential area in funding the Defense Department, senior leaders need to fully engage themselves into this realm—within legal bounds, of course.

The Role of Politics

The central fact about the defense budget is that it is a political problem. These [defense] questions involve matters on which the judgments of experts and politicians alike are bound to conflict. Issues of great public consequences about which intelligent, informed, and dedicated men disagree can have but one destiny and one destination. They must be resolved through the exercise of power in a political arena.

—Warner R. Schilling, Strategy, Politics, and Defense Budgets, 1962

In *On War*, Carl Von Clausewitz stated, "war is a continuation of political intercourse."[52] If he were alive today, he would probably agree military budgets are also fathered by politics. Article 1, Section 8 of the United States Constitution gives power to Congress to raise and support the military, which includes appropriating dollars for its operations.[53] The members of Congress have benefited from over 2 centuries of experience; they know budgetary control is the most effective tool they have over the military and they are not afraid to use it.[54]

The Defense Department expends a vast amount of personnel resources during its resources allocation process, or the Planning, Programming, Budgeting, and Execution (PPBE) system. Under PPBE, it takes a full year for the Defense Department to complete its portion of the President's Budget (PB). Once OMB submits the PB to Congress the first Monday in February, the Defense Department tends to lift its foot off the gas pedal, take a deep breath, and start focusing on the next year's budget. Of course, defense leaders will testify before congressional budget committees, and their staffs will spend countless hours answering committee questions. Once the hearings are complete, the Department moves on and does not spend much time or effort on the submitted budget; at least until the authorization and appropriation committees start marking it up during the late summer months.

In the future, it will be more crucial than ever for the Defense Department to engage Congress during the *transition period* from budget submission to budget markup. This period is important, because it is the period when the influence of politics takes place.

During the budget transition period, Congress will review several influencing factors. For example: What are the current threats to national security? What does the future hold and is the military prepared to face it? Is the military properly manned and equipped to do the job? What is public opinion saying? In terms of resources, Congress will review the nation's priorities, question whether the Defense Department has sufficient funds to accomplish its mission, and if not, determine how much more is required. The lists of questions could go on and on, however, the point is simple. In an era of uncertainty and unpredictability, it is in the best interest of the Defense Department to engage Congress when it asks these questions.

In Gregory Palmer's book, *The McNamara Strategy and the Vietnam War: Program Budgeting in the Pentagon, 1960-1968*, he made a very good observation. He said, "… the major constraint on peacetime military production, where national priorities are not so clear, is the budgetary one."[55] In other words, it is necessary for the Defense Department to ensure its military priorities are clear. It is also important to articulate to Congress how a large, modern, conventional military force fits into the broader national priorities. A well-designed engagement policy will help the Department accomplish this.

However, in dealing with its political masters, the Defense Department is in luck. As it turns out, Congress likes to support modern, technologically advanced, conventional forces because it is in their constituent's best interests—and consequently, their best interests. It is no secret the members of congress place great value in supporting industry within their districts, because it brings jobs and wealth to their constituents. Leon Sigal confirmed this in his book, *The Changing Dynamics of US Defense Spending* by stating: "… the biggest change since the end of the Cold War is the emphasis that congressional members with defense-related industries in or adjacent to their districts now place on preserving constituent jobs."[56]

For example, during the FY 2007 President's Budget build, the Air Force programmed for the shut down of the C-17 production line, effective at the end of FY 2008. While the Air Force wanted more C-17s, it could not afford to purchase more than the programmed 180 aircraft. To keep the production line open longer, Congress stepped in and appropriated an additional $2.1B in the FY 2007 Defense Appropriation Bill to procure an additional 10 C-17s.[57] Later, the FY 2008 Global War on Terrorism Supplemental included an additional $2.0B to procure 10 more C-17s.[58] Congress accomplished both of the actions to extend the C-17 production line operations and keep jobs in several congressional districts. The payback to these congressmen will come from votes during future reelection campaigns.

These are just two examples showing how it is in Congress' best interests to extend military procurement programs. There are certainly many others. Back in 1962, Warner Schilling summarized this congressional process by writing, "Once formed, the climate of opinion with regard to desirable and possible defense spending has been remarkably impervious to change."[59] Thirty-seven years later, when David Obey, the Chairman of the Committee on Appropriations was asked where overseers of the defense budget place their loyalties and emphasis, he answered: "...they come from areas [districts] where it is their number-one political requirement to preserve the status quo in the military."[60] While many define this behavior as *pork spending* and view it in a negative fashion, in a fiscally constrained and uncertain or unpredictable environment, it is a benefit to the Defense Department and the Department needs to continue to harness it in order to bolster modernization efforts.

Finally, political changes related to a new presidential administration have the potential to affect defense budgets. For example, what will the new administration's foreign policy look like? Will it reach out to the international community, or concentrate within United States borders? Will it emphasize democracy around the globe, or concentrate only in failed states? Will it choose to remain a leader among the world nations, or allow world nations to develop independent from US interests?

Will it choose to use the military as its dominant instrument of power or turn more toward diplomacy? How will it choose to view threats to US interests in this era of uncertainty and unpredictability? Will it believe large defense programs are archaic remnants from the Cold War and decide to undertake major transformation initiatives within the Defense Department?

Regardless of what will happen in the future, the Defense Department needs to stay actively engaged in the political process. Senior leaders need to put their own political views aside and carry the defense message to Congress without fear of reprisal. Congressmen, above all, understand how to play the political game. They understand their constituents' needs, and they understand how to satisfy them. It is up to senior leaders to ensure members of Congress understand the needs and desires of the Defense Department, as well as how it will help defend the interests of the United States.

Recommendations

The Department of Defense has the responsibility to prepare a budget, which clearly supports and executes the *National Defense Strategy*. The execution of this budget process affects the national security and the welfare of its citizens. The consequences of not getting it right are unacceptable. Fortunately, the Defense Department has worked this process for well over two centuries. Creating strategies to maintain scarce defense dollars and modernize legacy weapon systems are the current challenges. The recommendations below are not a panacea, but rather a place for the Defense Department to start or expand upon.

Gross Domestic Product Argument

The Department of Defense should stop using the GDP argument as a means to acquire additional topline. It is useful for comparative analysis, but the GDP has nothing to do with defense requirements or strategy, it is arbitrary in nature, it is not defendable, and it tends to make the Defense Department look desperate. Defense spending as a percentage of GDP is a great metric and the department should use it as that, but should not pursue it further.

Bonus Programs

The Defense Department needs to reexamine bonus programs as soon as troops redeploy home from Iraq and Afghanistan. Reducing these programs early has the potential to free up to $1B in scarce resources, which the department needs for modernization efforts.

Peace Dividend

The Defense Department needs to start preparing for a peace dividend now. If historical postwar funding trends hold true, the Department should expect to lose financial resources and forces at the end of hostilities in Iraq and Afghanistan. Unfortunately, this will only compound its difficulties in modernizing the force. However, developing a plan of action now will allow the department to make better choices on how it will carry forward difficult programmatic reductions.

Defense Strategy

Prior to hostilities ending in Iraq and Afghanistan, the Defense Department needs to redefine its capability-based strategy to better support both irregular threats and the need for a large, modern, conventional force. Granted, in an era where threats are uncertain and unpredictable, this will not be easy. A well-defined strategy that the average American and congressmen can understand will help support the defense budget in a fiscally constrained environment.

Political Actions

The Defense Department needs to continue pushing its way into the political process, past its comfort zone. Political constituency is the one salvation for modernization of conventional forces. Now is the time to be aggressive, honest, forthright, and perhaps a bit humble when dealing with congressional staffers and members.

Prepare for a New Presidential Administration's Policy on Defense

It is too early to predict what policy changes loom on the horizon for the Department of Defense; however, it is not too early to start preparing for forthcoming, tough questions, For example, two questions repeatedly asked are as follows, "Does the Department need to maintain such a large conventional supremacy over the rest of the world?" "To whom or what is this disproportionate supremacy geared toward, and at what costs are we as a nation willing to accept to achieve it?" These are not easy questions to answer, but if the Department is to sustain and modernize its conventional force—in a time of severe fiscal constraints—it might be required to justify its necessity to the new administration.

Conclusion

Budgeting for the defense of the United States during an era of uncertainty and unpredictability is an extreme challenge. There are simply no easy solutions. The need to modernize legacy weapon systems is real, but so are the fiscal pressures facing the US government. The future challenge for the Defense Department is how to take the most capable and best financed military force in the world, and shape it to meet future threats. Right now, the only threats the Defense Department cannot defeat are mandatory spending, the national debt, and future peace dividends. The Department must adapt to these.

Above all, the Defense Department needs to readdress its funding strategy based on the GDP. Defense spending as a percentage of the GDP is a useful metric in comparative analysis; however, strategy and politics will determine future defense budgets, not a percentage of GDP. Allowing this funding strategy to dominate budget discussions perpetuates the belief that the Defense Department has no better strategy to defend its half trillion-dollar defense budget.

However, it does not need to be this way. It is within the Department's expertise to build, defend, and articulate a better capabilities-based strategy. Most senior defense leaders are also political appointees and have the knowledge to take full advantage of the political process. Regardless of the approach taken, the Defense Department needs to be realistic. The outlook for bigger budgets in the future is not good. Now is the time to stop worrying about receiving more funding and start worrying about how to operate and modernize with less.

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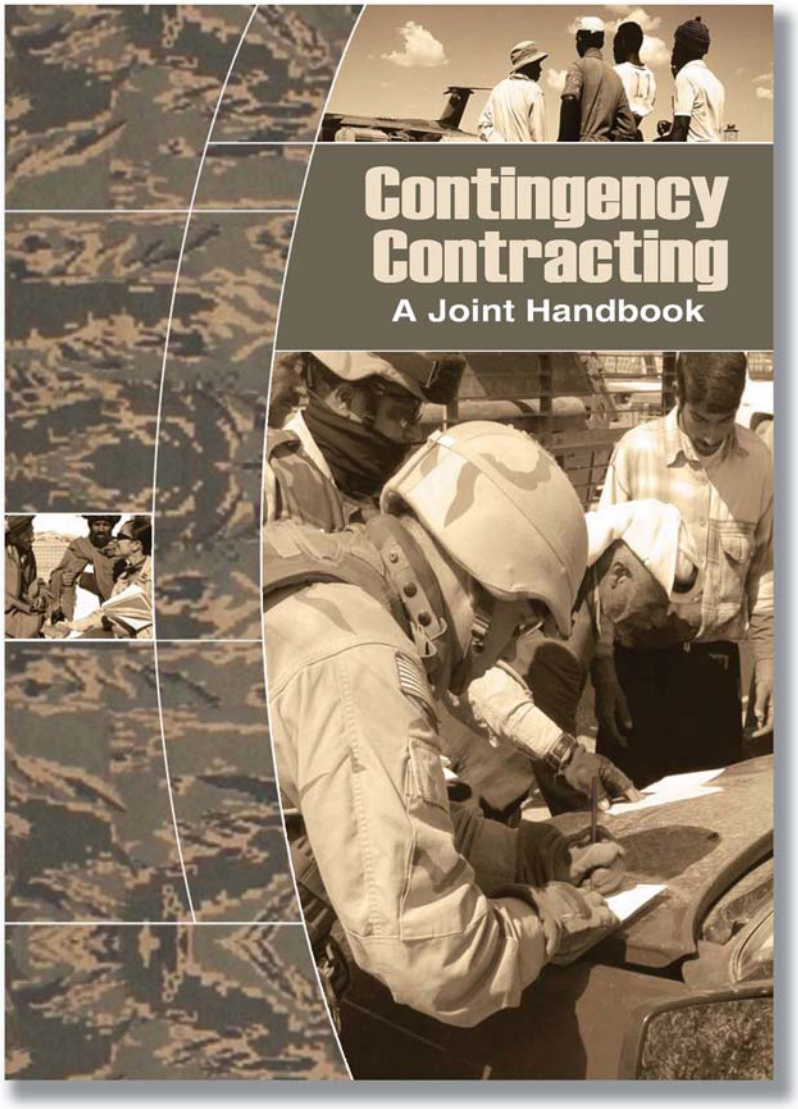

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Generating Opportunity from Uncertainty

David R. King, PhD, Lieutenant Colonel, USAF

Introduction

Uncertainty both pervades the current international security environment and obstructs our view of how this environment will evolve.

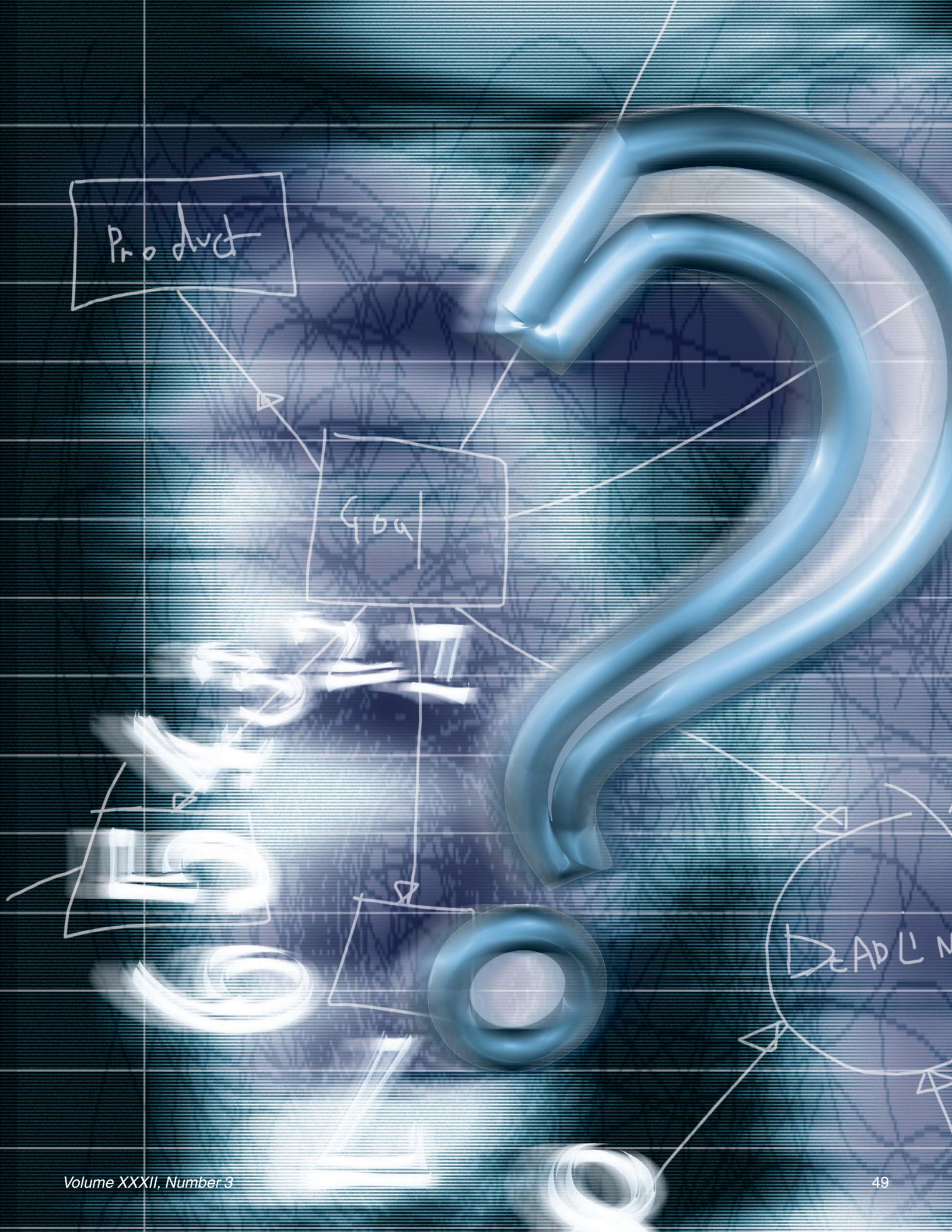
—David C. Gompert [1]

While the world displays growing strategic uncertainty, a potential disconnect has developed between military and business leaders on the treatment of uncertainty. The common view held today in business is reflected in the observation that organizations "abhor uncertainty."[2] Meanwhile, the military has long faced uncertainty in the conduct of war.[3] As a result, military leaders act on the best information available about how a human enemy will reason or react. Military theorists are familiar with uncertainty from Clausewitz's term *fog* that refers to the general unreliability of information.[4]

Uncertainty relates to both the existing *state* of an organization's environment and future *outcomes*. Uncertainty about the existing state an organization finds itself relates to vague, fragmented, unstructured, and the contradictory nature of information at a given time. Uncertainty surrounding future outcomes results from an imperfect understanding of variables and their relationship to enable predicting future outcomes. For both state or outcome uncertainty, at least some uncertainty remains irreducible in that not all available information or possible outcomes can be known with certainty.

Uncertainty tolerance is an important aspect of personal and organizational resilience. Similar to the relationship between a person's stress and performance, or teams and conflict, it is likely that organizations perform best under conditions with some uncertainty.[5] After it is introduced, uncertainty likely stimulates organizations to take actions to become more robust. Uncertainty creates stress by limiting the usefulness of interpreting information with current procedures.[6] The response to this stress is adaptive behaviors to increase uncertainty tolerance. However, uncertainty can progress beyond levels that can be effectively managed.

Well-led organizations display greater uncertainty tolerance and are more adept at operating under uncertainty. They will have an advantage over organizations less tolerant of uncertainty. While uncertainty can reach a point where it exceeds an organization's tolerance and performance falls, the performance of organizations at the same level of uncertainty varies based on their tolerance to it and impact the effectiveness of organizational responses to a changing environment. The goal therefore is not to eliminate uncertainty, but to benefit from it through sound leadership. If differences in operating under uncertainty exist between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organizations, a competitor with greater uncertainty tolerance will benefit from some uncertainty. Therefore, an obvious military strategy is to reduce the amount of fog (or uncertainty) you face about a situation's state or likely outcomes relative to an adversary. Leaders that use uncertainty to create opportunities display the most advanced system of thinking about strategy.[7] The goal is to change the rules of the game or get inside a competitor's decision cycle, so leaders and their organizations can achieve success.[8]

The military's history of facing an uncertain strategic environment provides examples and guidelines for facing and taking advantage of uncertainty. Outlining how leaders can better respond and prepare their organizations for uncertainty is the goal of this article. The article proceeds by first outlining an historical example, and then using it to develop responses leaders can take to increase their organization's ability to handle uncertainty. Before concluding with a discussion, the performance implications of uncertainty tolerance are considered.

Historical Example

An early example of the impact of uncertainty on a military organization comes from a Greek mercenary force of 10,000 hoplites (infantry equipped with shields and spears) that served and traveled into Persia with Cyrus, a contestant for the throne of the Persian empire around 401 BCE.[9] Following the battle of Cunaxa, where Cyrus was killed by the forces of his older brother Antaxerxes II, the real journey of the Greeks began, as their worst fears were realized with the death of their sponsor.[10] The Greeks were in hostile territory over 1,000 miles from home.[11] Additionally, the promise of wealth that initially motivated them disappeared with the death of Cyrus. Further, the Greek hoplites had already traveled and plundered the most direct route home—largely a flat plain that provided an advantage to the Persian cavalry.[12] Following the execution and capture of their leaders, the Greek mercenaries banded together, formed a council, and chose the uncertainty of going north into the uncharted territory of the Carduchian mountains.[13]

Following the decision to go north, the Greeks adjusted their tactics and invested to improve their capabilities as a military force. The Greeks first improvised their formation to form a hollow square surrounded by hoplites to protect their baggage train and camp followers.[14] This change alone did not offer protection from Persian archers and slings, as these light troops could engage the Greeks from long range and disperse before they could be engaged in close combat. Therefore, the Greeks scavenged for horses to field cavalry, and invested in slings and bonuses for people willing to volunteer as slingers.[15] The Greek slingers used lead, an improvement over the stones used by Persian slingers, providing the Greeks a greater effective range.[16]

The retreat north welded the different Greek divisions together with the common purpose of returning home. As the Greek force entered the mountains, the Persian army stopped its pursuit because few Greeks were expected to survive the oncoming winter. Additionally, the Greeks had no maps and the local inhabitants greeted them with hostility. Constant attacks threatened to separate the Greek force as it stretched out along mountain trails. The need for information resulted in sending scouting parties to find routes and places to make camp and to search for hostile activity. The need for information also led the Greeks to take and question local prisoners. At one point, when faced by a dead end guarded by hostile forces, two prisoners were questioned about alternate routes.[17] When the first denied any alternative in the face of threats, his throat was cut in front of the other. The remaining prisoner provided the Greeks another route through the mountains, yet Greek losses in these few days were comparable to the three months they spent in Persia.[18]

Sighting the Black Sea offered the Greeks a false promise of the familiar and resulted in a splintering of the remaining 8,200 survivors into three groups.[19] The smaller groups were more easily harassed, and resulted in 1,000 Greek casualties in a single week.[20] Even when the mercenaries came upon Greek settlements along the sea, their reputation preceded them and the mercenaries were denied assistance. Not only were the Greek outposts along the Black Sea not Greece, but the mercenaries themselves were changed from their experience. The harried Greek mercenaries increasingly relied on superstition and ritual sacrifice to divine a way forward. Because they learned how to survive as soldiers, the journey of the Greeks ended similar to how it began—they became mercenaries in another fight against Persia.

The example of the Greek mercenaries and their response to uncertainty offers three lessons. First, organizations respond to uncertainty by investing in improving their capabilities. Second, change that coincides with uncertainty affects both organizations and their environment. Third, even in a changed environment improved organization capabilities remain valuable. How these lessons relate to uncertainty today is discussed next.

Responses to Uncertainty

Clausewitz identified two responses for managing uncertainty—intellect and courage.[21] However, the example of Greek mercenaries suggests additional opportunities. First, the degree of uncertainty that can be managed will be directly and indirectly influenced by a leader's actions. The Persian attempt to disband the Greeks by removing their generals was overcome by the Greeks forming a council that decentralized decisionmaking. Second, the Greeks took action to increase uncertainty tolerance. In response to environmental change, the Greeks used resources on hand to field slingers and cavalry to keep their forces competitive. Translating the Greeks actions to today offers two strategies for increasing uncertainty tolerance—learning and resource investment.

Learning

Learning reduces variation in performance and may involve one of the most important ways to reduce uncertainty.[22] Organizations continuously learn by gaining knowledge about their capabilities and environment, and learning faster than competitors provides an advantage. For example, the Greeks used scouts and took additional actions to learn more about their environment. Additionally, organizations can learn simply by exercising capabilities.[23] The Greeks adapted a hollow square formation and developed cavalry to protect their movement from Persian attack. All organizations exhibit a capability to learn. Experience increases the organization's ability to effectively handle the amount of uncertainty.

Knowledge is dynamic in the sense that the best source for gaining additional knowledge is reflecting on what someone

already knows. The fact that knowledge builds on itself causes people with similar experience to develop their own language for discussing ideas. As a result, organizations under similar conditions evolve in similar ways as the demands of an organization's environment lead to the exercise of similar capabilities. The result is for professions to display a common body of knowledge.

The creation of standard bodies of knowledge also encourages specialization.[24] Specialization decreases an organization's variance by improving identification of possible outcomes and understanding of cause and effect, or increasing its uncertainty tolerance. Specialization can also increase variance between organizations by enabling an organization to develop a protective niche where it has a better understanding of the potential outcomes for change. The military equivalent to specialization is combined arms—the Greeks expanding their infantry resources to also include cavalry and slingers with ranged attack. Leaders will give their organizations the best ability to tolerate uncertainty by increasing the diversity of specialization. When uncertainty occurs where an organization has specialized resources, it will be better positioned to respond to change.

Resource Investment

Leaders can develop an expectation for change by investing to improve an organization's resources. Uncertainty helps justify higher investment by providing organizations appropriate resources to respond to competitors.[25] The ability of organizations to benefit from uncertainty varies because of differences in learning and level of resource investment.

Resource investment likely facilitates innovation by enabling organizations to act in accordance with the demands of an uncertain environment.[26] For example, the environment the Greeks faced led to their investment in lead shot that gave their slingers a relative advantage against the Persians. Sustained investment develops valuable resources that build an organization's knowledge.[27] Specifically, an organization's investment decisions and experience develop knowledge and an ability to recognize and exploit information.

As capability grows, improved information results in an organization having greater understanding of its environment and for new resource combinations that result in innovation. Innovativeness enables organizations to meet the demands of an uncertain environment by enabling sporadic or even continuous adjustments to organization resources and products.[28] Developed resources help predict the probability of success under uncertain conditions and provide resources that can be applied to other uses. For example, the Greek hoplites fielded cavalry from horses and soldiers already within their group or from available resources that improved their performance. As such, knowledge and resources have greater utility in uncertain environments because they build uncertainty tolerance and allow organizations to adapt and take advantage of opportunities.

However, resource investment offers diminishing returns because uncertainty persists in the face of efforts to reduce it. Continuing change may alter previous relationships resulting in a mismatch between an organization's actions and its environment. Still, organizations should continue to invest in new capabilities. Foremost, investments can introduce new resources and pave the way for organizational change. For example, the Greeks' survival was aided by combined arms or fielding cavalry and slingers that complemented their core hoplite infantry. Additionally, success in using new capabilities may depend on interactions with other capabilities or provide an organization the ability to surge or respond to challenges.

Even in the face of diminishing returns, continued investment still offers relative advantages. First, organizations may not represent an equal threat to one another or have the same uncertainty tolerance. Leaders need to recognize they only need better information than competitors, not perfect information, to have an advantage. Second, unsuccessful investments are still worthwhile because knowledge generated will often be useful elsewhere in an organization or in other contexts.[29] In other words, developed resources continue to have a residual value that provides a safety net for continued investment. Finally, uncertain environments may magnify the perceived value of developed capabilities. For example, the experience of the Greek mercenary force in retreat from Persia only made them more valuable in the next conflict.

Uncertainty and Performance

Leaders need to consider the impact uncertainty will likely have on their organization's performance. The initial impact of uncertainty will be reduced performance until adjustments are made. As an organization adapts, tolerance of uncertainty increases and performance should improve. For example, the Greek hoplites were at a disadvantage to Persian slingers until they adjusted their tactics. Organizations take action to reduce uncertainty by improving available information. As swift moving environments challenge beliefs, successful organizations accept the need to have an ability to adjust by building in the expectation for change.[30] For example, the uncertain environment confronting the Greek mercenaries served to clarify their goals and strengthen their organization.

When uncertainty is accepted performance improves. It provides purpose and efforts to increase knowledge and make better choices. For example, it has been observed that people learn to respond to chance in proportion to their observations, or try to maximize the number of times they are right by alternating their predictions instead of making the same bet every time.[31] From the perspective of organizations with better information, knowledge should translate into making better decisions based on a superior understanding of likely outcomes. A complication is that people tend to have difficulty recognizing when information is sufficient, past experience no longer serves a useful guide, or there is too much information.[32] Too much information can result in worse decisions because irrelevant information simply serves as a distraction.

If the environment continues to shift and no reliable information on which to base decisions is available, performance will decline rapidly. The only condition consistently leading to success other than superior information is luck.[33] As the number of potential outcomes expands, small changes can have a big impact and it may be difficult to know what has changed. The implication is that uncertainty—even with knowledge—can reach a point where continued success will depend on luck.[34]

Even though luck plays a role, organizations with greater knowledge should enjoy luck more often. Differences in

uncertainty tolerance should help explain differences in organizational performance. When uncertainty begins to exceed an organization's ability to easily respond, small differences in the ability of organizations to cope with uncertainty will make a difference. In uncertain environments, the ability to make more informed decisions rapidly will provide an advantage over competitors.

Increased luck may relate to leaders knowing their information is better. Differences in experience and accumulated knowledge result in different perceptions of opportunity for the same situation. For example, it has been observed that uncertain prospects are viewed as less attractive when they are also considered by someone else that is perceived to be more knowledgeable.[35] Though leaders may not know a complete set of outcomes, they may be able to rule out *bad* choices or identify better decisions than rivals.

Conclusion

Decisions are made despite uncertainty—even taking no action is a decision. Better decisions are likely to be made under conditions where an organization can tolerate and manage greater amounts of uncertainty. As a result, the impact of uncertainty on organizations is more complex than has generally been recognized. Leaders can make their organization's tolerance for uncertainty more robust. While its introduction may be unpleasant, uncertainty likely leads to a closer examination of the environment and an organization's role in it. This should contribute to expanding an organization's ability to make decisions based on identified potential outcomes, and improved decisionmaking from better information should contribute to higher performance. Doing better than competitors depends on higher tolerance of ambiguity from learning and capability development that ensures better information than its rivals on a range of topics. As such, leaders should ensure their organization avoids specializing in too few areas.

Leaders can apply several lessons learned from the observations and arguments explored here. First, attempting something is the first step toward managing uncertainty, as an outcome is certain only when no attempt is made. For example, instilling the belief that something is impossible will likely preclude any achievement inconsistent with that belief. As a result, it is on the margins where leaders make the biggest difference. If things went according to plan, we would not need leaders. At the same time, greater demands and discretion under conditions of uncertainty increase the responsibility for leaders to act appropriately—integrity first.

Leaders also need to dedicate time to figuring out what they want to achieve and how to get there. The challenge is to achieve "transformation that is revolutionary in result and evolutionary in execution."[36] The spoils will go to leaders of organizations that manage uncertainty to favorable outcomes by making their own luck along the way. There is no *one* way to be successful. Leaders should seek to employ workable solutions that can be adjusted as additional information becomes available, rather than waiting for perfect solutions that risk irrelevance.

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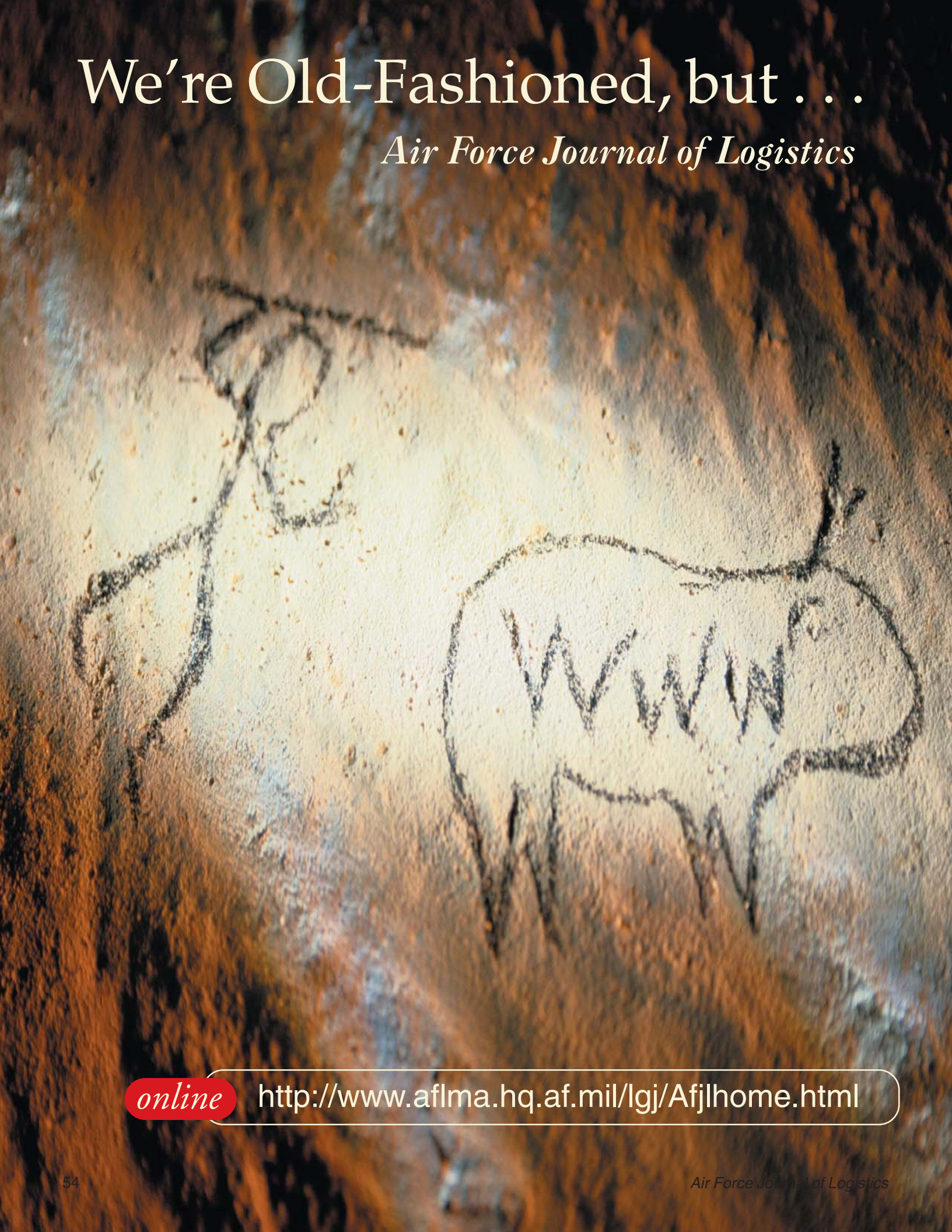

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Perceived Transfer of Basic Combat Skills Training in the US Air Force

Rodney E. McCraine, Captain, USAF
Kirk A. Patterson, PhD, Lieutenant Colonel, USAF
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Introduction

In early 2003, during Operations Enduring Freedom and Iraqi Freedom, many airmen, including those in certain support career fields, were deployed to hostile environments such as Afghanistan and Iraq. Deployments of this nature were a departure from normal Air Force operations where support personnel were normally far from the front lines of battle,[1] thus placing support airmen, especially those in logistics related career fields, at greater direct risk of participating in tactical ground operations.[2]

According to Major Barry Lineback,[3] "The battlefield makes rigorous physical, psychological, and moral demands that require both tangible and intangible qualities." Defining and studying these *tangible and intangible qualities* are important since the use of combat skills by logistics personnel is becoming increasingly necessary. A Headquarters Air Force coordinated white paper entitled, *Long-Term Integration of Expeditionary Airmen Concepts into the Air Force,* questioned whether the Air Force is effectively indoctrinating, training, educating, and sustaining combat readiness [for all support airmen] over the entire course of their career.[4] To address these issues, the Expeditionary Combat Airmen Integrated Process Team (ECA IPT) was created by the Directorate of Security Forces and Force Protection.[5] According to a draft charter for the ECA IPT, the purpose of the IPT was to "... provide direction to determine current combat skills for the ECA, current training support, the *training gap*, and recommend training and education to close the gap." [6]

Article Acronyms

AFI – Air Force Instruction
AFMAN – Air Force Manual
AT/FP – Antiterrorism/Force Protection
ECA IPT – Expeditionary Combat Airmen Integrated Process Team
ISD – Instructional Systems Development
LOAC – Law of Armed Conflict
MD – Mean Difference
ORE – Operational Readiness Exercise
ORI – Operational Readiness Inspection
SABC – Self-Aid Buddy Care

To date, there has been little research to guide the development of a formal Air Force basic combat skills training program or to address the factors affecting the transfer of those skills from the classroom to the battlefield. To address this deficit, we conducted a study to provide a working operational definition of Air Force basic combat skills and to determine the perceptions of support airmen and their ability to transfer skills from the classroom to the battlefield. Evaluating training in terms of actual results and behavior change is crucial because training basic combat skills is a multifaceted and complex task. As such, this study analyzed those factors that affected the transfer of five specific basic combat skills.

Review of Literature

Training

Training has been defined as a planned learning experience designed to bring about a permanent change in an individual's knowledge, attitudes, or skills[7] as cited in Noe.[8] Only recently have organizations begun to recognize that the knowledge base of their employees can be a key source of sustainable competitive advantage.[9] As examples, civilian corporations reportedly spent over $80B on formal training programs in 2004,[10] while the Air Force planned to spend over $9M in basic combat convoy training alone in 2005.[11] Additionally, new technology creates an increasingly globalized work environment, adding new pressures to improve the quality of services and products to stay competitive.[12] Training has been an essential part of both civilian[13] and military organizations throughout the 20th and early 21st centuries.[14]

Training Evaluation: Training Effectiveness versus Training Transfer

Training evaluation can be defined as a "systematic collection of descriptive and judgmental information necessary to make efficient training decisions related to the selection, adoption, value, and modification of various instructional activities."[15] In 1958 and 1959, D. L. Kirkpatrick released a series of four articles describing his hierarchical model for evaluating training programs.[16] Kirkpatrick's original model included the following:

- **Reaction.** How well the trainee liked the training program.

Training Type	Reference	Nomenclature
Anti-terrorism/Force Protection	AFMAN 10-100	Airman's Manual
	AFI 10-245	Air Force Anti-terrorism Standards
	AFI 31-301	Air Base Defense
Self-Aid/Buddy Care	AFMAN 10-100	Airman's Manual
	AFI 36-2238	Self-Aid Buddy Care Core Training
Chemical Warfare	AFMAN 10-100	Airman's Manual
	AFMAN 10-2602	Nuclear, Biological, Chemical, and Conventional (NBCC) Operations and Standards
Law of Armed Conflict	AFMAN 10-100	Airman's Manual
	AFI 51-401	Training and Reporting to Ensure Compliance with the Law of Armed Conflict
Weapons Training	AFMAN 10-100	Airman's Manual
	AFI 31-207	Arming and Use of Force by Air Force Personnel
	AFMAN 36-2227 (Vol. 1)	Combat Arms Training Program
	AFI 36-2226	Combat Arms Program

Table 1. Air Force Instruction References for Combat Skills

- **Learning.** The knowledge acquired, skills improved, or attitudes changed as a result of training.
- **Behavior.** Using those facts and skills learned on the job.
- **Result.** Outcomes that appear on the job as a result of training[17]

Kirkpatrick's model has been the foundational work used by many researchers in training evaluation studies.[18] However, Kirkpatrick's model included three key assumptions:

- Arranging the hierarchical levels in increasing order of value (Reaction → Learning → Behavior → Results)
- Causally linking the levels
- Positively correlating the levels[19]

Because of these assumptions, many researchers question the validity of Kirkpatrick's model in accurately evaluating training programs. According to Alliger, Bennett, and Tannenbaum,[20] using Kirkpatrick's model as the standard for training evaluation could actually hinder future research and growth in this arena by suppressing the development of new theories in training research.

Researchers have attempted to overcome the shortfalls within the Kirkpatrick model by suggesting new models and researching other variables thought to be key factors in the training process.[21] Noe, though using Kirkpatrick's model as a framework for his study, suggested there were also motivational and situational factors involved in the training process.[22] Alliger and Janek suggested expanding the Kirkpatrick model to capture behavioral data from trainees, subordinates, coworkers, and supervisors.[23] Kraiger, Ford, and Salas noted that variables such as organizational commitment and its effect on learning have largely been ignored.[24] Facteau et al[25] attempted to measure training success by using a model that subsequently showed a significant link between pretraining motivation and perceived training transfer. Alliger et al[26] expanded Kirkpatrick's reactions level to include affective and utility reactions and demonstrated a significant link between utility reactions and job performance. Development of new models and ideas has resulted in training evaluation research that has become more complex in determining training effectiveness.

One such method used in literature for determining training effectiveness is measuring training transfer. Training transfer can be defined as the ability to apply what one has learned from training back to one's job.[27] The constructs of training effectiveness and training transfer are linked in several studies.[28]

When evaluating training, many models use training transfer in combination with other constructs such as pretraining motivation, tests scores from evaluations given at the time of training, and job evaluations scores, to assess training effectiveness.[29] According to Hobbs,[30] studies which use the terms training transfer and training effectiveness interchangeably were less common.[31] One study by Gist, Bavetta, and Stevens[32] suggested training transfer was directly linked to perceptions of training effectiveness. This study found that MBA students with higher perceptions of training transfer were more likely to rate their training as effective.[33]

Perceived Training Transfer

The Baldwin and Ford[34] review of training literature identified three general factors affecting the transfer process and gave future transfer research a clear roadmap. The three factors were trainee characteristics, training design, and work environment. Trainee characteristics consisted of personality, motivation, and ability factors.[35] Training design characteristics incorporated principles of learning,[36] sequencing of training,[37] and training content.[38] Work environment characteristics consisted of support and opportunity to use.[39]

Training transfer research is a critical area for training evaluation. Some examples of general types of training studied in transfer research following the Baldwin and Ford study include the study of management training;[40] computer training;[41] and technical or occupational skills training.[42] Each of these studies highlighted possibilities for new relationships with training transfer. In the same manner, basic combat skills are a diverse construct consisting of the five separate combat skills. Analysis of components of the combat skills construct may provide some unique insight into the factors affecting combat skills as a whole. As such, the following hypothesis will be tested:

> Hypothesis: Perceptions of perceived training transfer will differ with respect to training type.

Method

The first step was to examine Air Force policy to determine what specific knowledge or set of skills all Air Force personnel should possess in order to survive and operate in hostile environments. Commanders determine deployment eligibility using Air Force Instruction (AFI) 10-401, *Air Force Operations Planning and Execution*[43] and AFI 10-403, *Deployment Planning and Execution*.[44] These and other written policies include five requirements for basic deployment eligibility and associated time frames for required training. The five basic requirements for deployment eligibility are as follows:

- Primary duty weapon training
- Law of armed conflict (LOAC) training
- Self-aid buddy care (SABC) training
- Chemical warfare defense training
- Antiterrorism and force protection level I (AT/FP) training[45]

These five requirements were used to operationally define *basic combat skills* in an Air Force context. Each of the skills and appropriate AFI references are listed in Table 1. We recognize in the current Air Force environment there are now more options available for combat skills training; however, at the time of this research, these options were not available.

Instrument Development

A Web-based survey was used to assess support personnel perceptions of combat skills training received. The targeted population was active duty support Air Force officer and enlisted personnel from multiple career fields. A stratified, random sample from each of the targeted career fields was taken to produce a representative sample with a confidence level of $\alpha = .05$.[46] The Air Force Personnel Center Survey Branch[47] provided a listing of 6,374 names, and a 34 percent response rate resulted (n=2,168).

In order to test perceived training transfer of basic combat skills as a single construct, a survey of the training attitudes of the five distinct skills was necessary. A separate 59-item survey was designed for each of the five basic combat skills, with each survey being identical in wording with the exception of the training type (for example, weapons training, chemical warfare training). Respondents were randomly assigned to a specific combat skill group and asked to answer 32 items regarding only that one skill, 13 demographic items, and 2 optional demographic items.

All items used a 5-point, Likert-type response format, ranging from *strongly disagree* (1) to *strongly agree* (5), with *neutral* (3) as the midpoint. Sample demographics included such items as gender, career fields, and rank. The yes/no items allowed survey participants to identify any prior combat skills training received as well as any recommendations for additions to the Air Force basic combat skill requirements. See McCraine[48] for details on survey development, pretesting and pilot testing, and nonresponse bias.

Respondent Demographics

The sample respondent demographics were comparable to the overall Air Force population for the selected career fields. The average age of sample participants (34 and 30 years for officers and enlisted, respectively) was consistent with the overall population demographics (35 and 29 years for officers and enlisted, respectively).[49] Gender statistics for the career fields used in this study had a mix of 78.6 percent male and 21.4 percent female Air Force-wide,[50] while the respondents in this study were 77.1 percent male and 22.9 percent female. The rank distribution of the original 6,370 potential respondents was known, and this information allowed a detailed comparison of the actual respondents with the original sample. Few differences between the original sample and the respondent population were noted regarding rank. The respondent population was comprised of 59 percent officers, while the initial sample contained approximately 61 percent officers. Interestingly, the respondent population had no responses from airmen (E-1) even though the original sample included 64 E-1s.

Measures

Perceived Training Transfer

Perceived training transfer was assessed with a four-item scale previously used by Hobbs[51] and based upon a review by Facteau et al[52] of the relevant literature.[53] Facteau et al[54] and Hobbs[55] reported internal consistency coefficients of $\alpha = .87$ and .92 for civilian and military samples, respectively. The reported internal consistency coefficient for this study was $\alpha = .72$ ($n = 932$). The scale mean and standard deviation were 3.42 and .22, respectively.

Deployment Experience

Deployment experience was measured with one item. The response range was comprised of five possible responses, with anchors of "0-1" and "8+" deployments.

Results

The purpose of our research was to determine if the reported perceptions of training transfer would differ by individual training type. This question was analyzed using ANOVA (Analysis of Variance Between Groups) and results indicate partial support (F (4,927) = 6.22, $p < .01$). When grouped by

Code	Specialty
1N	Intelligence
2F	Fuels
2G	Logistics Plans
2S	Supply
2T	Transportation
3C	Communications
3E	Engineering
3M	Services
3P	Security Forces
3S	Personnel
5J	Paralegal
5R	Chaplain Assistant
6C	Contracting
6F	Finance
7S	Special Investigations

Table 2. Air Force Enlisted Career Fields Surveyed

Code	Specialty
14N	Intelligence
15W	Weather
21A	Aircraft Maintenance
21M	Missile Maintenance
21R	Logistics Readiness
31P	Security Forces
32E	Engineer
33S	Communications
34M	Manpower
35B	Band
35P	Services
36P	Personnel
51J	Judge Advocate
52R	Chaplain
64P	Contracting
65F	Finance
71S	Special Investigations

Table 3. Air Force Officer Career Fields Surveyed

training type, results indicated perceptions of training transfer had unequal variances between the groups (Levene's Test Statistic = 10.08, $df = 4,927$, $p < .01$), so specific post hoc tests were needed to control for this assumption. The Games-Howell test is one such post-hoc test appropriate for use in large samples where the assumption of homogeneity of variances is violated.[56] The Games-Howel test was used to determine between which groups the perceptions of transfer were different (see Table 4).

Post hoc testing of the mean perceived training transfer responses described the differences between the training types (see Table 5 and Figure 1). A significant mean difference (MD) (MD = 0.21, $p < .03$) between perceptions of transfer in AT/FP ($M = 3.39$, $SD = 0.71$) and chemical warfare training ($M = 3.60$, $SD = 0.61$) as well as a significant difference in means (MD = 0.34, $p < .01$) between chemical warfare training and weapons training ($M = 3.26$, $SD = 0.80$) resulted. No other significant differences were found between training types.

Comparison of Training Types

The objective of this study was to determine if the reported perceptions of training transfer differ by individual training type. Using analysis of variance and specific post hoc tests, three groups of training types were found to be significantly different. Respondents taking the chemical warfare training survey reported the highest perceived training transfer and were significantly different from both weapons training (the lowest perceived training transfer response) and AT/FP training. This could be due to several factors. Respondents were only asked about attitudes about the formal training class without respect to practical experience. However, many respondents may have allowed their experiences and practice in chemical warfare training during operational readiness inspections (ORI) and exercises (ORE) to bias their responses which may explain the difference between weapons training and chemical warfare training. During ORIs and OREs, both chemical warfare skills and AT/FP skills are tested in a realistic environment. This explanation alone does not explain the difference between chemical warfare training and AT/FP training. Another possible explanation could be simply the way the training is presented. Unlike AT/FP, chemical warfare training is taught using multiple methods. There is normally a classroom lecture component, sometimes a video component, and in most cases, participants actually have to don the full chemical ensemble.

In addition to the quantitative analysis, respondents' qualitative inputs were valuable in understanding research results. Many respondents (56 percent) provided comments regarding what should be considered a basic combat skill—common themes emerged.

Training Comparisons		MD	Std Error	Sig
Anti-Terrorism/ Force Protection	Self-Aid Buddy Care	-.04	.07	.99
	Chemical Warfare	-.21(*)	.07	.03
	Law of Armed Conflict	-.05	.07	.95
	Weapons	.13	.08	.47
Self-Aid Buddy Care	Anti-Terrorism/ Force Protection	.04	.07	.99
	Chemical Warfare	-.17	.06	.06
	Law of Armed Conflict	-.02	.06	.99
	Weapons	.17	.07	.16
Chemical Warfare	Anti-Terrorism/ Force Protection	.21(*)	.07	.03
	Self-Aid Buddy Care	.17	.06	.06
	Law of Armed Conflict	.16	.06	.10
	Weapons	.34(*)	.07	.01
Law of Armed Conflict	Anti-Terrorism/ Force Protection	.05	.07	.94
	Self-Aid Buddy Care	.02	.06	.99
	Chemical Warfare	-.16	.06	.10
	Weapons	.18	.07	.09
Weapons	Anti-Terrorism/ Force Protection	-.13	.08	.47
	Self-Aid Buddy Care	-.16	.07	.16
	Chemical Warfare	-.34(*)	.07	.01
	Law of Armed Conflict	-.18	.07	.09

* The mean difference is significant at the .05 level.

Table 4. Games-Howell Post Hoc Results for Perceived Training Transfer

					95% Confidence Interval for Mean	
	N	M	SD	Range	Lower Bound	Upper Bound
Antiterrorism/Force Protection	172	3.39	0.71	1-5	3.28	3.50
Self-Aid Buddy Care	204	3.43	0.65	1-5	3.33	3.52
Chemical Warfare	189	3.60	0.61	1-5	3.51	3.69
Law of Armed Conflict	174	3.44	0.58	1-5	3.36	3.53
Weapons Training	193	3.26	0.80	1-5	3.14	3.37
Total	932	3.42	0.68	1-5	3.38	3.47

Table 5. Descriptive Statistics for Perceived Transfer by Training Type (n=932)

Enhanced Primary Duty Weapons Training

Respondents did not believe this training was offered frequently enough. Other respondents noted that the weapons training Air Force members currently receive did not align with actual situations faced while deployed. Comments indicated that learning how to shoot and move were vital skills not currently being taught. Two examples are:

> Current training only addresses how the weapon works and how to aim/ fire but doesn't address situations where airmen might be forced to use weapons in combat zones….

> M-16 and M-9 training, all ranks, once a year, include moving targets.

Joint Focused Training

Respondents suggested all airmen should learn to be infantrymen first like their Army and Marine Corps counterparts. Others took a more moderate approach and suggested airmen need to have a better conceptual view of the different

Services and how they work together.

> As we continue to shape our forces we also continue to deploy into Joint environments; therefore, our focus should lend [sic] some way of integrating and/or increasing contingency skills training with other military components.

> More Joint combat training based on deployment with Joint Services.

Survival Training

The topic of survival training spanned a much broader scope than simple attendance at the Air Force Survival School at Fairchild Air Force Base. Several respondents felt this should be a required course for all airmen regardless of Air Force specialty code. Others supported the current structure with more opportunities for those deploying to hostile areas to attend the survival school. In addition to formal survival training, several participants recommended all airmen be taught basic hand-to-hand combat skills (such as rifle fighting, knife fighting, and unarmed defense such as martial arts) as well as critical language training.

> Recognition techniques to tell the difference between friendly and hostile foreign nationals. Realistic survival/resistance training for everyone (not just aircrew).

> … survival training for multiple environments.

Relevant Material

Numerous participants in the study lamented that current weapons training is not relevant to potential deployed environments and locations. AT/FP training was said to be relevant for temporary duty assignments to places like Thailand, but not to hostile areas like Iraq. SABC was also thought to be inadequate for use in a hostile environment. Several respondents suggested a course similar to the Army's Combat Life Saver be incorporated into Air Force basic combat skills training.

> More hands-on training and in mock hostile environment ….

> … intensive courses in … air base defense tactics and small arms tactics would be highly beneficial in deployed environments.

Hands-on Training

Comments also focused on training delivery methods. Many simply said computer based training was not enough. Others noted that computer based training with hands-on experience would be better. Some respondents had never had any hands-on combat skills training in chemical warfare or weapons training. In addition, several respondents commented that Air Force personnel should *train like they fight* by implementing more realistic scenarios.

> … Apply the skills rather than just read them during computer-based training or talking about them in classroom/seminar.

> We need more hands-on weapons training and role playing in a combat environment that will involve war games with these situations with LOAC integrated in them to help prepare us.

Team Training

Respondents who discussed team training noted two primary issues. First, several participants recommended using teams to conduct weapons training. Learning how to move in teams while under fire was also mentioned. In addition, general training in teamwork, group dynamics, and small group leadership were also listed as possible candidates to be added to the basic combat skills list.

> Internal base defense, small team tactics, fire and maneuver, maneuver under fire, enhanced small-arms firing practice, threat recognition and reporting

> Real distance firing, squad/fire team based integrated fire exercises, basic urban

> [I] believe every airman and infantryman (like Marines/Army) need basic infantry skills, individual and team methods, basic air base defense.

Conclusions

The Air Force currently has no standard definition of what constitutes *basic combat skills*.[57] The most comprehensive guide to the Air Force combat skills program would have to be Air Force Manual (AFMAN) 10-100, *The Airman's Manual.*[58] Based on the responses to the open ended items of the survey, the *Airman's Manual* falls short of clearly defining the skills and knowledge one would need to have to effectively operate in a hostile environment. The *Airman's Manual* leaves out some of the skills and knowledge Air Force members consider important such as movement with weapons and small group leadership. Perhaps the Air Force should consider revising the manual to more closely align to the Army's *Soldier's Manual of Common Tasks.*[59] This regulation contains all basic combat skills required to be an Army soldier, regardless of military occupational specialty, and requires all soldiers be certified in each skill prior to graduation of basic training. In addition, detailed instructions of how to complete each task are provided.

Another concern with current Air Force combat skills training is the lack of a single organization responsible for training and guidance. The Air Force currently relies on numerous AFIs, headquarters directives, major command directives, base-level leadership, base and unit deployment manager interpretations, and to a great extent, locally developed training. To complicate matters further, the AFIs that define our basic combat skills come from four separate instruction series—security forces, personnel, operations, and civil engineering. Perhaps a single AFI listing all the basic combat skills could be drafted, and a single organization should be responsible for maintaining its currency. Since relevant training is the key, one recommendation is that Air Education and Training Command be responsible for analyzing, designing, developing, and implementing a unified combat skills training curriculum.

Central oversight of all training programs might lead to the use of the Instructional System Development (ISD) model which is set forth in AFMAN 36-2234, *Instructional System Development*[60] and used in most Air Force training programs. The ISD allows training programs (for example, Basic Communications Officer Training, Basic Logistics Readiness Officer Training, Basic Military Training) to follow a rigorous educational analysis, design, development, and implementation process. One key factor in this program is that recurring training evaluation is at the heart of the model and is a continuous process throughout each phase.

The driving question in this research, "Are Air Force airmen ready to survive in hostile or direct threat environments?" was asked by former Chief of Staff of the Air Force, General John J. Jumper.[61] Although 70 percent of respondents were neutral in their sense of perceived training transfer, it appears Air Force personnel in general are more comfortable with using chemical warfare skills than any other type of combat skill. In contrast, it appears Air Force personnel are least comfortable utilizing their primary duty weapons in a hostile environment.

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Air Force Logistics Readiness Officers: How to be Successful in a Joint Environment

Andrew Hunt, Major, USAF

From July 2007 to June 2008, I had the privilege of attending the United States Marine Corps Command and Staff College. For nearly a year, I studied the Marines' (and the other Services represented in my conference group) doctrine, history, and current tactics, techniques, and procedures. During that same year, I often found myself at the *pointed end* of some pretty good verbal jabs from my leatherneck friends. What became apparent to me was that the current fight does not lend itself to Air Force success stories. Instead of touting the efforts of our expeditionary combat support personnel, the Air Force has been forced to go on the defensive. The Secretary of Defense actively called-out the Air Force to do more in supporting the Global War on Terror (his comments were directed almost exclusively at the rated community). Where the Air Force has succeeded is in providing top-notch logistics support to our Joint comrades. Many sister Service members recognize the efforts of the Air Force logistics readiness community in the deployed environment. They see us on convoys, sitting in Joint operations centers, and often venturing outside the wire. Even though Air Force logisticians are viewed favorably in the Joint environment, there are certain steps logistics readiness officers (LROs) can take to ensure that they command the respect they deserve from their peers in the Army and Marine Corps. This short article addresses five keys to LRO success in a Joint environment.

First, be smart on Air Force Doctrine (and not just the 2-4 series). In the other Services (except for the Navy, where doctrine does not exist), doctrine is not a buzzword or a shiny new toy. Doctrine is a way of life. Marine Corps and Army officers know what their branch and their Service are supposed to do. In fact, most of those officers know what the other Services are supposed to do, too. Sometimes they know our doctrine better than we do. That's embarrassing.

It's going to take some time for the Air Force to embrace doctrine the way the Army and Marine Corps do, but it's got to happen. Doctrine has to be read, understood, and implemented by all airmen. Being knowledgeable about the Air Force's capabilities and core doctrine statements will go a long way to earning much needed credibility.

Article Acronyms

LRO – Logistics Readiness Officer
PT – Physical Training

The second key to success in a Joint environment is to possess a working knowledge of the tactics, techniques, and procedures, as well as the tables of equipment of the forces you are supporting. Understanding concepts of maneuver warfare, rates of advance, and rates of consumption by unit size will make any LRO a more valuable commodity. Logistics support of ground forces is, in my opinion, much more complex than supporting flying units from a fixed location. One of the best ways to get up to speed on this kind of information is to build and maintain a personal smartbook. There is a great deal of excellent information available through open sources; however, the best source of sister Service information will come from logistics professionals in that service. Make contacts and request briefings, slides, background papers, and anything that deals with combat support and combat service support. A slide show on the composition and airlifting of the Army's brigade combat team or a white paper on the Joint task force-port opening capability is out there if one knows where to look. The key is to keep the book up-to-date. As quickly as things change in today's world, last week's briefing may just be old news.

Third, don't feel like you have to apologize for how the Air Force does business. There are things you just can't do anything about. You can't control the length of our air expeditionary force deployments—don't be ashamed that you're only there 6 months when others are there for a year. That being said, be mindful of the sacrifices your comrades in the other Services are making. While 365-day taskings for LROs are on the rise, they have been the norm for the Army since this struggle kicked off. Be ready to correct perceptions that are flat-out wrong. Some folks think that the Air Force won't deploy anywhere there isn't a five-star hotel or a Starbucks. Show them the Joint manning document from the forward operating bases in the area of responsibility, highlighting where our airmen are. They might be surprised. This isn't to say a little self-deprecation isn't warranted now and again. Being able to poke fun at the Air Force will endear you to your Joint peers. Be ready, though, to stand up for what the Air Force brings to the fight. Remind folks that for the last 50 years, ground forces have enjoyed the luxury of not having to worry about aerial interdiction from enemy air forces.

You also can't do anything about how the Air Force viewed physical training (PT) in the past. Many of your Joint colleagues perceive the Air Force as being soft, a by-product of the much-

maligned (and probably rightly so) cycle-ergonometry test. Run with them, ruck march with them, and that perception will start to fade. PT is slowly—very slowly—becoming part of our culture. As with doctrine, the Army and Marines are way ahead of us. There's work to be done, but the Air Force is on the right path.

The fourth key to success is to demonstrate your expertise. The quickest way to lose credibility in a Joint environment is to show up unsure of how to do your job. That said, a learning curve is inherent. The challenge is to make that curve shallow and short in duration. Make contact with the LRO you're replacing and find out what kind of things you can do prior to deploying (such as getting a Global Transportation Network account). The quicker an LRO can insert him or herself into the fray and demonstrate competence, the better. Unfortunately, the LRO concept has made this key a difficult one to accomplish. Simply put, the depth of knowledge is different now than under the old 21S/T/G construct. Your Joint peers don't care. They expect you to know what you're doing 100 percent of the time. To them, you are the expert in your field.

The fifth and final key may seem superfluous, but it's not. LROs need to be well-read. In dealing with the officers from the other Services, you will find that they are, as a whole, very well-read and very articulate. This is a result of the importance that the Army and Marine Corps place on their reading lists and internal professional military education programs. It is a rarity to find a senior company grade officer or field grade officer in those branches that isn't versed on military history or current events. During my year at Quantico, I was blown away at the breadth of reading that my classmates had done. They actually read from their Commandant's reading list, and it pays dividends. Pick up a book by Thomas Barnett or Thomas Friedman, or fall back to a classic—*On War* by Clausewitz.

LROs have proven to be highly sought after individuals in today's Joint environment. We have demonstrated the ability to undertake various tasks and complete them in exemplary fashion. In fact, we've done so well, that we've become victims of our own success. Our 365-day taskings continue to increase while our personnel numbers stay the same or are reduced. Arguably, the LRO is the most visible and tangible link between the Air Force and the current fight against terrorism. Our Joint commitment will not diminish, nor will the expectations placed on us by our Joint colleagues. Take the steps necessary to show them that we deserve their respect and confidence.

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Bass Boats and a Man from Green Bay

Duane Anderson, USAF

Introduction

If you happen to drive onto Tinker Air Force Base on a summer Saturday morning, you will notice a strange phenomenon. On the south side of the flag pole, taking up two parking spots, are a large number of F150s, F250s, Dodge Rams, and Chevy Super Cabs, hitched to boats of all kinds, but mostly bass boats. Since I am a new Air Force civilian employee (having only worked a bare 10 years), I have been told by seasoned employees that there used to be many more boats in the parking lot on Saturdays, and that the bass boat population has especially declined.

Why all the boats? The answer is overtime. Often, overtime becomes more like base pay, simply part of the overall paycheck, subsumed by the family budget to cover groceries, clothes, shoes, and sports fees for the kids. It is also common for maintenance and other employees to work overtime to pay for leisure time amenities.

While this is good for the Bass Pro Shop, it may be another story for the Air Force. Civilian mechanics working overtime results in more expensive repair and throughput. Perhaps more important, overtime may lead to a loss of productivity and an increase in sometimes fatal safety incidents, for both civilians and our men and women in blue.

I have found that there is only a certain point to which an *outsider* can dig into the data concerning overtime—it is culturally sensitive at the depot. In quiet conversations I have learned that overtime is funded from a separate *bucket* than normal man-hours and is budgeted (at Tinker) at approximately 13 percent of total labor costs. This stovepipe creates many problems—one of which is for supervisors. Whether for fear of not using up all the bucket of money (and thus not being funded next year) or simple pressure from above to meet a production schedule, overtime may be scheduled somewhat loosely. "Why," the mechanic may ask himself, "should I bust my tail Monday through Friday, when, if I don't, I can make overtime on the weekend?" This is certainly not the norm, nor do I intend to express that mechanics themselves are trying to somehow *beat the system*. Rather, the system itself is set up to reinforce this sort of behavior.

The System Needs to Change

Unlike some civilians, I worked *on the outside* for a few years as a front desk supervisor and then later as an assistant general manager at a hotel. They were terrible jobs. In those days, managers were tied to pagers the way they are to Blackberries today. I can remember many a night when the pager would go off at 2 in the morning, and I knew I was headed to the hotel to fill out a police report, or to tell a group of drunken hoodlums that it was time to hit the road or pay the price. The general manager, my boss, was a meat-handed high school educated man who had once worked 10-hour shifts loading trucks in the dead of winter in Green Bay, Wisconsin. He was not a man with whom you wanted to argue. He had risen to his position by sheer force of will and hard, hard work. His suits were bought from Goodwill (which he bragged about), and somehow he never learned to tie a tie, so the end of it was always somewhere between his belly button and the middle of his chest.

I can remember my interview with him. I was dressed in my black conservative suit, complete with tie tack and cuff links. He wore a pair of dirty jeans and a T-shirt, because he had been helping the maintenance crew rip out carpet from some of the rooms. I'm not sure what questions he asked me, or how I answered, but one thing I will never forget is that, at the end of the interview (after he told me I had the job), his next sentence was "I don't ever want to see overtime on yours or anyone else's timesheet. Hire as many people as you like, but no overtime and we will meet our labor percentage each month."

Based upon this fairly severe direction from a 6 foot 4 inch, 320 pound boss, I set about creating a front office staff that was flexible and well trained. I hired full time employees, scheduled them at 40 hours, and made sure they went home when they reached their 40. I hired college kids to work 24 hours a week. I hired moms who could work from 5 to 9 or from 9 to 3, just as long as they could get their kids to school. I hired retired folks who would happily work 15 hours one week and 30 the next. I trained housekeepers to check in and check out guests and I trained front office clerks to flip a room. So, when someone quit or didn't show up, or we had an especially busy night, I could call up Joe, Michelle, or even Suzie from housekeeping, and still service the customer, without overtime.

This is the type of flexibility we need in the Air Force. This is the type of surge capacity we need.

Now, I am not proposing we go out and hire some college kids to fix airplanes. But, I am suggesting that if four mechanics work 50 hours per week, at $20 per normal hour and $30 per overtime hour, their combined gross pay is $4,400 dollars for 200 hours of work. If five mechanics work 40 hours per week at $20 per normal hour, the gross pay is $4,000—a cost avoidance of $400 per week (assuming all other costs are equal). If you apply this to 10,000 civilian mechanics, the *simple savings* is $250,000 per week, or a *roughly estimated* $13M per year (recognizing this is not completely linear).

Reliable and scalable studies have also shown that productivity decreases as the amount of overtime is increased, as illustrated in Table 1. The results of a very large study showed that efficiency was impaired as the work schedule exceeded 40 hours per week. The average efficiency for 50 hours, 60 hours, and 70 hours (per week) was 0.92, 0.84, and 0.78, respectively.[1]

The loss of productivity as overtime increases results in an even larger cost increase. In the simple example used earlier, the use of overtime results in 184 effective man-hours of productivity, at a cost of $4,400. With no overtime, the results are 200 effective man-hours at a cost of $4,000.

Expressed as a ratio of actual productivity baseline hours divided by gross pay, in the example where no overtime is worked, the simple cost per productive hour is $20. In the example where 50 hours are worked by each mechanic, the simple cost per productive hour rises to $23.91.

In fact, if productivity performance at 45 hours is 95 percent, you could not only decrease the number of mechanics, but also keep your total productive hours at the same level, as illustrated in Table 2, using 13 percent overtime in the calculations.

It is doubtful that my general manager figured his *no overtime* mantra using this sort of math. The idea is very intuitive. What he did know was that paying someone 9 bucks an hour versus 6 bucks an hour was bad business. The above projections yield weekly cost avoidance of approximately $2M a week and an annual cost avoidance of approximately $100M, per 10,000 mechanics in place now.

A second benefit to working less overtime is improving the general quality of life of Air Force employees. Employees in blue collar jobs who work more than 45 hours per work experience a 50 to 61 percent increase in safety incidents.[2] This leads to increased workers compensation, death benefits, disability payouts, more lost or light duty time, and in general, a more hazardous environment. I can't quantify this in cost savings or avoidance, but I have personal experience as a first-level supervisor of how quickly you can burn yourself out. You work 60 hours in a week and you are grumpy, your wife is grumpy, your kids are grumpy, and your home starts to feel like someplace you visit every now and again to mow the yard and *snarf* down a reheated dinner.

Beyond my personal experience, medical studies show that stress level increases in employees who consistently work more than 40 hours per week. This has many effects, including higher blood pressure leading to higher cardiovascular risk, increased mental illness needs, and lowering of employee morale.[3] Again, these savings are qualitative, but I believe self evident.

I have discussed this idea with a number of my colleagues, and even submitted (and resubmitted) it formally to the IDEA program, where it got turned down. The response has typically been, "Well, it makes sense, but it will never happen here." Or, "Yeah, but some senator or general will just shoot it out of the sky, the union will fight it, or it's just too big of a challenge."

Well, maybe they are right. Maybe it is too big of a challenge— too hard. But tell that to a man from Green Bay who used to load boxes onto a truck in subzero temperatures and is now a regional director of a small hotel chain pulling in $80K a year and a big fat bonus to boot. And, if you happen to see him, tell him the blazers I bought at the flea market look darn good after they get dry cleaned.

Number of Mechanics	Hours Worked per Mechanic	Gross Pay	Baseline Productivity	Actual Productivity Hours
4	50	$4,400	92%	184
5	40	$4,000	100%	200

Table 1.Productivity Decrease

Notes

1. H. Randolph Thomas, *Productivity Supporting Information: Effects of Scheduled Overtime on Labor*

Number of Mechanics	Normal Hours	Overtime 13%/Week	Total Hours Including Overtime	Total Gross Pay/Week	Productivity Baseline	Basic Pay per Hour	Overtime Pay per Hour	Total Productivity Hours
10,000	40	5.2	45.20	$9,560,000	0.95	$20	$30	380,000
9,500	40	0.0	40.00	$7,600,000	1.00	$20	$30	380,000

Table 2. Total Productive Hours Compared with Productivity Baseline

Productivity, University Park, PA: Pennsylvania State University, May 2006.
2. A. E. Dembe, J. B. Erickson and R. G. Delbos, and S. M. Banks, "The Impact of Overtime and Long Work Hours on occupational Injuries and Illnesses: New Evidence from the United States," *Occupational & Environmental Medicine*, 629, September 2005, 588-597.
3. *Ibid.*

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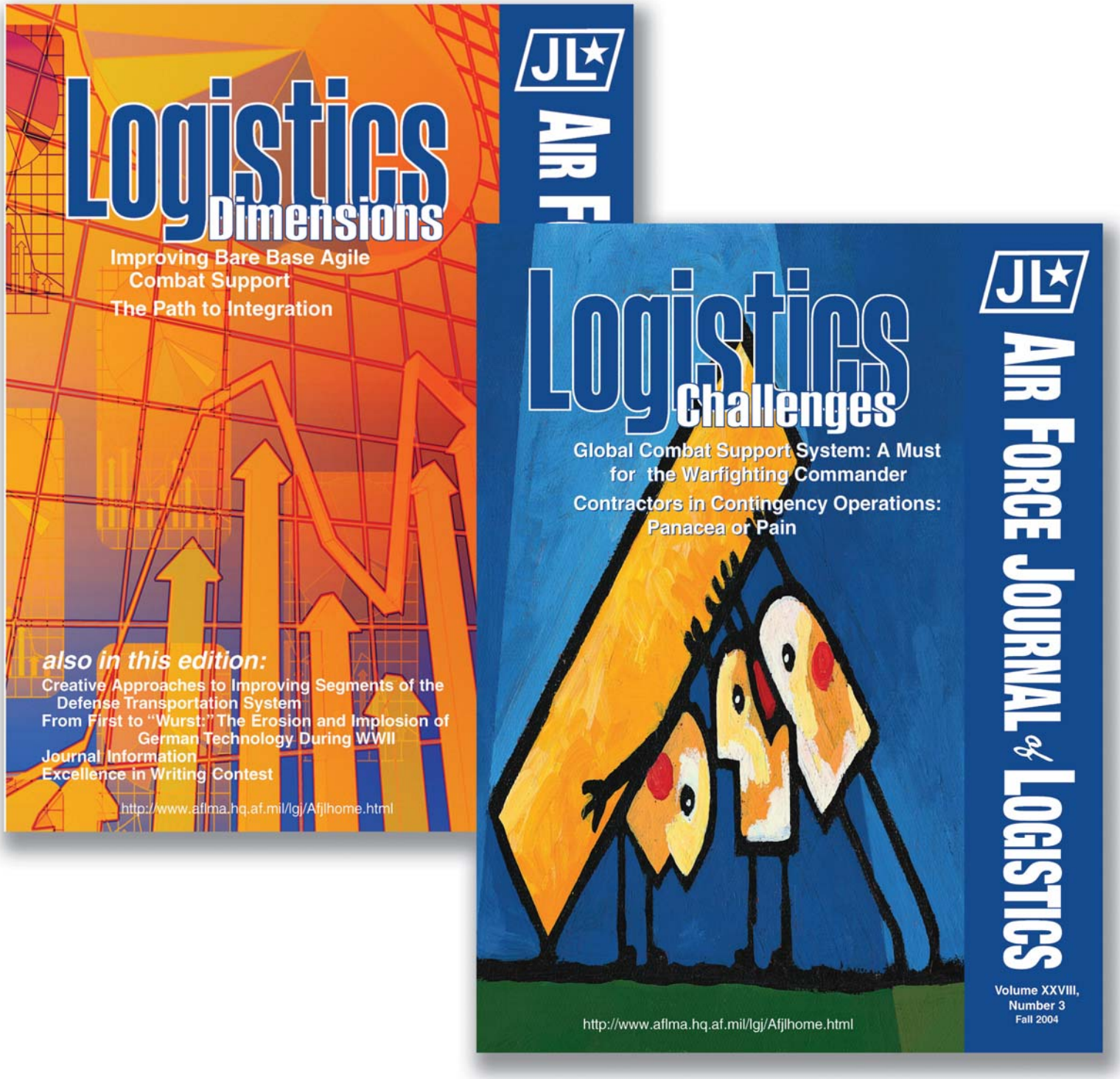

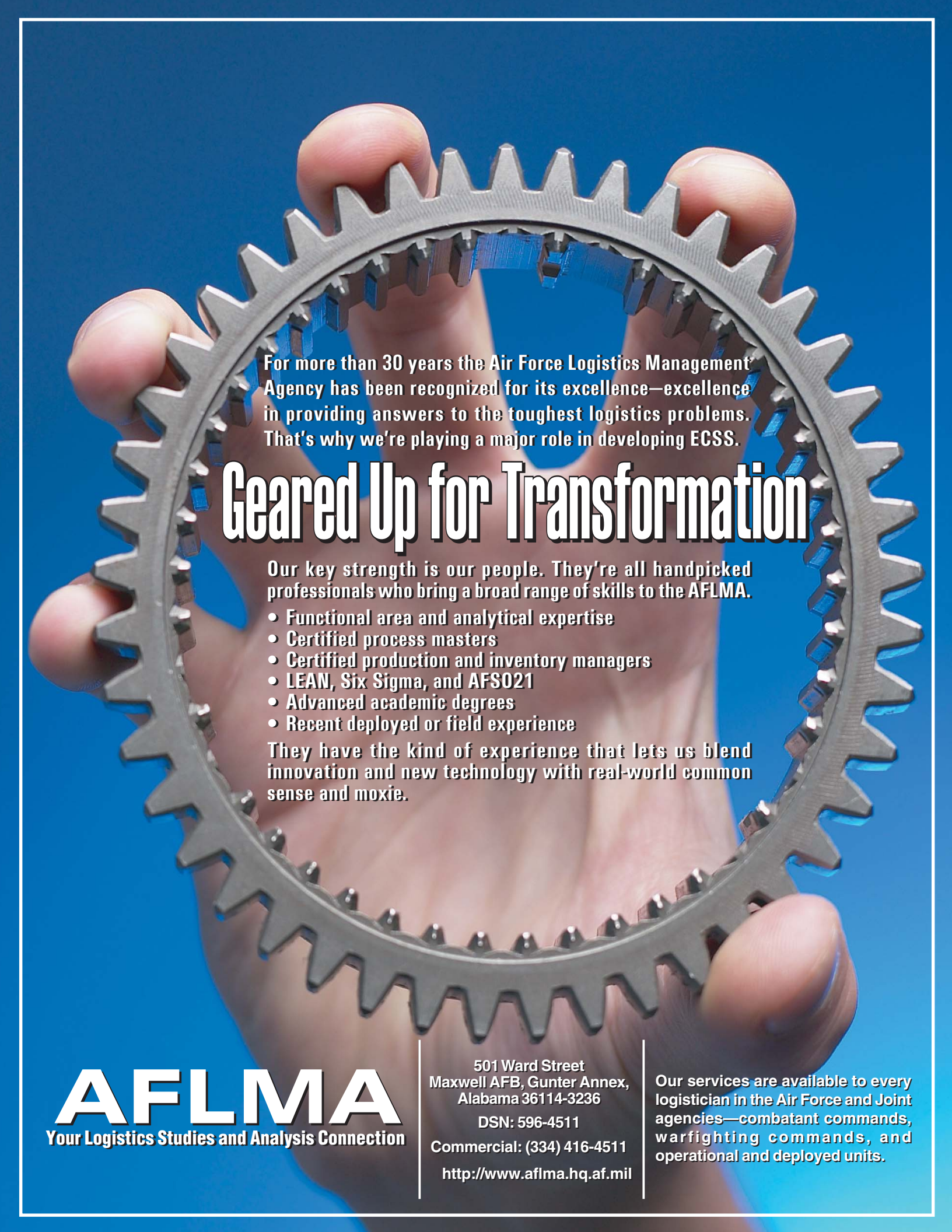

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