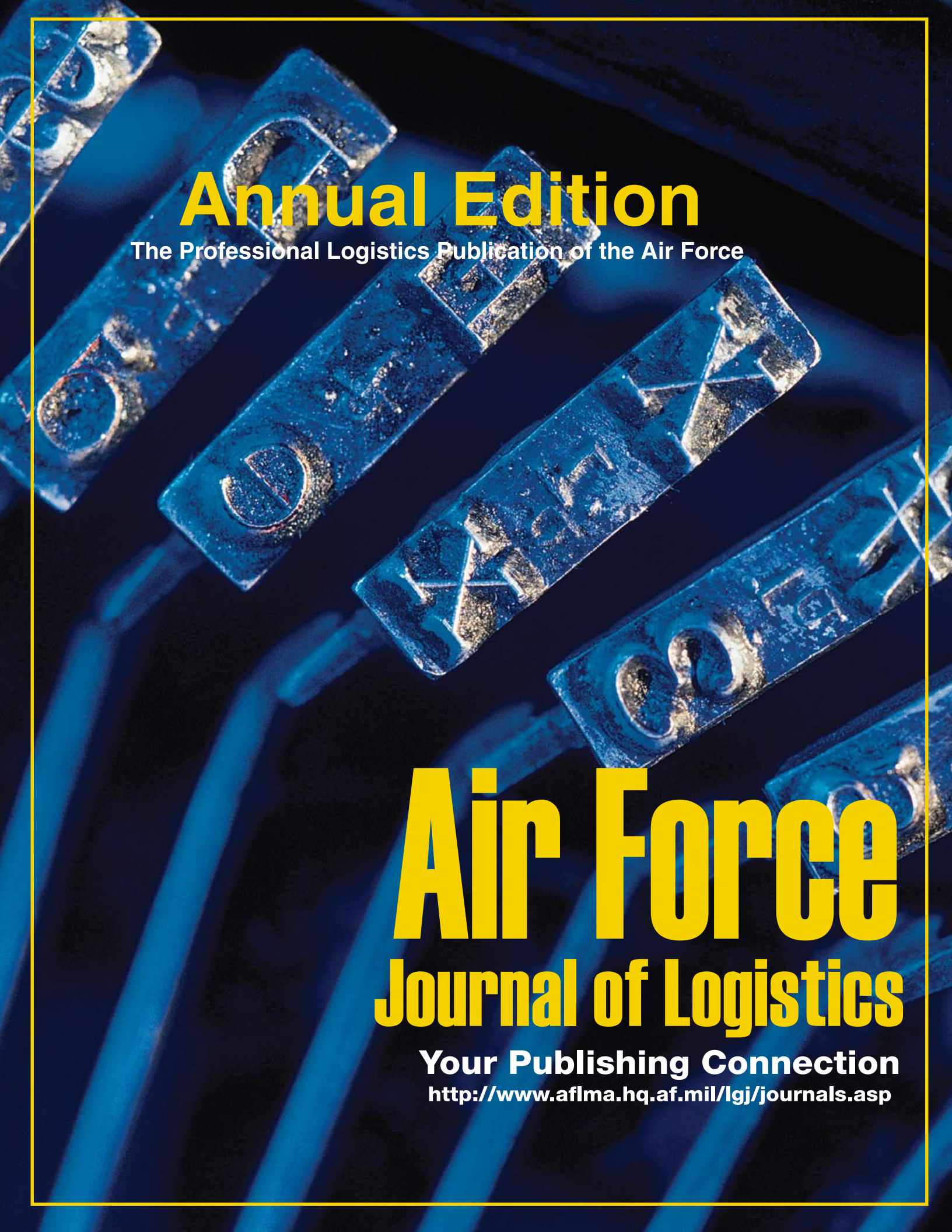

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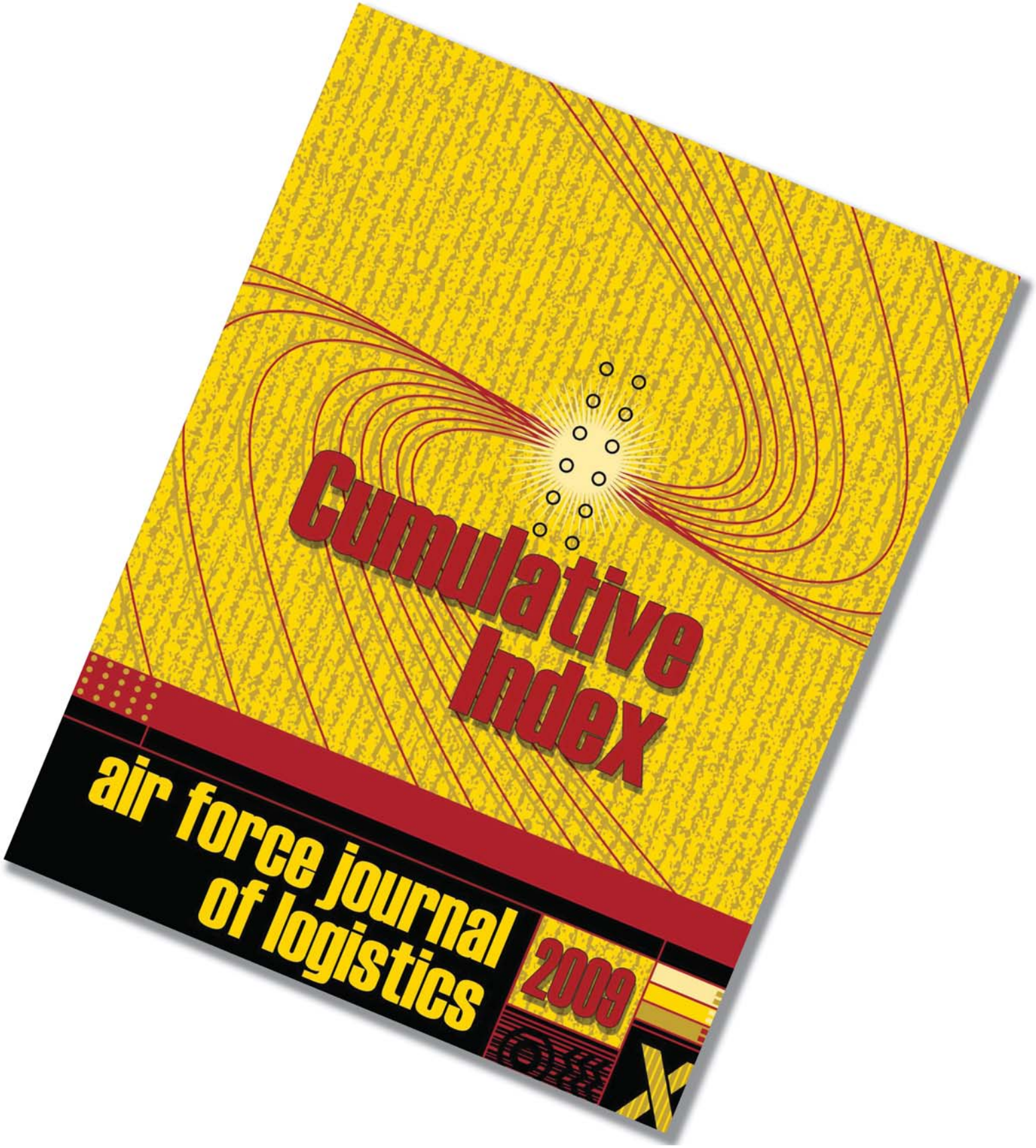

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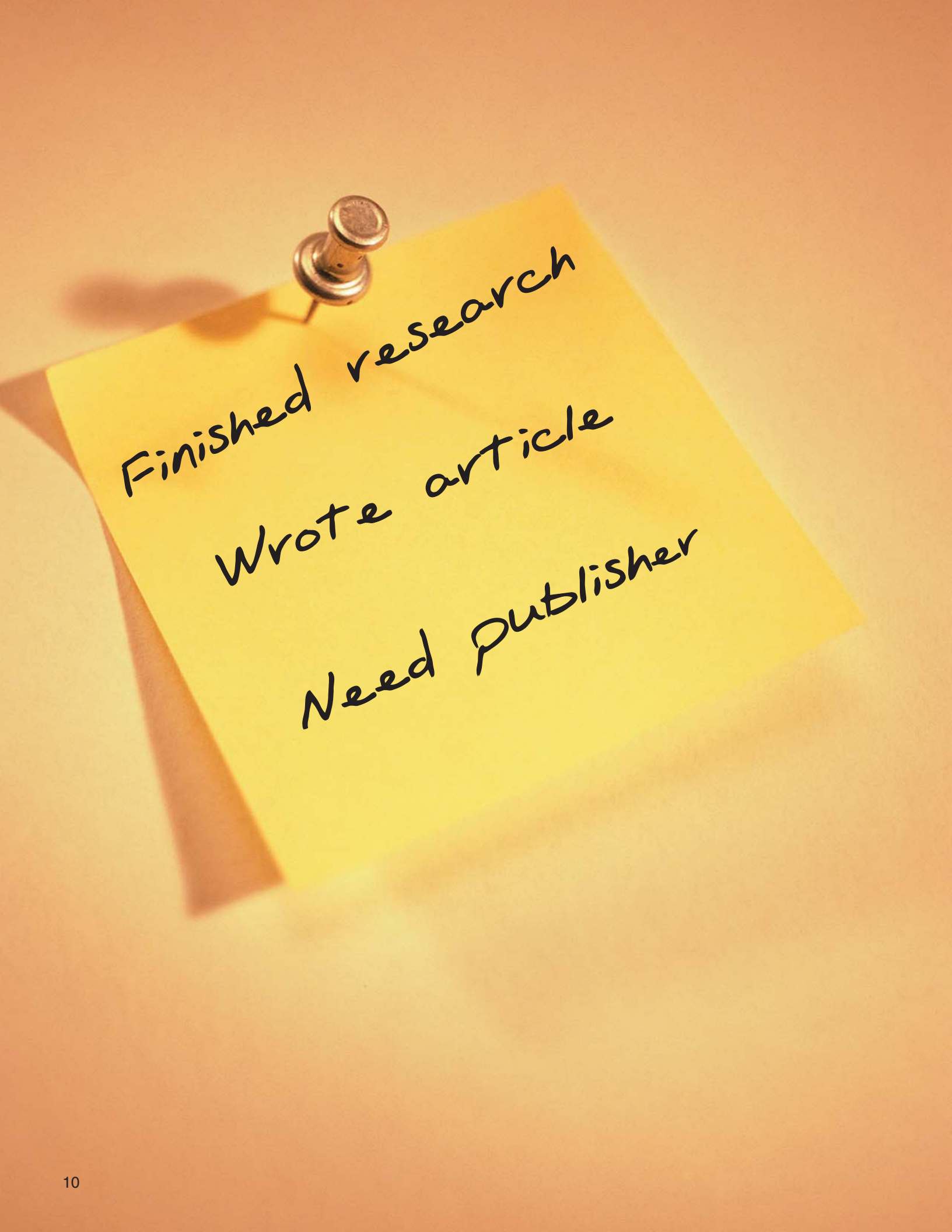
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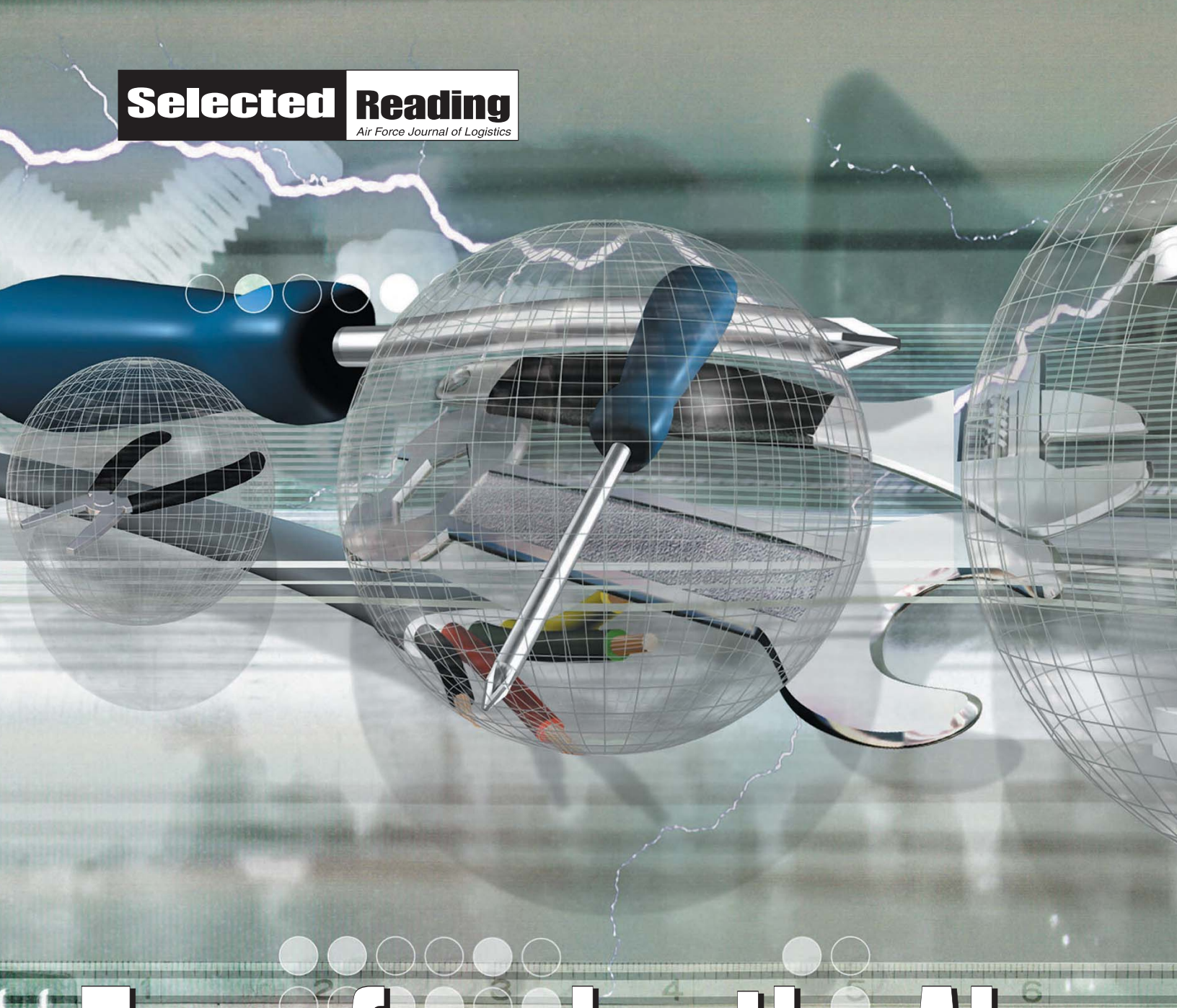


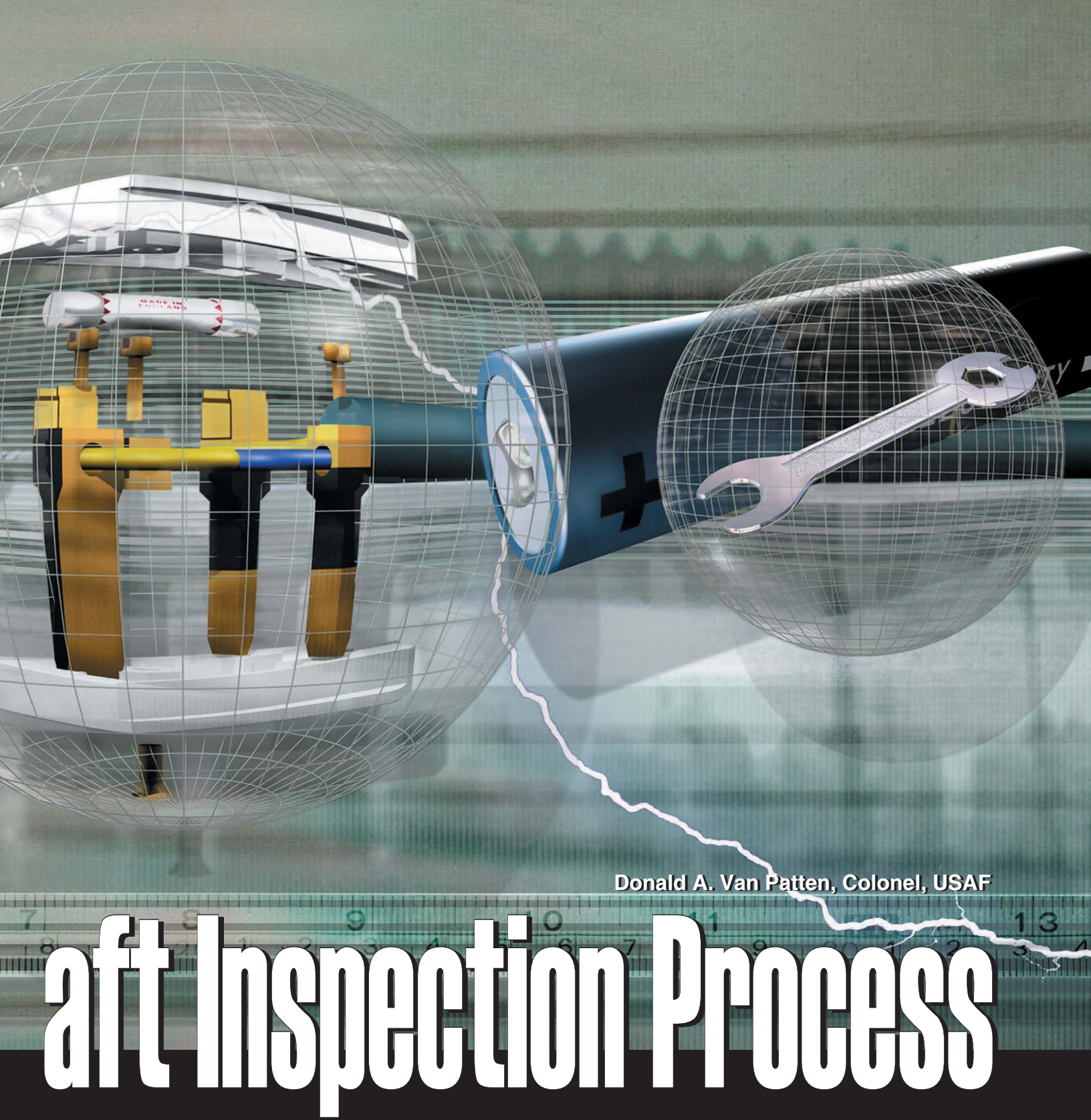
Transforming the Aircr

Introduction

To everything there is a season, a time for every purpose under heaven; … a time to break down, and a time to build up; … a time to keep, and a time to throw away; … a time to keep silence, and a time to speak; … a time of war, and a time of peace.[1]

—Ecclesiastes 3:1-8

The next 5 years promise to bring significant changes to the Air Force's current operating environment. This change is prompted by several budget initiatives to provide funds for vital programs that include recapitalizing the growing inventory of aging aircraft. Some of these initiatives target manpower billets in specific



Donald A. Van Patten, Colonel, USAF

aft Inspection Process

areas across the active, reserve, and National Guard forces with a projected goal of reducing full-time equivalent positions by approximately 40,000.[2] One initiative, released as Programmed Budget Decision (PBD) 716, directs the offsets to be fully executed by the end of fiscal year (FY) 2011 across most Air Force specialty codes (AFSCs) in order to minimize huge losses within a few areas. Within the past year, the period to complete the offsets has been accelerated to the end of FY09. PBD 716's impact on aircraft maintenance is to reduce aircraft inspection manpower by 402 billets—a significant decrease in maintenance capability.[3]

The Air Force's plan to reduce the inspection manpower focuses on regionalizing inspection centers for select aircraft types. Although the depot-level overhaul locations would remain unchanged, this plan would eliminate the base-level inspection docks by flying the aircraft to regional sites for their incremental hourly and periodic maintenance inspections.[4]

In addition to the manpower reductions, the Air Force has begun efforts to improve aircraft availability and decrease cost. Faced with decreasing budgets, Air Force leadership established goals to increase aircraft availability by 20 percent and reduce costs by 10 percent.[5] Known as the Aircraft Availability Improvement Program (AAIP), all levels of aircraft sustainment have been directed to develop efficiency initiatives to achieve the PBD goals.[6]

In order to achieve the projected PBD 716 manpower savings of $23.4M over the Future Year Defense Plan (FYDP), there appear to be three viable options. The first option would be to yield the manpower positions while retaining the phase and isochronal inspection docks at their current base-level locations.[7] A second option would be to fully comply with the PBD and regionalize select inspection activities. The last option would be to develop a hybrid alternative—sending aircraft to the regional facilities for heavy inspections, but performing the light checks or minor inspections at the base.

This article analyzes these three options against the goals to increase aircraft availability by 20 percent, while decreasing cost by 10 percent. Additionally, it examines a third impact of these options on a unit's ability to control its success or destiny with respect to mission requirements. As part of the analysis, this study also investigates the theory of reliability-centered maintenance and analyzes its applicability to the inspection options.

Impetus for Change

The Air Force cannot increase aircraft availability and decrease operating costs without revamping the current inspection process. The first of several reasons for change is that the average age of our aircraft today is almost a quarter of a century (23.5 years) and has grown steadily over the past 3 decades. In 1967, the entire fleet's average age was only 8.5 years.[8] This equates to a 176 percent increase in fleet age over the 40-year period. Although the Air Force has started receiving the F-22, the average age of the Air Force's main fighter fleet is still over 20 years. This fact is not insignificant. Because the fleet has become geriatric, it is now susceptible to the normal problems that begin to surface with older airframes. For example, wiring has become a top driver for the F-15C/D. The insulation on the Kapton wiring used widely throughout the fighter aircraft has become brittle and cracked, resulting in an increasing number of electrical shorts and fires. The KC-135 has experienced peeling with its internal fuel tank coatings, leading to contaminated fuel systems and filters.[9] These age-related problems will continue to drive additional aircraft inspections, which in turn, will increase the amount of time the aircraft will not be available for flying.

The second drive for change is increased downtime for the aircraft fleets due to the increased inspections and other maintenance-related aging factors. Over the past 15 years, the amount of aircraft downtime per flying hour has increased and is reflected in the Air Force's maintenance man-hour per flying hour (MMH/FH) ratio metric. For the entire Air Force fleet, this ratio increased 61 percent between FY91 and FY05 (see Figure 1).[10]

This is significant because the Air Force retired some of its oldest fleets of F-4 and F-111 aircraft during this same period without any major impact on the MMH/FH metric. For the aircraft maintenance community, this increase in workload, even with a newer total fleet, is monumental.

Additionally, the size of Air Force budgets has continued to slow at a disconcerting pace over the past several years. Based on current projected budget programs, the FY11 budget will be only 16 percent larger than the FY06 budget—a significant spending departure compared to the previous six-year period of FY01 to FY06, when the budget grew nearly 44 percent.[11] Due to decreasing budget dollars, the Air Force will be forced to stretch recapitalization plans for replacement aircraft and need to retain older aircraft longer than originally planned to provide the required combat capability.

A fourth impetus for change is the increase in operating costs. Given the volatility of fuel prices, personnel pay and benefit expenditures, and other operating factors that comprise the Air Force total ownership costs (AFTOC), this important sustainment factor promises to rise faster than planned for in the budget requests through FY11.[12] The cost to operate an average aircraft in FY96 was just over $3M. In FY05, the same cost reached nearly $5.5M, an 83 percent increase.[13] This makes the stated AAIP goals even more challenging to achieve.

The last reason for change is the track record of legislative involvement. During the last 4 fiscal years (FY03-FY06), Congress prevented the Air

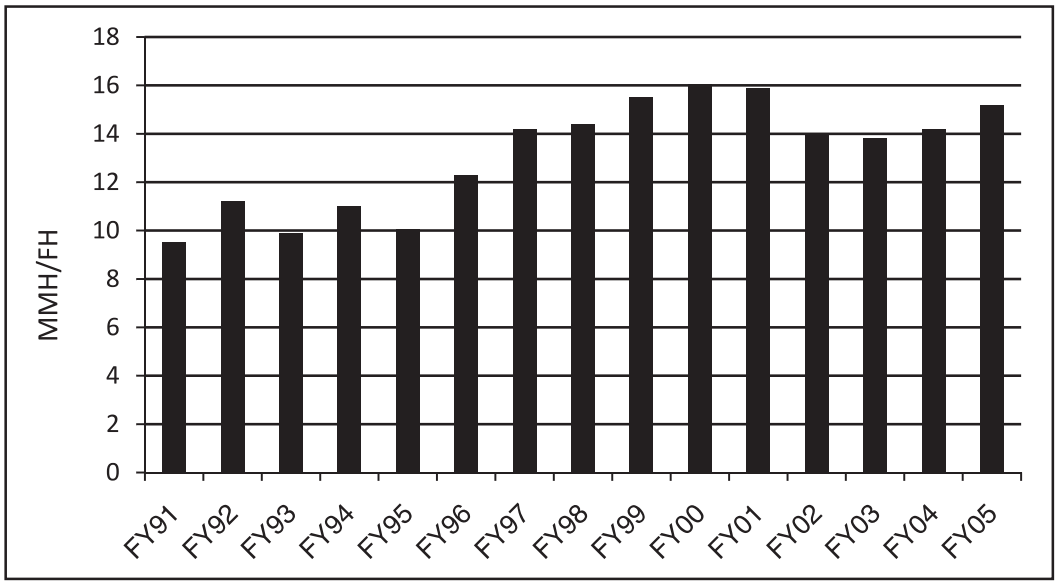


Figure 1. Total Air Force Maintenance Man-Hours per Flying Hour, FY91–FY05

Force from retiring aircraft deemed too costly to operate from the B-52, C-5, C-130E/H, F-117, and KC-135 fleets. As of October 2005, the number of aircraft congressionally restricted from retirement had grown to a total of 104, creating a burden on critical budget dollars.[14] This well intentioned legislation has forced the Air Force to divert shrinking funds from other vital programs to sustain these geriatric weapon systems.

Analysis Criteria and Inspection Types

The types of inspections discussed in this article are limited to the phase and isochronal inspections. The phase-type inspection is determined strictly by the number of operating or flying hours. If an inspection is due at 200 hour intervals, then the aircraft must be inspected at this point before it can be flown further. Aircraft that begin and end their sorties at the same location—such as fighter aircraft—normally operate on the hourly phase inspection concept. Isochronal inspections are based on a specified number of calendar days. Isochronal is a Greek word that means to occur in regular intervals of time.[15] The isochronal intervals are derived from an average number of flying hours that would be accumulated in the interval without degrading safety. The isochronal inspection concept is ideal for aircraft like tankers or airlifters that may fly multiple sorties away from home station. In conjunction with military representatives, the original equipment manufacturers (OEMs) determine the inspection type and intervals during the aircraft's initial operational test and evaluation stage. These types and intervals normally serve the aircraft with minimal change up to retirement.

To sufficiently analyze the data, two aircraft will be examined. Due to their significant numbers and the availability of research data, the phase-interval type F-15C/D fighter aircraft and the isochronal-interval type KC-135 tanker aircraft were selected for this study.

The three proposed options will be evaluated against three criteria: aircraft availability, maintenance operating costs, and unit control. Because having aircraft available for combat and training is a vital prerequisite to enable a unit to accomplish its wartime mission, the Air Force constantly evaluates the aircraft availability of its fleets to identify causes of negative trends. Aircraft availability measures the ratio of time a unit possessed aircraft is mission capable (MC) or mission-ready against the total time of possession by all organizations.[16] The formula used to calculate this rate is as follows:

Availability Rate = (MC Hours/Total Possessed Hours) x 100

An aircraft is considered in possession when it is under its assigned unit's control. For example, if the Air Force had a fleet of 100 aircraft, and in one day 20 aircraft were not MC and 10 aircraft were possessed by depot maintenance, the number of aircraft mission-ready or MC for this 24-hour period would be 70 percent. The calculation would be as shown below:

(70 MC unit possessed aircraft x 24 hours/100 unit and depot possessed aircraft x 24 hours) x 100

Of course, actual aircraft availability calculations are much more complex, as aircraft cycle through only a few of minutes or hours per day of not-mission-capable status before returning to MC status. As stated previously, the Air Force is striving to achieve a 20 percent improvement in availability across all its fleets of aircraft. A major way to impact availability rates would be to decrease the amount of time an aircraft is not mission capable and increase the amount of time an aircraft is unit-possessed and mission capable.

In light of PBD 716's emphasis on cost reduction, the second criterion analyzes the maintenance operating costs across the three options. As stated previously, the AFTOC data base captures the operating expenditures of unit-level consumption, intermediate maintenance, depot maintenance, contractor support, sustaining support, indirect support, and aircraft modifications from program element code (PEC) 3400 – Operations and Maintenance (O&M), and military and civilian pay from PEC 3500 – Pay and Allowances. The aircraft total operating cost is the total annual system costs of the two PECs divided by the total aircraft inventory (TAI).[17] The AFTOC costs most easily influenced at the unit, intermediate (regional), and depot levels are the maintenance and consumables expenditures. Minimizing these costs through a reanalysis of the OEM-developed phase and isochronal inspection construct would directly impact the inspection frequency and workforce size.

The last criterion for judging the effectiveness of the three options is the degree of control a unit retains over its phase and isochronal inspection program. Unit control has always been a foundational building block for maintaining a healthy fleet of aircraft. A flying organization plans and executes its flying hour program with respect to its home station and deployment requirements, exercise and evaluation cycles, contingency rotations, and other local factors, including weather. The integral factor to achieving a successful flying hour program is being able to control the flow and rate at which aircraft are inspected. The inspection process is the banking mechanism for building a savings account of flying hour capability. It is commonplace for a unit to surge its inspection program periodically to respond to an externally-driven mission requirement that necessitates phase or isochronal inspection flexibility in order to accomplish the mission. The Chief of Staff of the Air Force (CSAF) recognized the importance of conjoined authority and responsibility when searching for a replacement to the objective wing structure that divided maintenance authority and responsibility between two groups. Under organizational structures where the maintenance group commander exercises both authority and responsibility for fleet health, aircraft performance has flourished.[18] Separating the phase and isochronal inspection capability from the direct control of the unit, as called for under PBD 716, partitions the necessary authority and responsibility to maintain fleet health in high tempo environments, especially combat and contingency operations. The most recent guidance in Air Force Instruction (AFI) 21-101 states that "Aircraft should not normally deploy with phase or isochronal inspections or engine time changes due immediately upon AOR (area of responsibility) arrival."[19] A unit's direct authority over its aircraft inspection program equates to being able to determine its own destiny or success, especially in combat and contingency operations. Pulling the phase or isochronal capability away from the unit has the strong potential to severely limit its flexibility to match flying requirements with fleet health maintenance.

The MSG-3 Inspection Construct

In the 1960s, an airline industry task force known as the Maintenance Steering Group (MSG) developed a new inspection program, known as MSG-1 (the first report published by the MSG), that produced substantial savings for the Boeing 747 (B747) over the DC-8.[20] Table 1 reflects the savings of the MSG approaches over the traditional approach.[21] In 1970, the Air Transport Association (ATA) led the airline industry in developing a second report (MSG-2).[22] This revised program converted MSG-1 into an inspection logic applicable to aircraft other than the B747.[23]

Interestingly, the preponderance of Air Force aircraft developed during this period utilized the MSG-2 preventive inspection logic. Although these early MSG preventive inspection processes produced huge savings, they were bottom-up approaches that focused on the failures of the individual items versus the effect of failures on the entire system. In addition, these early MSG approaches did not factor in operating performance data as the aircraft matured nor did they establish intervals for the preventive tasks.[24]

To overcome the MSG-1 and MSG-2 shortcomings, the reliability-centered maintenance (RCM) methodology was developed by United Airlines for the Department of Defense (DoD) in 1978. The ATA incorporated this new preventive maintenance program into the revised MSG-3 decision logic published in 1980.[25] The heart of RCM is the failure mode, effects, and criticality analysis (FMECA) which targets components and structures from a top-down systems approach.[26] The effectiveness of RCM is achieved through an *iterative* application of the FMECA throughout the weapons life cycle.[27] Additionally, a predetermined level of system performance and acceptable degradation are established during the analysis, as shown in Figure 2.[28]

The importance of reaccomplishing the FMECA analysis at appropriate intervals cannot be overstated; the cost efficiencies are realized by analyzing performance data on a recurring or iterative basis. Although the terms MSG-3 and RCM are often used synonymously, RCM is the methodology to determine failures and preventive maintenance actions. MSG-3 is the governmental- and industry-sanctioned application of RCM by way of a strong, integrated network of Federal Aviation Administration (FAA), airline operators, and original equipment manufacturer members. The MSG-3 construct allows the operator to adapt and change the inspection program to its particular operating requirements once reviewed and approved by the FAA.[29] The preference to use the MSG-3 term in this article is intentional; MSG-3 connotes responsiveness and receptiveness to change. This is evident in the seven revisions made to MSG-3 from 1987 to 2005 to improve safety and preventive maintenance activities.[30]

Type of Preventive Maintenance	Traditional Approach	MSG-1 & MSG-2 Approach
Structural inspections for 20K flying hours	4M man-hours for DC-8	66K man-hours for B747
Overhaul	339 items for DC-8	7 items for DC-10
Turbine engine overhaul	Scheduled	On-condition (cut DC-8 shop maintenance costs 50 percent)
*Traditional approach to maintenance held that the more frequently equipment was inspected and overhauled, the better it was protected against failure, thus resulting in numerous tasks.		

Table 1. MSG-1 and MSG-2 Savings

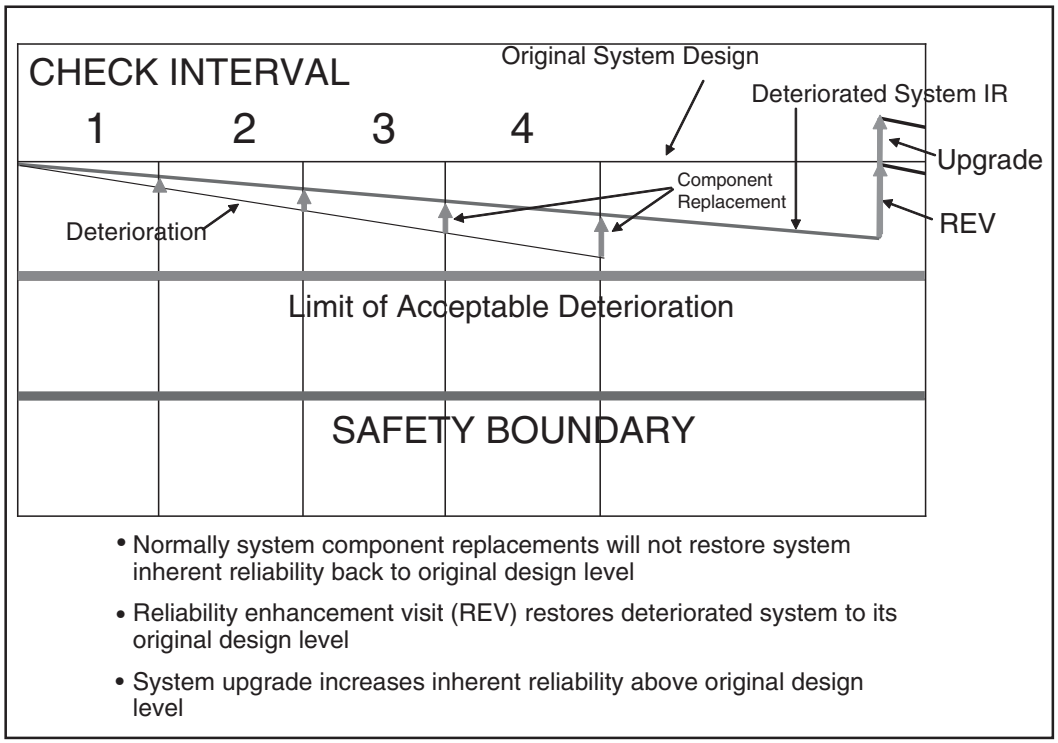


Figure 2. Predetermined Levels of System

Unfortunately, when the Secretary of Defense initiated sweeping reforms to the defense acquisition process in 1994, he also rescinded DoD's mandate to use RCM as well as the numerous Military Standards (MIL-STDs) that provided the methodology to accomplish the analysis. In its place, he mandated the services to rely on industry standards and best practices.[31] This action essentially orphaned legacy equipment, whose extended life cycles need the iterative engineering and operating analysis provided by RCM and the MIL-STDs. This statement is not intended to marginalize efforts by the weapon systems' engineers to improve the inspection continuum. However, constrained resources within Air Force Materiel Command (AFMC) have limited improvements to merely administrative-type changes to the OEM's initial inspection framework.[32]

Consequently, the Air Force's older legacy aircraft now operate on an infantile preventive maintenance inspection concept primarily

developed by the OEMs without having had the benefit of an MSG-3 end-to-end reevaluation of previous decades' systems and structural performance history.

Analysis of Three Options

We must fundamentally change the culture of our Air Force so that all airmen understand their individual roles in improving their daily processes and eliminating things that don't add value to the mission.

—Secretary of the Air Force and Chief of Staff of the Air Force, 7 November 2005

To provide a meaningful analysis of the three options, it is important to examine these alternatives against actual aircraft that are potential candidates for the PBD 716 initiatives. The notional candidate fleets considered for regionalized inspections are the A-10, F-15, F-16, F-22, B-1, B-52, C-130, and KC-135 aircraft.[33] The analysis will be conducted using one aircraft from each inspection construct, the F-15C/D for phase inspections, and the KC-135 for the isochronal construct.

The F-15 inspection construct combines a series of light and medium hourly post flight (HPO) inspections and a major periodic inspection (PE) in a series of 200 flying-hour intervals. For a complete phase inspection cycle, the F-15 undergoes five HPOs and one PE to produce a total of 1,200 flying hours.[34] A complete cycle from the first HPO-1 to the PE entails 3,500 steps, 584 work cards, and 1,001 man-hours.[35] The average time the F-15 fleet was not mission capable (NMC) or not available for flying due to scheduled maintenance (phase inspections) per year during FY97 to FY06 was 2,169,296 hours out of 41,281,421 unit possessed hours, or 5.25 percent.[36] This equates to an average NMC time for phase inspections of 450.1 hours per aircraft per year. Additionally, during the same 10-year period, the availability rate averaged 67.0 percent and the total operating costs from the AFTOC data base averaged $3.676M per aircraft.[37]

The KC-135 uses an isochronal or calendar-based inspection cycle that is accomplished in 360 calendar days. The HPOs occur at day 30, 120, 180, 240 and 300.[38] Additionally, critical corrosion inspections occur at day 180 and 300, along with a mid-PE inspection at 600 flying hours and a major PE during the 300-day inspection.[39] Although the work cards do not provide a standardized timeframe to complete the steps, the average number of HPO and PE work cards and steps per year total 197 and 1,638 respectively. The average time the KC-135 fleet was NMC for scheduled isochronal maintenance during FY97 to FY06 was 2,878,133 hours out of 3,821,265 unit possessed hours, or 75.32 percent.[40] Although this number seems unbelievable, and has been triple checked against the Multi-Echelon Resource and Logistics Information Network (MERLIN) database source, one possible reason for such a high scheduled maintenance rate may be due to the fact that the Air National Guard (ANG) possesses 196 airframes or nearly 40 percent of the total KC-135 fleet.[41] Since the ANG typically works only one shift per day, the doubled time to complete an inspection would contribute to the high scheduled maintenance rate when compared to the unit's time of possession. The average NMC time for isochronal inspections totaled 543.0 hours per aircraft per year during FY97–FY06 and produced an availability rate of 59.9 percent.[42] Additionally, the total operating costs from the AFTOC database averaged $4.184M per aircraft.[43]

Option 1 - Stay the Course

The first option is to continue accomplishing phase and isochronal inspections under the current organizational construct but with a reduction of 402 personnel, as called for in PBD 716. However, instead of the aircraft having its inspection performed at a regional facility, this option calls for completing the inspections at the possessing base. Evenly distributing the 402 manning losses across the Air Force's 73 active duty inspection docks in operation after the projected Base Realignment and Closure-2005 adjustments equates to a loss of 5.5, or 6 whole personnel per dock. As a result, the average F-15 phase dock would drop from 30 personnel to 24 and the average KC-135 isochronal dock from 35 to 29. This loss of manpower equates to an annual loss per inspection dock of 12,096 man-hours (6 personnel x 8 hours per day x 252 O&M work days per year). While it is difficult to measure the exact decrease in aircraft availability that would result under this option, a loss of 6 inspection personnel per F-15 dock would most likely extend the inspection of each aircraft by 1.5 days for HPO-1s, 2 days for HPO-2s, and 2.5 days for PEs. In a 1-year period, a single F-15 unit with 27 assigned aircraft would fall behind the current inspection production rate by 66 days, totaling 1,584 hours of aircraft nonavailability.[44] For the KC-135, the results would be similar. An annual inspection cycle with 35 personnel requires 40 days. Reducing the inspection dock down to 29 personnel would increase the time to complete the annual cycle to 48 days, causing a 12-aircraft unit to fall 96 days behind per year and lose 2,304 hours of aircraft availability. As is evident, this option would negatively impact aircraft availability due to the unit requiring more days to complete phase or isochronal inspections with less manpower. Consequently, the increase in aircraft nonavailability would drive a proportional decrease in possible sorties as well.

Operating costs would obviously decrease with this option due to the PBD-driven reduction in manpower. As the PBD 716 document states, this reduction would provide an annual savings of $58,209 per person, or $23.4M for all 402 technicians.[45] At the unit level, the loss of 6 technicians would equate to a cost reduction of $349,254, thereby positively impacting the cost criterion. However, all other costs would remain the same.

Unit control for this option, the greatest strength of the current inspection approach, remains unchanged. Although the unit will experience a lower aircraft availability rate, it will possess its assigned aircraft the same amount of days as compared to operations before PBD 716. Therefore, this option is judged as having a positive impact on this criterion.

Option 2 - Fully Employ PBD 716 Initiatives: Regionalize Inspections

Fully implementing PBD 716's initiatives, as notionally determined by the Air Staff, would require units within eight aircraft types—A-10, F-15, F-16, F-22, B-1, B-52, C-130, and KC-135—to accomplish all of their phase or isochronal inspections at regional inspection facilities while reducing the work force by 402 personnel. The concept calls for 10 regional stateside

inspection facilities for the Combat Air Forces and four such facilities for the Mobility Air Forces, as shown in Figures 3 and 4.[46]

For overseas-assigned fleets, bases with similar fleets in the same geographical areas would combine their inspections at a single regional inspection site.

Aircraft availability stands to achieve significant increases under this option. One of the improvements in this plan is to standardize the work cards that direct the inspection activities. Currently, almost all aircraft technical order work cards are organized according to the AFSC-tasked inspection and aircraft zone, but not according to the most efficient flow of the inspection. This has led owning organizations to develop their own inspection flow sequencing based on their own requirements and preferences. This lack of standardization across the entire aircraft fleet causes lost time when inspection personnel are rotated among other bases and must learn the new unit's sequencing. Secondly, the locally-developed procedures are not updated promptly, if at all, to incorporate changes due to systems or structural improvements which represents lost efficiencies. Transitioning to a few regional inspection facilities affords the opportunity to conduct an Air Force Smart Operations 21 (AFSO21) study to mitigate these inefficiencies. AFSO21 is the Air Force's model to harness industry process efficiencies to improve operational support and eliminate nonvalue-added work using efficiency tools such as Lean, Six-Sigma, and Theory of Constraints.[47] These improvements would sequence the inspection activities for maximum efficiency and standardize the inspections across the entire fleet. Additionally, a robust training program would be developed to ensure maintenance inspectors fully understood their role in the flow sequencing and the rationale behind it. Early estimates proposed that each aircraft fleet's inspection flow time could be reduced by nearly 50 percent by incorporating these efficiencies.[48] Such reductions would enable the F-15 fleet to decrease scheduled maintenance downtime from a 10-year inspection average of 19 days to 12 days per year.[49] This could potentially add 7 additional days of availability per aircraft per year and up to 14 sorties annually. A similar improvement in isochronal inspections with the KC-135 fleet would decrease scheduled inspection downtime from a 10-year average of 23 days to 14 days per year, leading to 9 additional days of availability and potentially 18 sorties per year.[50] For contingency operations, four additional deployable docks, two at each stateside regional site, would provide the capability to perform inspections at deployed sites. Aircraft availability under this second option would improve significantly. The rationale for such a prediction is based on the process efficiencies of restructuring the inspection flow for each aircraft.

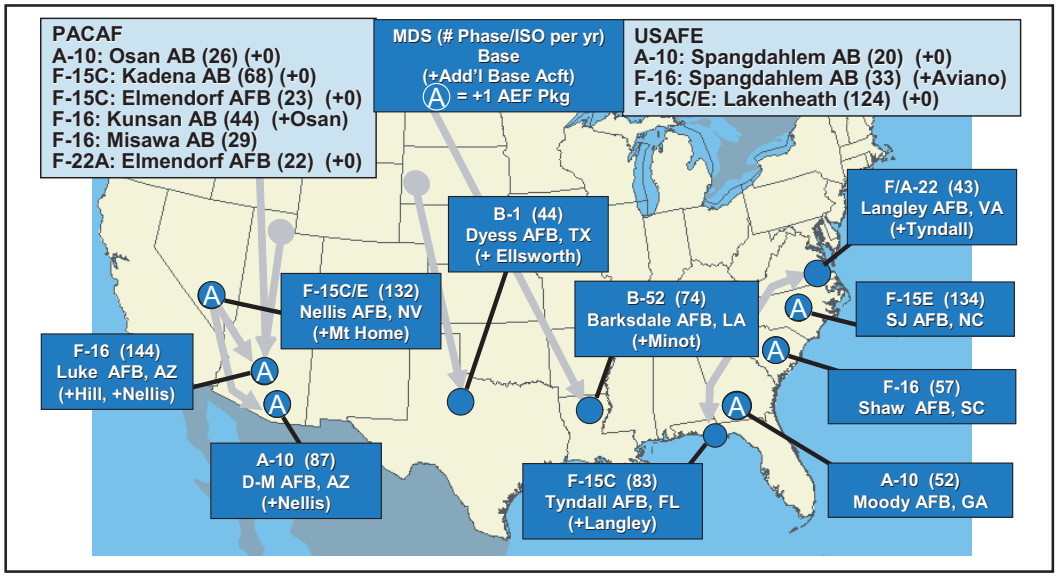


Figure 3. Option 2 Regional Inspection Concept—Combat Air Forces

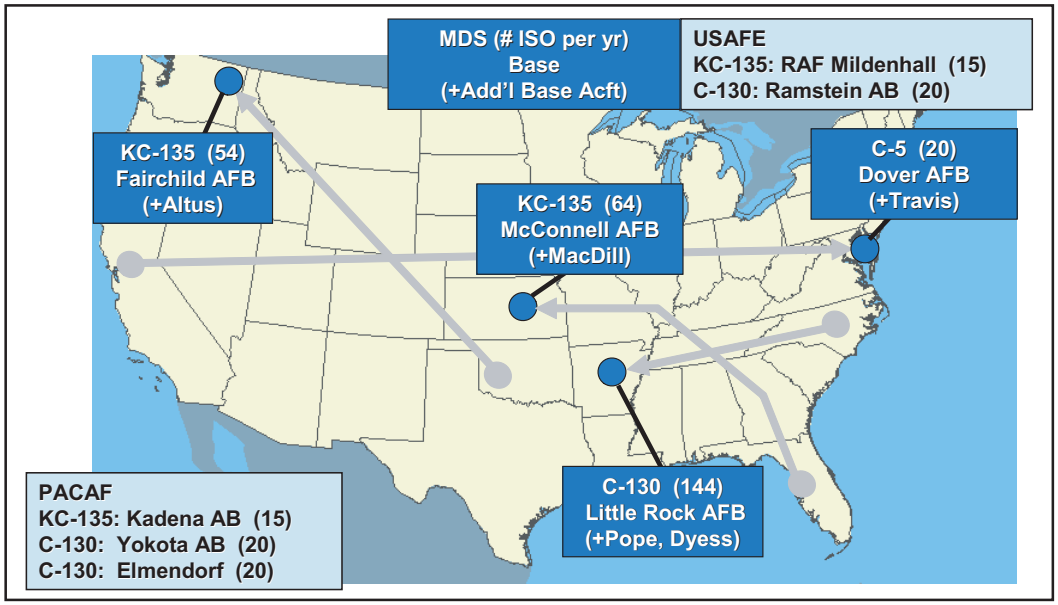


Figure 4. Option 2 Regional Inspection Concept—Mobility Air Forces

Costs for this option would be similar to those of the first option—reduced primarily due to the loss of 402 personnel, providing a savings of $23.4M. However, these savings would be offset by onetime costs, as shown in Table 2.[51] Expenses to relocate the remaining 1,020 of 1,555 inspection personnel to their respective regional inspection centers, as well as fuel and travel costs incurred in ferrying the aircraft to and from the regional inspection facilities, would offset the

savings. Achieving maximum benefits through an AFSO21 review would require assistance by experienced consultants. A projected $300K cost to implement the new concept at each of the 27 stateside and overseas regional sites would total approximately $8M; a cost well worth decreasing inspection flows by half.[52] An additional cost of $130K to relocate special equipment, hardware, and other assets per fleet would add $1.04M.[53] Despite these costs, a total projected annual savings of nearly $12M would accrue, excluding personnel relocation and aircraft ferry costs.

Inspection Dock Calculations		
	Before	**After***
A-10, F-15, F-16, F-22	50	29
B-1, B-52	7	4
KC-135	6	4
C-130	10	7
Total	73	44
* Based on 50 percent inspection flow reduction; does not take credit for BRAC		
Inspection Personnel Calculations		
Post-BRAC/Pre-Regional Personnel: 2,033		**After**
A-10, F-15, F-16, F-22	(30/dock x 29 docks) _ (30/dock x 6 AEF docks)	1,050
B-1, B-52	30/dock x 4 docks	120
KC-135		140
C-130		245
Total		1,555

Cost Calculations (in $M)							
1st FY = AFSO21 training/contractor and reorganization per MDS site = $0.30M **2nd FY = Regionalization/relocate assets per MDS = $0.13M**							
Aircraft	**Sites**	**FY07**	**FY08**	**FY09**	**FY10**	**FY11**	**Total**
F-16	5	$1.50	$0.13				$1.63
C-130	4	$1.20	$0.13				$1.33
A-10	4		$1.20	$0.13			$1.33
KC-135	4		$1.20	$0.13			$1.33
C-5 **	4			$0.30	$0.13		$0.43
F-15C/E	6			$1.80	$0.13		$1.93
B-52	1			$0.30	$0.13		$0.43
B-1	1				$0.30	$0.13	$0.43
F-22	2				$0.60	$0.13	$0.73
Total		$2.70	$2.66	$2.66	$1.29	$0.26	$9.57

Table 2. Option 2 Notional Implementation Costs

Unit control under this option would be the factor most significantly decreased. Current inspection operations allow the unit to determine their phase or isochronal production rate to meet internal and external flying requirements. This flexibility provides a critical buffer to balance mission requirements with maintenance capacity. Internally, a unit will increase or decrease the number of inspections based on the flying hour program, sometimes phasing multiple aircraft simultaneously to yield short periods without any aircraft undergoing inspection. This approach has been a critical unit tool to support periods needed to upgrade pilots to four-ship aircraft flight lead prior to deployments or exercises. Additionally, units often preload their inspections to fly sortie surges. For example, an F-15C fighter squadron recently set a world record for the number of sorties during a 3-day surge—a feat not likely under a regional inspection concept.[54] In addition, external real-world mission requirements, such as short-notice contingency operations and deployments, would also be difficult to execute without being able to change inspection priorities or production rates. Prior to an air and space expeditionary force (AEF) rotation overseas, fighter units will typically increase or even surge their inspection production rate to amass enough inspections hours so that the unit doesn't need to accomplish any inspections immediately upon arriving in-theater. This surge enables the unit to have sufficient spare aircraft available with adequate remaining inspection hours.

Weather would also potentially impact the flow of aircraft inspections through a regional facility. Flying units normally attempt to maximize aircraft availability during the good months of summer flying—counterproductive to establishing a smooth fleet flow and maximizing capacity under the regional inspection dock concept. Consequently, during months of poor flying weather, the regional facilities would not have enough capacity to inspect the required number of aircraft. The regional inspection construct would require a highly responsive scheduling function in order to provide the same degree of flexibility. Finally, with inspection docks located miles away rather than just off the flight line, opportunities to cannibalize critical parts to generate sorties would be lost.

This option would improve the flow days through an efficiency study, standardized inspection technical orders, efficiently sequenced actions, and a highly skilled and trained work force. These positives would be offset by the other factors that would restrict flexibility at the unit level. The unit's ability to prepare for AEF commitments, sortie surges, and weather-driven issues, as well as respond to no-notice contingency operations, periods of low aircraft availability, time compliance technical orders (TCTO), other preventive maintenance, and pilot-training requirements would be more limited and only serve to defeat mission accomplishment. In a perfect world, this alternative would be an optimal solution; however, equipment, weather, and human requirements demand more flexibility not inherent in this option.

Option 3 - Hybrid Solution

Whereas the first and second options are merely administrative changes (improvements within an existing construct), the third

option changes the model by employing RCM and MSG-3 concepts to their maximum extent. First, the entire inspection continuum requires a top-to-bottom reevaluation using the analysis developed under MSG-3. Drawing on the operational systems performance data already being collected, engineers could reevaluate the FMECA for each type of aircraft and realign the inspections into intervals based on the new failure projections, establishing preventive tasks as required based on the analysis. The MSG-3 construct facilitates shifting the most time-consuming, major structural inspections to the heavy PE inspections later in the phase or isochronal cycle, which allows the light-to-medium HPO inspections to concentrate on systems reliability.[55] These minor inspections can be packaged into 6-hour segments and completed during nonflying periods of the day or week at the aircraft's assigned base. Therefore, aircraft would only need to be flown to the regional inspection facility for PEs requiring more rigorous repairs or refurbishment not possible at the home station.

By employing MSG-3 on their Boeing 737 (B737) fleet of 447 aircraft, Southwest Airlines has been able to sustain over 3,050 flights daily with 435 of their aircraft. This equates to 97.3 percent of their fleet dedicated to the daily flying schedule. Southwest Airlines accomplishes all of their light and medium inspections overnight at airports and their heavy inspections at one of three regional locations. Using the MSG-3 model, Southwest Airlines anticipates each B737's 30-year life span will only require 82 days of downtime for scheduled inspections, resulting in a 99.97 percent aircraft availability rate throughout the aircraft's life span.[56] Annually, this downtime averages 2.73 days, or 0.7 percent, per aircraft.

Analyzing this hybrid option against the aircraft availability criterion would produce the greatest benefits by far. While no US military examples of a total conversion to an MSG-3 approach exist, AFMC has begun an MSG-3 conversion study for the C-5 fleet. The realignment of newly developed inspection tasks lengthened the 105-day, 420-day, and 840-day isochronal inspections to 120, 480, and 1460 days, respectively.[57] The net effect is to increase C-5 fleet aircraft availability by 5 aircraft per year, a 4.5 percent increase in aircraft availability.[58]

Applying the MSG-3 construct to the F-15 inspection continuum would allow the preponderance of structural inspections to be accomplished during PE checks. Consequently, HPOs could be limited to systems inspections and packaged into smaller segments that could be accomplished across several days during nonflying periods. For example, currently an F-15 averages 450 hours per year undergoing scheduled phase inspections.[59] The complete F-15 phase cycle takes approximately 5 years to complete, averaging 94 days of scheduled downtime per aircraft during that period. Because PEs require 10 days out of this entire cycle, the ability to be able to accomplish all HPOs on the ramp would add 84 days of aircraft availability over 5 years, or nearly 17 days per year for each F-15. The total extra days of availability across the fleet of 482 aircraft would be the equivalent of gaining 17 additional F-15s per year and equates to a 4.6 percent increase in aircraft availability.[60] For FY06, the availability rate of 68.7 would have increased to 73.3 percent, surpassing the Air Force goal of 68.5 percent.[61] While it is unrealistic to assume that the aircraft would remain mission capable during the HPOs, estimating a 25 percent nonmission capable time during the inspections would still yield an additional 17 aircraft per year and a 3.5 percent increase in availability.

The KC-135 fleet would likewise benefit from an MSG-3 analysis and inspection approach. Over a 10-year period, each KC-135 was unavailable for an average of 23 days a year due to scheduled isochronal inspections.[62] The KC-135 is required to complete an entire isochronal cycle of six inspections within 12 months.[63] Assuming that five of the six light and medium HPOs consume 13 days and the sixth heavy PE accounts for 10 days, the MSG-3 reevaluation would repackage inspection tasks into 6-hour segments. This would allow the light and medium HPOs to be conducted at the base, while the heavy PEs would occur at a regional inspection facility. Consequently, each KC-135 could be available 13 additional days per year, increasing the fleet availability rate by 3.5 percent. The total extra days of availability across the fleet of 530 aircraft would be the equivalent of gaining nearly 19 additional KC-135s per year, equating to an increase in availability from 61.4 to 64.9 percent for FY06, surpassing the Air Force goal of 61.4 percent.[64] Assuming a similar 25 percent nonmission capability during the minor inspections would still yield 14 additional aircraft and a 2.9 percent availability rate increase.

Of course, this hybrid option is not without significant costs. Conducting the MSG-3 analysis requires a substantial investment in time, resources, and personnel. However, one aviation maintenance expert predicts "conversion to an MSG-3 based maintenance schedule will provide significant and tangible returns [with] as much as a 30 percent reduction in scheduled maintenance costs."[65] For the C-5 fleet, AFMC has invested approximately $7M to date to standardize historical performance data and conduct a complete FMECA evaluation of all the aircraft's systems.[66] This effort began in 2002 with a staff that included engineers, analysts, systems technicians, maintenance overhaul representatives, OEM representatives, flight crews, and quality assurance personnel.[67] Their strategic intent was to reduce costs and increase aircraft availability by increasing inspection intervals without compromising safety.[68] These goals have yielded a cost avoidance of 32 percent for the C-5As and 5 percent for the C-5B fleet through the interval changes.[69] Although the finalized cost data has not been fully tabulated, the cost avoidances are in the multimillion dollar range due to the inspection interval changes.[70]

Applying a similar percentage based on the C-5's financial gains against the two test case aircraft would most likely yield similar investment costs and cost avoidances due to the MSG-3 efforts. If a modest 10 percent cost avoidance factor were applied to the F-15 unit-level consumable costs, the annual savings could amount to $9.46M per year (10 percent of the average costs during FY97-FY06).[71] However, an estimated cost to conduct the MSG-3 study for the F-15 fleet could total as much as $10M. Amortizing the $10M cost of the MSG-3 study across the entire fleet of 482 aircraft would amount to a onetime investment of $20,750 per aircraft. The net savings across the FYDP of 5 years would include the $10M MSG-3 study cost and the $47.3M cost avoidance in unit-level consumables, yielding a net FYDP savings of $37.3M.

If the same modest 10 percent cost avoidance factor were applied to the KC-135 unit-level consumable costs, the annual savings could reach $8.28M (10 percent of the average costs

during FY97–FY06).[72] As with the F-15, accounting for the $10M investment to conduct the MSG-3 study across the fleet of 530 KC-135s would produce a cost per aircraft of $18,870. The net savings across the FYDP would include the $10M MSG-3 study cost and the $41.4M cost avoidance in unit-level consumables, yielding a net FYDP savings of $31.4M.

Moreover, this hybrid option would accrue the $23.4M savings projected from the reduction of 402 personnel due to the PBD 716 manpower cuts. However, rather than moving all remaining 1,555 inspection personnel to regional facilities, only a percentage would be required at the central inspection sites, due to the MSG-3's lengthened intervals for heavy inspections. Therefore, a greater percentage of inspection personnel could remain within their unit to assist with the onsite light and medium inspections. Furthermore, the inspection personnel would be assigned to the sortie generating squadron so that they could form the inspection cadre to accomplish the light and medium checks, train other flight line personnel in these duties, and contribute to sortie generation activities during slack inspection periods. Because of the realignment of inspection tasks and lengthened intervals, fewer aircraft would flow through the regional inspection facilities. Assuming that the heavy PE inspections would account for one-sixth of all current base-level inspections, as is the case with the F-15 and KC-135, then just one-sixth of unit inspection personnel would need to be assigned to the regional facility. Even if 20 percent of the 1,555 inspection personnel were required to perform the heavy PEs, only 311 personnel would need to be relocated to the regional sites—a substantial cost savings compared to Option 2's requirement to move all 1,555.

Finally, unlike under Options 1 and 2, the hybrid alternative maximizes unit control of assigned aircraft. This option enables the unit to conduct its light and medium inspections at the base using the MSG-3 approach. Being able to break inspections into small, 6-hour blocks enables a unit to more readily control the inspection flow to better meet unforecasted requirements, taskings, and AEF deployment demands. Furthermore, the unit still retains the inspection personnel who can deploy with them to the AEF location to ensure that inspections are accomplished during the deployment. These benefits are simply not available under the regionalized concept of Option 2.

Summary and Implementation Considerations

This chapter has examined three options for allowing the Air Force to perform phase and isochronal inspections with 402 fewer personnel. Option 1 retains the current inspection concept of performing the inspections at the base but with 402 fewer personnel. Unfortunately, with less manpower to complete inspection tasks under the current construct, inspection time would increase, causing aircraft availability to decrease. Option 2 sends all aircraft to a regional inspection facility. As compared to Option 1, this option would improve aircraft availability but would require implementation expenditures and significantly degrade a unit's flexibility to accomplish mission requirements and thereby control the health of its fleet.

Option 3 provides a hybrid solution that significantly improves both aircraft availability and unit control. This option requires approximately $10M per aircraft fleet, or $80M across the Air Force's eight aircraft types, to conduct the failure analysis and to determine the inspection task packaging for the MSG-3 approach. The initial investment is minimal when compared to the gains. When analyzed against the F-15 and KC-135 fleets, the MSG-3 approach offers the equivalent of gaining 31 additional aircraft per year from both fleets. This option packages the minor inspections into 6-hour segments that can be accomplished overnight or between sorties by personnel assigned to the sortie generating unit who can continue the inspection rhythm at home station or deployed to a combat environment. Consequently, the unit to which the aircraft are assigned retains both responsibility and authority for the health of their fleet. Pride of ownership, as General Wilbur Creech demonstrated with the dedicated crew chief program during his tenure as commander of Tactical Air Command, is not inconsequential for maintaining and improving aircraft readiness levels. Additionally, Option 3's plan to fly the aircraft to a regional inspection facility for the heavy, structure-focused inspections leverages the regional experience and industrial-type test and repair equipment not found at the base level.

Most importantly, by fully supporting the most significant Army restructuring in the last 50 years, Option 3 offers significant benefits for Joint operations. In keeping with their emphasis on expeditionary, brigade-sized organizations, the Army is eliminating 36 heavy field artillery units, 10 air defense units, and 19 armor units to build military police, civil affairs, psychological, and biological detection units.[73] As a result, the Army will fully rely on the Air Force and the other Services to provide their artillery fire support through improved precision attack munitions. Option 3's opportunities for increased aircraft availability and unit control establish the foundation for the Air Force to better shoulder this Joint fire support responsibility and increase its relevance in the Joint arena. Even though the savings for Option 2 are greater in the short term, Option 3 provides hundreds more airframes across the entire fleet every year; a long term increase in aircraft availability that more than justifies the initial additional investment. In today's environment of Joint interdependency and constrained aircraft recapitalization, the low-risk, high-yield dividends demand serious consideration of Option 3. Table 3 summarizes the key aircraft availability, cost, and unit control data for the F-15 and KC-135 test cases.

To implement a vigorous MSG-3 reevaluation across the eight or more weapon systems candidates, several actions need to be taken. At the Air Staff level, policy and sufficient funding must be established for conducting the MSG-3 review and analyses. The process needs to be formalized, with standardized guidance for mandatory participants [Headquarters United States Air Force, major commands (MAJCOM), system program offices (SPO), and others] regarding responsibilities, time lines, and funding requirements. A decision and approval process for initiating and conducting subsequent iterative MSG-3 reevaluations needs to be established. The lead MAJCOMs for the candidate aircraft need to partner with the SPOs to standardize the inspections flow for the most efficient sequence, devise user-friendly, industry-standard type work cards to improve technician efficiency, and fund AFSO21 consultants to outline the most efficient way ahead. Additionally, the commands must develop acceptable levels of system degradation and formalize them in a revised minimum essential systems list (MESL) to balance mission requirements against sustainment costs. Along with these changes, the new

COMPARISON OF THE THREE OPTIONS						
	Option 1 Stay the Course		Option 2 Regionalize Inspections		Option 3 Hybrid MSG-3 Solution	
	F-15	KC-135	F-15	KC-135	F-15	KC-135
Aircraft Availability (AA)	Decreases 1,177 days* (Equiv of 4 less F-15s/yr; -0.7% AA)	Decreases 4,240 days* (Equiv of 12 less KC-135s/yr; -2.2% AA)	Increases 3,374 days* (Equiv of 9 more F-15s/yr; +1.9% AA)	Increases 4,770 days* (Equiv of 13 more KC-135s/yr; +2.7% AA)	Increases 6,146 days** (Equiv of 17 more F-15s/yr; +3.5% AA)	Increases 5,167 days** (Equiv of 14 more KC-135s/yr +2.9% AA)
			Additional Investment of:		Additional Savings of:	
Operating Cost	No additional savings above $23.4M FYDP Manpower Savings for all Air Force Fleets		$1.93M in FYDP	$1.33 M in FYDP	$37.3M*** In FYDP; $9.46M/FY Thereafter	$31.4M*** In FYDP; $8.28M/FY Thereafter
Unit Control	Retain in Status Quo Approach		Significantly Decreased in Regionalization Approach		Retained in MSG-3 Approach h	
*** Increases/decreases are calculated across the entire fleet of 482 F-15 and 530 KC-135 aircraft. ** Accounts for assumed 25% nonmission capable status during light and medium inspections. *** FYDP savings deducts the one-time $10M investment for the MSG-3 study; annual savings; thereafter would be based on 5-year savings of $47.3M (F-15) and $41.4M (KC-135).**						

Table 3. Comparison of the Three Inspection Options

inspection process must be gradually phased in, allowing pilot units to test and refine the new system before employing it across the fleet. Finally, units need to set up training programs for their inspection personnel and employ AFSO21 consultants to assist in transitioning to the new MSG-3 inspection construct. These recommendations would create the type of responsive and predictive inspection environment that would produce improved aircraft availability and reliability with decreased operating costs.

Conclusion

As the author of the Bible verse in Ecclesiastes observed, there is a time for everything, including change. The budgetary decreases across the next several FYDPs mandate that the Air Force reexamine all of its current processes. Driven by the manpower cuts dictated in PBD 716 and 720, the time for changing aircraft inspections is now. Increasing aircraft availability while decreasing operating costs without sacrificing combat capability requires more than mere administrative changes to the Air Force's current phase and isochronal inspection processes.

Compelling reasons exist to radically change the current inspection process. The Air Force's inventory of aircraft has become more geriatric than ever before, leading to increased downtime due to inspections and age-related maintenance factors. Consequently, operating costs for these mature aircraft fleets have soared 83 percent over the last decade.[74]

Because of the projected budget shortfalls, aircraft recapitalization programs will be severely constrained and will take 20 years or longer to fully replace their predecessors. As a result, older aircraft will be forced to continue in service to cover the combat capability gaps until the replacement aircraft achieve full strength. Additionally, the cost of replacement weapon systems has become so great that Congress has enacted legislation to prevent the Air Force from retiring aircraft, forcing older aircraft to be flown and be maintained for longer periods to maximize their return on investment.

Overlaid on these factors is the fact that the Air Force has been engaged in combat operations since 1991 and will likely continue to be for the foreseeable future. The combination of high operations tempo, an aging total fleet, and continual personnel reductions makes it imperative for the Air Force to apply AFSO21 concepts to the aircraft inspection process. The threat of terrorism and asymmetric warfare has forced the Air Force to be continually ready to deploy and fight. The Army's transformation and increasingly joint nature of military operations make it imperative for the Air Force to achieve and sustain the highest levels of aircraft availability possible. With the PBD-driven manpower reductions, the Air Force cannot continue to carry out the current manpower-intensive inspection requirements and still sustain today's levels of combat capability. The MSG-3 approach offers the Air Force an opportunity to fully exploit AFSO21 efficiencies to produce combat-ready aircraft with increased availability, reduced cost, and improved unit control through an iterative and responsive inspection construct. Transforming the aircraft inspection process is one approach to produce the efficiencies required to better defend the United States and her allies in the global war against terrorism.

Notes

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3. Department of Defense, *Program Budget Decision (PBD) 716: Directed Offsets - Air Force*, Washington, DC: Office of the Under Secretary of Defense [Comptroller], 20 December 2005, 9.
4. Aircraft initially proposed by Headquarters USAF/A4MY in Fall 2005 as potential candidates for regionalized inspections were the active duty A-10, F-15, F-16, F-22, B-1, B-52, C-130, and KC-135 fleets.
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6. Col John Stankowski, Chief, Weapons System Division, HQ USAF/A4MY, Briefing, subject: eLog21 - AAIP, 1 December 2006, slides 3-25. The AAIP was formed in April 2005 to improve depot overhaul efficiency and parts processes for 20 aircraft fleets.
7. Department of Defense, *Program Budget Decision 716: Directed Offsets - Air Force*, 2.
8. Lt Gen Steve Wood, Director of Requirements, Headquarters USAF/A8, Subject: Blue Horizons, Briefing, 3 August 2006, Slide 22.
9. Headquarters USAF/A4MY, subject: What are the Effects of Aging?, 2 February 2006, slide 1.
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14. Maj Gen Frank Faykes, Deputy Assistant Secretary for Budget (Financial Management and Comptroller), Headquarters SAF/FMB, subject: FY07 USAF Posture & Acquisition Hearing (HAC-D) briefing, 8 March 2006, slide 10.
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20. Dave Nakata, "Why Transition to a MSG-3 Based Maintenance Schedule?," EmpowerMX White Paper, [Online] Available: http://www.empowermx.com/whitepapers/MSG3.pdf, accessed 12 December 2006.
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32. Discussion with Col Steve Schumacher, Chief, Weapons System Division, Headquarters USAF/A4MY, Pentagon, DC, 7 April 2006.
33. Colonel Schumacher, "Enterprise View of Aircraft Inspections," briefing, slides 36-37.
34. The complete cycle for an F-15 phase inspection requires an HPO-1, HPO-2, HPO-1, HPO-2, HPO-1, and PE to produce 1,200 phase hours. The HPO-1 contains 494 steps in 77 separate work cards, totaling 120 man-hours. The HPO-2 includes the HPO-1 inspection items and comprises 673 steps in 114 work cards and nearly 201 man-hours to complete. The PE includes both HPOs, has 705 steps in 125 work cards, and requires 239.4 man-hours to complete.
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The 14 days of scheduled maintenance downtime includes 2 days required to deliver the aircraft to and from the regional site.
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Colonel Donald A. Van Patten *is a career aircraft maintenance officer. At the time of writing of this article he was a student at the Air War College, Maxwell AFB, Alabama. His maintenance assignments have taken him to bases in Air Education and Training Command, Air Combat Command, and United States Air Forces in Europe, sustaining F-16A/B/C/D, F-15C/D, EF/F-111E and A-10 aircraft, and other joint and NATO aircraft while assigned to Operations PROVIDE COMFORT and NORTHERN WATCH. He commanded the 33^{d} Logistics Support Squadron and 33^{d} Maintenance Squadron at Eglin AFB, FL, followed by a tour in the Pentagon as Chief of Base Maintenance Policy and Chief of Tanker Aircraft Sustainment in the Chief of Staff Deputate for Installations and Logistics, Headquarters, United States Air Force. Colonel Van Patten holds a bachelor of arts degree from Iowa State University, a master of science degree from Golden Gate University, a master of arts degree from the Air Command and Staff College, Air University, and a master of arts degree from Air War College, Air University. He is currently the Deputy Commander, 57th Maintenance Group, Nellis AFB, Nevada.*

For Want of a Spanner

A curious minor logistical mystery of Royal Air Force History in World War II was the shortage of hand tools. This lasted well into 1943, four years after the war began and nine years after rearmament started in 1934.

Before wartime expansion, fitters and riggers did their initial course at No. 1 Technical Training School at Habton. They specialized either as engine fitters or as airframe riggers. Upon completion of the course, they were sent to squadrons where in seven years their education was completed.

At the squadron they reported to A, B, or C Flight where they were issued a toolkit. If they were transferred from one flight to another, they had to turn in their toolbox and have the contents accounted for before proceeding across the street to draw another set from their new flight. In biplane days, a fitter or a rigger assigned to a two seater not only acted as the gunner, but in colonial theaters lashed his toolbox to the wing next to the fuselage in case of a forced landing.

What makes the case of the missing hand tools so intriguing is that the historical documentation concerning the ordering of such necessary items has disappeared (meaning it has either been destroyed or it has been filed with the papers of a successor organization of unlikely title).

The first clue to the problem came from the Operational Record Book (ORB) of a repair and salvage unit (RSU) in the Middle East in 1940 which opened by noting that of the RSU's 62 personnel, only 25 had tools. So they were happy to pass on salvaged aircraft to whoever claimed them.

What this meant was that in a theater then desperate for serviceable aircraft, many were standing idle because the necessary repairs could not be made *for want of a spanner*, let alone the necessary spares.

But the matter is important because in 1943 in Burma (South-East Asia Command or SEAC), the Beaufighters of No. 26 Squadron only sortied once every 18 days due to lack of tools and spares.

The fact that the RAF had insisted on standardized nuts, bolts and other fittings meant that special tools were not needed. Unserviceability was due to the unavailability of regular tools.

Robin Higham, PhD

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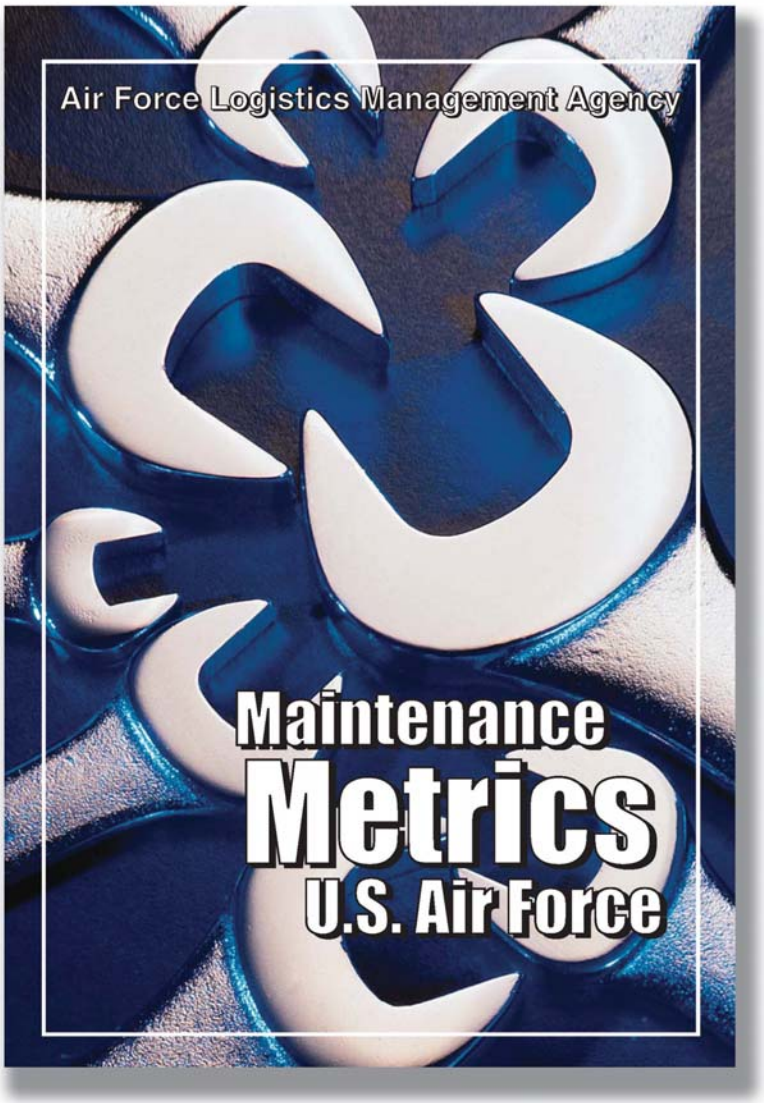

Aircraft maintenance metrics are important. Don't let anyone tell you differently! They are critical tools to be used by maintenance managers to gauge an organization's effectiveness and efficiency. In fact, they are roadmaps that let you determine where you've been, where you're going, and how (or if) you're going to get there. Use of metrics allows you to turn off your organizational autopilot and actually guide your unit. But they must be used correctly to be effective.

This handbook is an encyclopedia of metrics and includes an overview to metrics, a brief description of things to consider when analyzing fleet statistics, an explanation of data that can be used to perform analysis, a detailed description of each metric, a formula to calculate the metric, and an explanation of the metric's importance and relationship to other metrics. The handbook also identifies which metrics are leading indicators (predictive) and which are lagging indicators (historical). It is also a guide for data investigation.

AFLMA

Generating Transformational Solutions Today; Shaping the Logistics Enterprise of the Future

Introduction

One's first step in wisdom is to question everything—and one's last is to come to terms with everything.

—Georg C. Lichtenberg

Special Feature

After personally experiencing four organizational structures impacting flight line maintenance and only 5 years following a major Air Force reorganization, many Air Force personnel found themselves contemplating another potential realignment in 2008. Again, this realignment placed the reorganization of flight line aircraft maintenance, otherwise known as the aircraft maintenance unit (AMU), as a central consideration. Similar to previous considerations, this issue raised an emotional and controversial debate throughout the Air Force. Many sought wisdom and comfort from senior officers. In a number of instances, the only wisdom or comfort offered in public forums was the understanding that the Chief of Staff of the Air Force (CSAF) held the responsibility for training, equipping, and organizing the Air Force to best serve the interest of the United States (US).

Naturally the salute smartly advice offered did not set well in the minds of many officers and senior noncommissioned officers. Many wanted to know the reasons behind the unexpected change in direction. Why had the previous Air Force chief moved to realign the tactical organization to the combat wing organization only to see it being changed back to a structure that resembled the objective wing organization of 1992 to 2002? What happened to the need to align the organization because of frustrating experiences realized during the air war over Serbia in 1999 back to the system established by General Creech? What happened to the need to balance fleet health with operational requirements and the need to have experts with PhDs in both maintenance and operations? Finally, the question that resonated in the minds of many leaders is the question of what failed in the last 5 years for the Air Force Chief to drive realignment.

To address the rationale behind the former CSAF, General T. Michael Moseley's decision to realign the AMU in the Combat Air Force (CAF) flying squadron, this article will provide an historical summary of flight line maintenance up to the late 1970s. Following this rationale is an analysis of the contributions of arguably the two most influential leaders on the placement of the AMU. General Wilbur L. Creech and General Merrill A. (Tony) McPeak laid the foundations for flight line organizations that divide the Air Force into two schools of thought for the proper flight line maintenance structure. The examination of these great Air Force leaders will be followed by an overview of issues leading up to the 1999–2002 Chief's Logistics Review, and the decisions leading up to the 2006–2007 analysis completed by the Air Force Inspection Agency (AFIA) on behalf of General Moseley. After analyzing General Moseley's views on the proper alignment of flight line maintenance, the diminished leadership challenge due to the size and scope of responsibility of the operations group and fighter squadron as expressed by General McPeak will prove to be the main factor behind General

Flight L

Selected Reading
Air Force Journal of Logistics

Ray A. Lindsay, Lieutenant Colonel, USAF

ine Maintenance

Creech versus McPeak

Article Highlights

Flight line maintainers will forever find themselves in a tug-of-war between the two camps characterized by the views of General Creech and General McPeak.

In "Flight Line Maintenance: Creech versus McPeak" Lieutenant Colonel Lindsay examines the rationale behind former Chief of Staff of the Air Force (CSAF), General T. Michael Moseley's decision to realign the aircraft maintenance unit (AMU) in the Combat Air Force flying squadron. The article begins with a historical summary of flight line maintenance up to the late 1970s. Lindsay follows this with an analysis of the contributions of the two most influential leaders on the placement of the AMU—General William L. Creech and General Merrill A. McPeak. Creech and McPeak laid the foundation for flight line organizations that today divide the Air Force into two schools of thought regarding the proper flight line maintenance structure. Lindsay then provides an overview of issues leading up to the 1999–2002 Chief's Logistics Review, and the decisions leading to the 2006–2007 analysis completed by the Air Force Inspection Agency on behalf of General Moseley. Lindsay contends the diminished leadership challenge due to the size and scope of responsibility of the operations group and fighter squadron as expressed by General McPeak was the main factor behind General Moseley's decision to realign flight line maintenance under the tactical flying squadron. The analysis that follows highlights General Creech and General McPeak's views on flight line maintenance and how their perspectives will remain as viable options for any attempt at Air Force reorganization. Finally, the article argues that the concept envisioned by General Creech best supports the dynamics and challenges of maintaining Air Force weapon systems.

Moseley's decision to realign flight line maintenance under the tactical flying squadron. The analysis that follows highlights General Creech and General McPeak's views on flight line maintenance and how their perspectives will remain as viable options for any attempt at Air Force reorganization. Finally, the research demonstrates that the concept envisioned by General Creech best supports the dynamics and challenges of maintaining Air Force weapon systems.

Historical Lineage of Flight Line Maintenance (1909 -1978)

Logisticians are a sad, embittered race of people, very much in demand in war; who sink resentfully into obscurity in peace.

—Admiral Isaac Campbell Kidd, USN

In the early years of aviation (1909 to 1945), flight line maintainers were embedded in flying squadrons. This was a time when US Airmen were trying to establish an independent identity. Aircraft inventories grew exponentially and with the introduction of the B-17 and B-29, aircraft systems became more complex.[1] Aircraft maintenance technicians were initially jacks of-all-trades and were responsible for all maintenance performed on the aircraft. They slowly evolved from generalist to specialist due to the complexity of new weapon systems.[2] As the Air Force evolved, so did the concepts of maintenance. Under Army Air Forces Regulation 65-1, the traditional air organization divided aircraft maintenance into four echelons.[3] First echelon maintenance closely resembled maintenance performed by today's crew chief and aerospace ground equipment (AGE) technician. It consisted of servicing aircraft and aircraft equipment; preflight and daily inspections; and minor repairs, adjustments, and replacements. All essential tools and equipment had to be air-transportable.[4] Second echelon maintenance was similar to what is termed today as heavy on-aircraft maintenance. It consisted of more in-depth servicing of aircraft and equipment; performance of the periodic preventive inspections; and such adjustments, repairs, and replacements, to include engine changes, as done by the use of hand tools and mobile equipment authorized by the combat unit's tables of allowance. The majority of second echelon equipment also had to be air-transportable though some support elements required ground transportation.[5] Third echelon maintenance was comparable to today's combat logistics support. It included repairs and replacements that required mobile machinery and other equipment of such weight and bulk that it had to be moved by ground transportation. The technicians were highly specialized, with an emphasis in field repairs and salvage, removal and replacement of major units, assemblies, fabrication of minor parts, and minor repairs to aircraft structures and equipment. This echelon specialized in heavy field repairs within a limited time.[6] The fourth and final echelon mirrored today's depots. It included operations needed to completely restore worn out or heavily damaged aircraft to a condition of tactical serviceability and also included the periodic major overhaul of engines, unit assemblies, accessories, and auxiliary equipment.[7]

One of the unique characteristics of this concept of maintenance echelons is that the first two echelons were owned and the actions were performed by the using organization, while

maintenance in the remaining two echelons was performed by the Air Service Command (ASC). Additionally, the third echelon of maintenance resembled the theater centralized intermediate repair facilities employed today.[8] Of special note, the echelon structure caused maintenance personnel similar frustrations and perceptions as those realized today. There were instances where one squadron of maintenance personnel worked around the clock to prepare their aircraft for the next day's mission while the maintenance personnel of a sister squadron in the same bomb group played basketball. Additionally, the flight line maintainer often complained that the ASC subdepots were unresponsive to the urgency of day-to-day mission requirements. To remedy the perception regarding ASC maintainers, General Arnold directed control of third echelon maintenance under Bomber Command, marking the first attempt to combine all maintenance at an operational location under a single commander.[9]

During the period between the two World Wars, the pendulum for the aircraft mechanic swung from an orientation on specialists back to one on generalists. Reductions in the size of the Air Force and its manning made this change necessary. The issue of generalizing or specializing flight line maintenance remains a topic of debate today—as seen during periods following wars, the debate is often reenergized by a reduction in forces.[10] In 1947, the Air Force had to face massive reductions. Similar to trends exhibited in the recent past, the most highly skilled aircraft technicians left the Air Force for more lucrative civilian job opportunities. The resulting strategy developed to address this challenge was the *Hobson Plan*.[11]

The *Hobson Plan* established a wing structure that contained a combat group, a maintenance and supply group, an airdrome group, and a medical group. For flight line maintenance, the combat squadron within the combat group was responsible for first and second echelon maintenance.[12] A key milestone following the *Hobson Plan* was a 1948 survey that outlined a plan to increase peacetime effectiveness, reduce cost, and establish sound organization for mobilization. In 1949, the outcome led Strategic Air Command (SAC) to establish command guidance, SACR 66-12, that would hold the maintenance organization accountable for the full utilization of personnel, equipment, and facilities to produce the maximum aircraft availability. Tactical Air Command (TAC) elected to not establish command level guidance, but instead, to delegate authority to wing commanders to establish the policy and structure that best fit their unit. A similar concept of leadership would resurface in the latter years.

The new and more complex weapon systems of the 1950s brought with them the need for specialization within flight line maintenance. The 1950s also brought in a new era in aircraft maintenance. With the publishing of Air Force Manual (AFM) 66-1, *Maintenance Management Policy*, flight line maintenance was moved from flying squadrons to a squadron aligned under a single authority for all maintenance activities within a wing. With the new alignment came standardization across all major commands, metrics designed to measure a unit's performance, and a system of data collection and reporting.[13]

The US entry into Vietnam caused another shift in the alignment of flight line maintenance. Tactical units chose to disband the organizational alignment directed by AFM 66-1. Instead they chose to organize in accordance with Pacific Air Forces Regulation (PACAFR) 66-12. In this command structure the combined organizational maintenance squadron (OMS), which is equivalent to the aircraft maintenance squadron of today, was disbanded. All

Article Highlights

Lindsay concludes, "General Creech had it right by stating the flying squadron and AMUs are a single entity married by a commonality of mission and camaraderie. That marriage, regardless of command channels, is always the combat unit." The organizational structure that best supports the right alignment for flight line maintenance should be one where trained, educated, and experienced experts are available when things do not go as planned. That organization is the one envisioned, standardized, and perfected by General Creech.

Article Acronyms

AEF – Aerospace Expeditionary Forces
AFB – Air Force Base
AFFWO – Air Force Future Flying Wing Organization
AFIA – Air Force Inspection Agency
AFM – Air Force Manual
AGE – Aerospace Ground Equipment
AMU – Aircraft Maintenance Unit
ASC – Air Service Command
CAF – Combat Air Forces
CLR – Chief of Staff's Logistics Review
COMAFFOR – Commander Air Force Forces Logistics Staff
COMO – Combat Oriented Maintenance Organization
CSAF – Chief of Staff of the Air Force
CSAR – Combat Search and Rescue
CWO – Combat Wing Organization
DOGM – Deputy Operations Group for Maintenance
EAF – Expeditionary Aerospace Forces
IAF – Israeli Air Force
MAF – Mobility Air Forces
OAF – Operation Allied Force
OG – Operations Group
OMS – Organizational Maintenance Squadron
PACAFR – Pacific Air Forces Regulation
PBD – Program Budget Decision
POMO – Production Oriented Maintenance Organization
SAC – Strategic Air Command
SACR – SAC Regulation
SecAF – Secretary of the Air Force
SOF – Special Operations Forces
TAC – Tactical Air Command
US – United States

OMS functions, to include munitions loading, were assigned to the tactical squadrons.[14] This concept was not completely new to tactical squadrons. In the mid-sixties, TAC initiated a similar concept with a TAC enhancement program whereby maintenance and support personnel augmented the tactical squadron to give it an independent operating capability.[15] In the face of another reduction of forces following the Vietnam War, tactical units returned to the structure defined under AFM 66-1.

Following the US withdrawal from Vietnam, the Air Force's attention shifted to maintaining higher states of readiness in Europe. Unfortunately, the reduction of forces and requirement for higher readiness were in opposition. Unhappy with the inability of the flight line maintenance units to generate the desired sortie rates, the US looked to recent Israeli Air Force (IAF) successes in the 1973 Arab-Israeli War to find answers. In essence, the US team examining the IAF's structure for flight line maintenance found the efficiencies were gained from the alignment of personnel directly responsible for sortie generation to the flight line and all others to the squadrons not in direct support of day-to-day sortie generation. Inspired by the Israeli concept of maintenance, the Air Force established the production oriented maintenance organization (POMO). The primary objectives of this new structure were to increase the effectiveness of maintenance, support for the operational mission, and unit readiness.[16] Under the POMO concept, flight line maintenance personnel were organized into aircraft maintenance units and were cross-trained to perform a variety of general aircraft maintenance tasks.[17]

General Wilbur L. Creech: The Reformist

Workers take more responsibility when they have a sense of ownership

—Gen Wilbur L. Creech, USAF, Ret

General Wilbur (Bill) L. Creech took over command of TAC in 1978. He is described as the antithesis of the blustery, cigar-chomping, tantrum-throwing generals who had long been the favored role models in the combat-pilot ranks.[18] General Creech inherited one of the world's most formidable combat units. TAC had 3,800 aircraft, 115,000 full-time civilian employees, and 65,000 military personnel scattered around the world at 150 military installations. However, as great a military machine as he had in numbers, over half of his aircraft were not mission capable and an average of 220 aircraft were out for longer than 30 days (hangar queen). Finally, training sorties were dropping at a rate of 8 percent per year. As a result, frustrated pilots were leaving the Air Force at an alarming rate.[19]

Although flight line maintenance had experienced a major organizational shift under POMO, the structure was not sufficient to produce the required sortie rates. To accurately capture the atmosphere within the command at the time, one 1 FW crew chief expressed his view of aircraft maintenance as follows: "We were all aware that a human being was strapping into that jet, but there was a lot of sloppy work done to get it into the air, and if it missed its sortie, it was no big deal."[20] A Nellis Air Force Base (AFB) pilot described the atmosphere as follows: "Used to be you could take an airplane off, but your radar wasn't working or the inertial navigation system didn't work. So even when we did fly, the sorties were often low quality."[21] With an understanding that a picture is worth a thousand words, the state of affairs is easily highlighted by the following statement: "It all added up to a lackluster fighter force, beset with apathy, sagging morale, and horrifying statistics. Only 20 percent of 'broken' planes were getting repaired in a typical 8-hour shift. Pilots who needed a minimum of 15 hours of flying time a month were getting 10 or less. The average plane, which had flown 23 sorties a month in 1969, was flying only 11 by 1978. Finally, for every 100,000 hours flown, seven planes crashed. Investigators blamed many of these crashes on faulty maintenance."[22]

To further improve processes established under POMO, General Creech elected to break up the 2,000-person wing maintenance operations into much smaller squadron repair teams.[23] The streamlined organizational maintenance effort focused on a squadron of 24 planes, rather than a much larger 72 aircraft wing approach to flight line maintenance. Starting on a trial basis at a few installations, General Creech created squadron repair teams, drawing technicians from each of the maintenance disciplines. The team would work only on their own squadron's aircraft. Additionally, instead of operating out of rear-area dispatch locations, Creech's plan moved them right down to the flight line.[24]

TAC established the combat oriented maintenance organization (COMO). Under COMO, General Creech focused heavily on the flight line maintenance organization and its teaming with the assigned flying squadron. In addition to establishing a common awareness of purpose and mission through unit patches and organizational ball caps, COMO dedicated to each flying squadron and AMU its own AGE team, crew chiefs to each aircraft assigned, schedulers, analysts, debriefers, and supply support.[25] Although AMUs and their affiliated flying squadron had two separate command channels, they trained, exercised, and deployed as a single entity. Pilots quickly noticed the changes in their crew chief's attitudes. The crew chiefs were spending time on their days off cleaning and enhancing the appearance of the aircraft which now sported their names. [26] When pilots returned from sorties, the crew chiefs were standing at attention, saluting proudly.

The crew chiefs' behavior was not directed or mandated by their leadership; instead, it was driven by the pride they held for their aircraft and a pride they wanted their pilots to share when they flew their aircraft.[27] The natural progression of the relationship was the development of a strong camaraderie between the crew chiefs and their pilots. Squadrons built strong identities and tradition by painting squadron colors on the tails of their aircraft.[28] Finally, a healthy competition evolved between squadrons as they worked diligently to beat other squadrons in the wing on both pilot performance and quality of maintenance.[29]

COMO was institutionalized by multiple command and TAC Regulations 66-5. General Creech's leadership and the effectiveness of his reform were soon reflected in the statistics. In 1 year alone, the sortie rate rose 11 percent. By 1980, the average fighter aircraft use rose from 17 hours a month to 24 hours a month. Within 2 years of General Creech taking command, TAC improved the aircraft mission capable rate by 10 percent—on average, over 60 percent of the aircraft were mission capable.[30]

It is also very important to consider General Creech's opinions on the need to organize for war. In his description of COMO, he explained that the organizational structure trains wartime leaders.

General Creech believed strongly in squadron identity. He also emphasized the need for units to organize in peacetime as they would deploy and fight in wartime. As previously mentioned, he supported the synergy of squadron sized units which consisted of an AMU organized and equipped to deploy with and maintain the aircraft assigned to their perspective flying squadron.[31]

When questioned about keeping the AMUs organizationally separate from the flying squadron, Creech listed three reasons. The first was the need for the flying squadron commander to remain focused on flying in order to remain credible in the mission. The second centered on his philosophy regarding training for war. He wanted maintenance leaders focused on maintaining aircraft and he wanted operations leaders focused on combat flying. Finally, he supported the need for maintenance officers to have a clear track for career progression. This represented his recognition that great maintainers should be home-grown by experts schooled in the art and science of aircraft maintenance.[32]

General Creech helped lay the foundation of one of the mightiest military machines seen throughout the history of the Air Force. His impact would neither be forgotten by the generations that followed nor would his service be appreciated more than by those he served with or mentored. Following the successes of air power during Desert Storm, Lieutenant General Charles (Chuck) Horner, the Joint Forces Air Component Commander commented that General Creech gave the Air Force the organization and training that made success possible. General David C. Jones, a close associate of General Creech, ranked General Creech (along with General Curtis E. LeMay) as one of the two most influential men in his [Jones] long Air Force experience.[33]

General Merrill A. McPeak: Renaissance Man

The common habit of referring to technology in terms of its capabilities may, when applied within the context of war, do more harm than good.

—Martin van Crevald

Following Desert Storm, arguably the greatest air campaign in the history of the US military, the Air Force found itself faced with another major reorganization—the entire Air Force was about to undergo cosmetic surgery. To some, the Air Force would be leaner and meaner. However, to others, the Air Force returned to its historical lineage. At the center of this major reconstructive surgery was the wing organization and the placement of flight line maintenance. Many were confused about the CSAF's decision to move flight line maintenance to the flying squadron after the existing organizational structure perfected by General Creech proved so effective. Additionally, although SAC was not organized under COMO, General McPeak chose to standardize all flying organizations throughout the Air Force with the AMU in the flying squadron.

To set the stage for the path General McPeak followed, it is important to understand the appreciation he had for General Creech's accomplishments. This appreciation is best captured in Lieutenant Colonel (Lt Col) James Slife's book, *Creech Blue.* In his book, Slife writes the following:

> In the hours before the start of Operation Desert Storm on 16 January 1991, the Air Force Chief of Staff General Merrill A. McPeak, wrote a letter to one of his old bosses. In it, he said, 'We are about to harvest the results of years of hard work and leadership by you and a handful of other great Airmen. We will do well. But we need to recognize that we are beholden to you, because you really built this magnificent Air Force we have today.'[34]

The success of the Air Force is highlighted by General McPeak's comments:

> Our in-commission rate for every aircraft in-theater hovers around 93 percent. If I didn't know the people involved, I would think they were lying. It sounds too good, really. Our people around the Air Force have been doing great work."[35]

In the face of another drawdown, General McPeak wanted to ensure the Air Force had relevance and its purpose, goal, and mission to be the country's dominant air component would remain unchanged.[36] His restructuring plan contained three main underlying operating principles. The first was to streamline the organization by eliminating layers of command. Second, McPeak's plan stressed eliminating activities that added little value. Finally, he sought true accountability for performance at every level by combining authority and responsibility where possible.[37]

Although General McPeak's restructuring impacted policy, as well as MAJCOM and Air Staff alignment, one of his prime targets was the alignment of the AMU. General McPeak considered the squadron to be the basic combat unit, which he described as the team that flies and fights. The team consisted of the aircrews that fly and the crew chiefs that service the aircraft.[38] General McPeak felt the integrity of the team could be restored by returning responsibility for on-aircraft maintenance to the flying squadron commander. According to General McPeak, this move made it clear that the mission of the Air Force was to fly and fight, and the flying squadron commander was the leader for that mission.[39]

It is important to understand two main aspects of General McPeak's plan to realign the AMU under the flying squadron commander. First, this concept was similar to that of the traditional Army Air Force structure noted earlier. Air Force heritage influenced many of the reforms General McPeak pushed during his time as CSAF. Additionally, the concept mirrored the Composite Strike Air Force concept used by TAC in the 1950s and 1960s. This concept required a squadron and support to deploy and operate autonomously.[40] Second, his reasoning rested with the launch, flight, and recovery requirements of the combat unit. General McPeak anticipated less troubleshooting for flight line maintenance because of the Air Force's investments to improve reliability and maintainability of weapon systems.

As General McPeak analyzed options for the wing structure, one of the key issues he wanted to address was the balance of responsibilities between groups. For instance, he highlighted the fact that the maintenance deputy (DCM), under the tri-deputy structure supervised more than twice as many people as any other deputy. He also stressed that this was accomplished with very few officers and a low officer-to-enlisted ratio. When compared to the operations group (OG), he stated the OG was small and heavily officer oriented. He described this as being not much of a leadership challenge.[41] General McPeak emphasized that this imbalance would be partially corrected by moving the AMU

back to the flying squadron, which would in turn give the flying squadron commander a much wider scope and offer a much tougher set of responsibilities.[42] Referring to the expanded responsibilities of the flying squadron commander, General McPeak stated:

> A squadron commander, a flight line operational squadron commander, no longer has 65 college-graduate volunteers under his command. He has got 300 guys, most of whom are not college graduates, trying to do something ugly out there with airplanes. The lieutenant colonel now has a completely different problem, and he is better prepared to handle the kind of intellectual challenge that high command involves. So we make people flexible, by which I mean break the mold on static thinking.[43]

General McPeak also reemphasized the need to restore the sense of teamwork between aircrews and their crew chiefs.[44] The question that stands out is whether or not the teamwork could be restored without the alignment of the AMU in the flying squadron. He pointed out that the teamwork would prove crucial to the success of deployed operations. He also emphasized that war plans often call for mobilizing single squadrons. Unfortunately, the flying squadron commander was faced with serious on-the-job training in field conditions. To prevent this, the right structure is one that aligns peacetime with wartime organizational configurations.[45]

To further strengthen his position, General McPeak pointed out that the air forces of a number of nations as well as the US Navy operate with flight line maintenance aligned within the flying squadron. Finally, he reinforced his stance by recalling the traditional flying squadron that was established in the early years of US aviation, "We ourselves used to be organized this way. Why did we get away from it? Frankly, because maintaining aircraft is a tough complicated business. And we organized to solve the logistics problems."[46] With investments in improving reliability and maintainability, General McPeak felt it was time to put emphasis where it rightly belonged. He stressed that the Air Force existed to operate and employ equipment, not to fix it.[47] One can speculate he meant for intermediate level maintenance responsibilities to transfer completely to the depot, leaving the operational flying wing leaner and more expeditionary in its organizational construct.

Chief of Staff's Logistics Review (CLR): PhDs in Operations and Maintenance

> *Those who build great companies understand that the ultimate throttle on growth for any great company is not markets, or technology, or competition, or products. It is one thing above all others: the ability to get and keep enough of the right people.*
>
> **—Jim Collins**

When the Air Force completed its first major air campaign following Desert Storm, there were no praises of logistics successes as seen in the previous war. Instead, there was widespread criticism of failed processes and failures in leadership. Operation Allied Force (OAF) highlighted problems that raised major concerns about the tactical air force's ability to maintain required readiness levels. It may be said that OAF was arguably the culminating point for many failures of the combat unit under the objective wing established by General McPeak.

The Commander Air Force Forces logistics staff (COMAFFOR/A4) raised issues over aircraft arriving for combat with high-time engines, engines overdue time changes and grounding inspections, and aircraft requiring phase inspections immediately upon arriving in the area of responsibility. To make matters worse, many units arrived to their designated combat locations without critical tools for repair. This resulted in aircraft spending several days nonmission capable while units awaited tools that were standard pieces of equipment for deployed operations.[48] Without the intervention of COMAFFOR/A4, the combat effectiveness of some units may have been in jeopardy.

To gain a better understanding of the problems experienced by the deployed forces, several field visits by the COMAFFOR/A4 revealed a myriad of issues. First, several deputy operations groups for maintenance (DOGM), who were charged with oversight of all maintenance activities within the operations group, lost sight of the bigger picture because of being bogged down in day-to-day operations. Second, flying squadron commanders paid little attention to the logistics of supporting their operational requirements. Finally, both officer and enlisted maintenance leadership throughout many areas of operations neglected or were never schooled on the requirements for sustaining fleet health in high operational tempo environments.[49] In essence, they failed to monitor and manage the accelerated phase flow and time change requirements needed to sustain their combat operations.

In order to remedy the problems seen with the combat unit, the United States Air Forces in Europe (USAFE) team led by Commander USAFE, General John P. Jumper, approached then-CSAF, General Michael E. Ryan, about the need to address issues seen during OAF. USAFE's briefing to the Chief highlighted the following five areas:[50]

- Light, lean, and lethal expeditionary aerospace forces (EAF) requirements
- Operating in environments highlighted by constrained resources
- Decreasing mission capable rates and an aging fleet
- OAF experiences and lessons learned
- Deployable squadron concept does not suit EAF requirements

In terms of the proper placement for flight line maintenance, the Headquarters USAFE team emphasized two critical perspectives to General Ryan—the two most important things the Air Force does are to fly and fix airplanes. Arguing the case for the Air Force to grow leaders with expertise or a PhD in each but not both, they recommended the consolidation of maintenance under a single authority for maintenance within the wing structure.[51] Although General Ryan did not approve USAFE's request, the team's efforts served as the catalyst of what became known as the CSAF's Logistics Review or CLR. Following CLR, near-term and long-term testing of several options, the Air Force moved forward with changes that consolidated flight line maintenance in an aircraft generation squadron under a single authority for aircraft maintenance, the maintenance group commander. Interestingly enough, the final changes were institutionalized nearly a year after General Jumper became CSAF.[52]

It is important to capture the potential influence General Creech had upon General Jumper. That influence was so strong

that General Jumper, as CSAF, took the opportunity to provide the foreword to Lt Col James C. Slife's book on General Creech, *Creech Blue.* In the foreword, General Jumper praised General Creech as a leader, a visionary, a warrior, and a mentor.[53] General Jumper also credited General Creech with essentially transforming the Air Force. By working closely with General Creech over a number of years, General Jumper recalled his influence over not only tactics, training, and leader development, but also organization. Without a doubt, General Jumper's back-to-basics philosophy mirrored that of his mentor in both practice and his determination for the proper alignment for flight line maintenance. Like his mentor, General Jumper felt the complexity of operational requirements and the challenges of effectively managing a fleet of aircraft in the wing structure were best accomplished by a career maintenance O-6.

Number 18's Return to Renaissance

There are going to be times when we can't wait for somebody. Now you're either on the bus or off the bus.

—Ken Kesey

On 19 July 2007, the eighteenth CSAF, General T. Michael Moseley, sent a correspondence to key Air Force leaders that temporarily stopped time for many in the aircraft maintenance and operations career fields. In the memo, he spoke of inputs to "potential adjustments and enhancements" to the existing wing organization. He surveyed squadron, group, and wing commanders for their input to the wing organizational structure. After informing his audience that he felt the major parts of the wing and group structure were right for both home station and deployed operations, he expressed his opinion as to where crew chiefs should work or where an AMU should be positioned. His beliefs are quoted as follows:[54]

- The Air Force's mission is to deliver decisive effects on a global scale; our task is to properly organize, train, and equip the Air Force to deliver those effects … both from expeditionary locations and from home station
- Relative to mission … there is no empirical evidence that either organizational template is better relative to fleet health.
- There is also no historic evidence that squadron-level maintainers that served in flying squadrons were disadvantaged in promotions or career options.
- The expeditionary or deployed organization and home station template should be focused on assigned mission … vice function.
- The home station organization template should be the same as deployed … and we should not look to change the structure somewhere enroute between home station and the expeditionary location.
- The structure should facilitate the training and experiencing of those officers that will command both expeditionary operations and home station operations—at all levels (squadron, group, wing, NAF, and theater)

After identifying these key beliefs, General Moseley highlighted the need to find the right organizational template—one that keeps leadership focused on mission, vice function. General Moseley believed that many of the views on the proper placement of the AMU were distorted by emotionalism and urban myths surrounding fleet health, sortie generation, promotion rates, and home station/deployed organization parallels. Finally, he emphasized the right structure should prepare the next generation of officers to command at higher levels.[55]

General Moseley closed the memo by recognizing the need to be cautious by not injecting additional turbulence into the Air Force in the midst of another drawdown of personnel presented by Program Budget Decision (PBD) 720.[56] He stressed that his near-term focus was PBD 720 execution and program objective memorandum build. However, he believed that the right path for the future alignment of the AMU was under the flying squadron commander.[57] Prior to General Moseley releasing his correspondence to key Air Force leaders, his team had already been examining new Air Force organizational concepts which also included options for the alignment of flight line maintenance. One of the taskings directed by General Moseley was Sierra Bravo. It was conducted in conjunction with the Defense Advanced Research Projects Agency. The other tasking was conducted by the Air Force Inspection Agency (AFIA). It became known as the Air Force Future Flying Wing Organization (AFFWO).

A memo from the Secretary of the Air Force (SecAF) generated Sierra Bravo. The memo directed the CSAF in March 2006 to examine possibilities for a new Air Force structure. The SecAF directed that options considered should begin with a theoretical mission. He also directed to not use General Spaatz's template of the bomb group, but instead, to start from scratch. SecAF reemphasized the focus was mission first and then determining the right size to meet that mission.[58]

In follow-up correspondence, SecAF provided the following guidance:

> I want you to take a target that would reduce airfield operations, to include pilot input by 30 percent with a stretch to 40 percent. Therefore a dedicated air base would be reduced to seventy percent with a stretch to sixty percent staffing without backfills…. This reduction can be accomplished a number of ways, consolidating maintenance … eliminating local tower operations … having the pilots service their own aircraft for minimal needs … designating the area as the pit stop … kind of like a Navy carrier…."[59]

Like General McPeak, General Moseley found himself faced with the opportunity to find the best Air Force structure in the face of another large reduction in forces. With regards to the right alignment for flight line maintenance, the design principles for Sierra Bravo focused on the following key principles:

- Mission precedes ownership and size.
- Home station organization design must be applicable to air expeditionary force (AEF) expeditionary bases.
- Centralize installation, maintenance and logistics support in forward operating areas (FOA).
- Streamline readiness and link expeditionary combat support to AEF cycle.
  - Standardize a core capability package by mission type.
  - Train as a unit, deploy as a unit, fight as a unit.
- Realign functions based on enhanced capability, vice present day community identification.
- Sustainable career development path to leadership positions.

With the assumption of regionalized installation, maintenance, and logistics centers in place and working effectively, Sierra Bravo called for all maintenance and operations combined under a fighter group commander with deputies for both maintenance and operations. The specific recommendation for flight line maintenance was to leave it combined in an aircraft maintenance squadron.

The next critical input to the CSAF on reorganization was the AFFWO analysis from the AFIA.[60] In a January 2007 update, the AFIA focused on answering four CSAF areas of interest. They examined the history of wing organizational structures, three aspects of organization, of which two impacted the alignment of flight line maintenance, leadership development, and the benefits of reorganizing in relation to the turbulence of doing so.[61]

In examining the history of the Air Force wing organization, the AFIA was masterful in graphically showing the transformation of operations- or maintenance-led sortie generation. The AFIA highlighted that the Air Force often elected to centralize maintenance following periods of large drawdowns of personnel or forces. After providing a historical perspective to peacetime and contingency flight line organizations, the team found that large expeditionary wings were closely aligned to their home station operations and that in a few instances there were slight differences in flying wing organizations which were largely dependent on mission design series, mission, location, and nature of operation. Senior leaders surveyed indicated home station and expeditionary organization was "about right."[62]

Flight line maintainers will forever find themselves in a tug-of-war between the two camps characterized by the views of General Creech and General McPeak.

The second consideration for the organizational alignment of flight line maintenance focused on sortie generation. The AFIA found that factors such as funding for spares, age of the aircraft, operations tempo, and reduction of forces influenced capability. Because of these factors, they found no correlation between combat wing organization (CWO) and the objective wing on aircraft availability, mission capable rates, or sortie generation rates. The team also found that combat air forces (CAF) general officers favored flight line maintenance under the flying squadron commander because of the expanded leadership opportunities and unity of effort. On organization at the wing level and below, the team found that commanders were split on blending maintenance into the operations group. Finally, the AFIA found a majority of the mobility air forces (MAF) and Special Operations Forces (SOF) GOs favored the current wing structure because it was better suited for mobility and special operations, and because the deployed tempo of MAF and SOF units are much greater than a fighter squadron.

One can easily argue that the missions of the MAF and SOF provide a greater leadership challenge due to continuously managing dispersed forces. This fact supports the argument that if development of future leaders is the key consideration, the MAF and SOF are better suited than their CAF counterparts for the alignment of AMUs in the flying squadron. In addition to the MAF and SOF GOs, the maintenance community as a whole supported the CWO structure. In the end, the AFIA stated there was no conclusive evidence that either the objective wing or combat wing organization had a measurable impact (positive or negative) on combat effectiveness.[63]

The next consideration for the AFIA research team was whether or not the Air Force was organized properly in order to develop future flying wing and expeditionary leadership. This analysis found that promotions to O-5 for pilots declined while support officer promotions had increased since the implementation of the CWO; however, they attributed this to pilots recalled to active duty to fill vacant operations billets, pilot shortages, and pilots who lacked appropriate professional military education. Although the CSAF distributed guidance highlighting a masters degree or professional military education was not a prerequisite for promotion, many nonrated officers felt the necessity to complete both in order to remain competitive with the rated career fields. The team also found that pilots were not afforded the same proportion of command opportunities as their mission support counterparts. As for senior leader concerns, the CAF GOs expressed concern about future wing commanders lacking experience with maintenance and lacking leadership experience of enlisted personnel. The team's final analysis was that there was no conclusive evidence the organization had a measurable impact on developing flying wing and expeditionary leadership.[64]

The final AFIA analysis was related to the benefits of reorganization over the turbulence of doing so. The team found no evidence that combat capability or leadership development would be either hindered or improved through reorganization. They felt opportunity cost, effort, and time might be better spent on other AFSO21 events and initiatives which would provide a higher return on time invested.[65] As for senior leaders, the majority were comfortable with the existing organization, but they did state that they would support change if deemed necessary. If change was necessary, the majority of these leaders favored either flight line maintenance under the operations group or a fighter or bomber group that contained all operations and maintenance functions. The team concluded that the benefits of suggested changes would not outweigh in the near term the turbulence caused by the changes.[66]

Unfortunately, there was no evidence that the AFIA attempted to address the issues CLR identified and tried to address in 1998. There was no discussion of the flying squadron commander's attention being divided between combat sorties and logistics. The AFIA also chose not to (or failed to) address why, in times of drawdowns or declining levels of readiness or mission capable rates, the Air Force often elected to centralize wing-level maintenance under the leadership of seasoned maintenance officers. General Moseley's reorganization would have been the first to deviate from this tendency.

Following the July 2007 report from the AFIA, General Moseley distributed a memorandum (December 2007)

announcing his intentions to reorganize wing maintenance and logistics. Regarding flight line maintenance, his decision and reasoning mirrored that of General McPeak. He stated that the Air Force's main priority was to properly organize, train, and equip our Airmen so they could deliver decisive effects globally. Since the squadron was the building block of the Air Force organizational structure, he felt it should be organized for mission success. He emphasized the need to facilitate the training and expand the experience of officers who would command expeditionary operations.

The most effective formula for such professional development was to structure Air Force units by mission and not by function. He restated his belief that aligning maintenance units responsible for sortie generation with the flying squadron they supported was best for the Air Force. He also stressed that as a vital element of the flying squadron's mission success, the maintainers that directly supported sortie generation belonged in the chain of command of the squadron they supported. Finally, he articulated that the alignment of flight line maintenance under the fighter squadron provided a scalable capability that can easily be presented to the combatant commander. Of interest, he directed the realignment only for fighter and combat search and rescue flying squadrons and stated further examination of options for bomber, airlift, SOF and intelligence, surveillance, and reconnaissance platforms was required.[67]

Critical Analysis and Conclusion

If it is not advantageous, do not move

—Sun Tzu

Days before the kickoff of another Air Force reorganization, the US military's primary air arm would see a changing of the guard in its two highest positions. With a new SecAF and CSAF, one of the first orders of business was to halt the reorganization. Whether General Norton Schwartz fully supported General Moseley's decision on reorganization is uncertain. One can only speculate his operational background places him in the category of the MAF, SOF GOs that favored the current CWO. Considering the turbulence caused by turnover of Air Force leadership, the questions surrounding nuclear surety, and the state of the Air Force in the midst of personnel cuts under PBD 720, General Schwartz may have viewed the proposed changes as ill-timed. During a question and answer session with the men and women of the 325th Tactical Training Wing at Tyndall AFB in Florida, General Scharwtz commented that a collective decision had been made to not integrate aircraft maintenance with the operational flying squadrons. He stated that not doing so would help ensure that in years to come more sophisticated cadres of aircraft maintenance personnel will be more tightly focused on maintaining critical weapon systems. He followed this by stating that the partnership between maintenance and operations is integral to success. He stressed the need for a deep bond and camaraderie between crew chiefs and the aviators they support. He closed the query with a strong statement summarizing his views on maintenance: "Maintenance is not a part-time business and full-time attention is needed for the long haul to sustain our rigorous standards."[68] General Schwartz's closing statement reflects the principles and views of General Creech.

Flight line maintainers will forever find themselves in a tug-of-war between the two camps characterized by the views of General Creech and General McPeak. The McPeak structure had many characteristics of the organization implemented by General Spaatz. It also placed a heavy emphasis on the prestige of the fighter pilot-led organization—"the quarterback that leads his team to victory."[69] There are a number of benefits to the objective wing structure. It does help develop rated leaders who are better prepared to handle budget, training, resource, and enlisted personnel issues as well as lead flying operations. Another key benefit of the AMU within the flying squadron is the fact that enlisted personnel are often awed and inspired by the mystique of the fighter pilot. This is the natural order of Air Force business. Documented Air Force history typically glorifies the pilot as the great leader and little emphasis is given to leadership at other levels of responsibility. In General McPeak's analogy of the quarterback leading the team to victory, the appreciation for the offensive line, running backs, receivers, and defense is often overlooked. A commander cannot achieve success without the dedication and commitment of his or her team.

The need to develop future wing commanders is a legitimate concern, especially when one considers that pilots are arguably the least experienced of all Air Force specialties in leading large organizations prior to assuming wing command. In spite of this lack of experience, they are often tasked to lead major Air Force programs outside of their operational purview. Lt Col Walter Burns probably captured this point best when he wrote:

> Very few flying squadron commanders had any experience with maintenance personnel other than their crew chiefs, and now they were responsible for them. The Air Force seems to have done a poor job of preparing pilots for operational squadron command. One flying squadron commander operating under the objective wing structure stated that he was certainly not trained for the job beforehand even though he'd attended the obligatory squadron commander's course.[70]

Although the objective wing has strong benefits for the growth and development of rated officers, it did present challenges for the maintenance leadership assigned to the OG. Senior maintainers have commented that the objective wing structure stifles the growth and grooming of maintenance officers and senior noncommissioned officers—core elements of growing seasoned maintainers are lost because of failures in accountability, mentoring, and oversight of all aspects of effectively leading and managing an AMU. Additionally, the DOGM was put in place to provide the needed balance between officer development, sortie generation, and fleet health, yet they found themselves often in conflict with the flying squadron commanders. In several instances, the conflict resulted in the DOGM seeking new opportunities outside of the OG in order to preserve career opportunities.[71]

The perfect scenario for maintenance under the flying squadron is a true remove and replace environment for line replaceable units—one in which troubleshooting is the push of a button to isolate the faulty part and where reliable parts are readily available. Even with today's most recent acquisition, the F-22 Raptor, the prime contractor is allowed approximately 8 years after fielding its first operational Raptor to mature the weapon system to the levels of performance sold to the Air Force. In the meantime, each sortie and new unknown maintenance challenge is on the backs of certain Air Force specialists supporting the platform. If the reorganization had gone as General Moseley had planned, the F-22 would have definitely been an

exceptional leadership challenge for the flying squadron commanders.

Unless the Air Force changes requirements placed on defense contractors or air logistics centers and holds them accountable, reliability and maintainability will always be an issue for weapon systems from the initial acquisition to their retirement to the bone yard. As long as the military is affected by budget constraints, fleet management challenges of aging aircraft will always impact readiness. Until the Air Force further improves the quality of life for the flight line maintainers and ensures reduction in forces do not short-change true personnel requirements, the challenges of balancing training and operational requirements will remain at the forefront of leadership challenges.

The organization that best resolves all of the issues previously mentioned for both peacetime and contingency operations is that built by General Creech. General Creech had it right by stating the flying squadron and AMUs are a single entity married by a commonality of mission and camaraderie. That marriage, regardless of command channels, is always the combat unit. The combat unit is strengthened by a squadron of aircraft that proudly displays both the pilots' and the crew chiefs' names as well as their squadron's colors on the tails.

The area of greatest controversy between operations and maintenance is the need to balance fleet heath with operational requirements. General McPeak emphasized the need to restore the trust between the AMU and the flying squadron. A thorough analysis is required to truly understand whether or not the trust is really degraded between the maintainers and aircrews.

Unfortunately, mistrust is often a result of either operations or maintenance failing to understand each others requirements. Together, operations and maintenance must unite in highlighting shortfalls that prevent them from being a successful team. Mistrust is not a natural order for any flying squadron/AMU team and it should not be expected or tolerated. If a critical shortfall is determined to be mistrust among existing leadership, then replacement of the leadership is essential in order to ensure success of the mission.

The new CSAF's decision to stay within the confines of the CWO brought a great sigh of relief throughout the maintenance and much of the operations communities. However, one cannot help but wonder whether or not the Air Force will find itself facing another restructuring in years to come. Will the alignment of flight line maintenance remain at the center of any proposed restructuring resulting from a further reduction of forces? Will the need to grow future Air Force leaders override the need to ensure balance is retained between operational and fleet health requirements? Will the concept perfected by General Creech remain at the forefront of the most efficient structure for ensuring combat capability to our nation's Air Force or will it be overshadowed by the need to better grow future leaders as expressed by General McPeak? Finally if a decision is made to realign the AMU to the flying squadron, how does the Air Force ensure the issues surrounding OAF are not repeated?

There will always remain varying views regarding the previously stated questions. However, the Air Force owes it to its people to select one flight line organizational structure, perfect it, and put it in place to stand the test of time, ideologies, personalities, and changing of Air Force leadership. The organizational structure that best supports the right alignment for flight line maintenance should be one where trained, educated, and experienced experts are available when things do not go as planned.[72] That organization is the one envisioned, standardized, and perfected by General Creech.

General Creech had it right by stating the flying squadron and AMUs are a single entity married by a commonality of mission and camaraderie. That marriage, regardless of command channels, is always the combat unit. The combat unit is strengthened by a squadron of aircraft that proudly displays both the pilots' and the crew chiefs' names as well as their squadron's colors on the tails.

Notes

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65. In a 21 February 2006 article Air Force Materiel Command defined AFSO21 as follows: In December, a decision was made to rename the Air Force's continuous process improvement initiatives Air Force Smart Operations for the 21st Century, or AFSO21. AFSO21 is the name assigned to the business-improving initiatives mandated by Secretary of the Air Force Michael Wynne and US Air Force Chief of Staff General T. Michael Moseley. In a Commander's Log, AFMC commander General Bruce Carlson wrote, "Under AFSO21 we're constantly examining all of our processes in an effort to eliminate waste and unnecessary work. By doing so, we will remain fresh and focused on what's important to mission accomplishment … while continuously improving all we do." "It's (AFSO21) a mindset, a change in our behavior, a way of operating … and of thinking," he wrote. At the core of AFSO21 are continuous process improvement initiatives such as Lean, Six Sigma and others which have been a part of the air logistics centers' cultures for a number of years.
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72. In correspondence with Dr (USAF Colonel ret) Joseph Boyett, Jr, he stated, "In my opinion that's a significant factor affecting organizational schemes—organizing so that trained, educated, and experienced experts are available when things don't go as planned.

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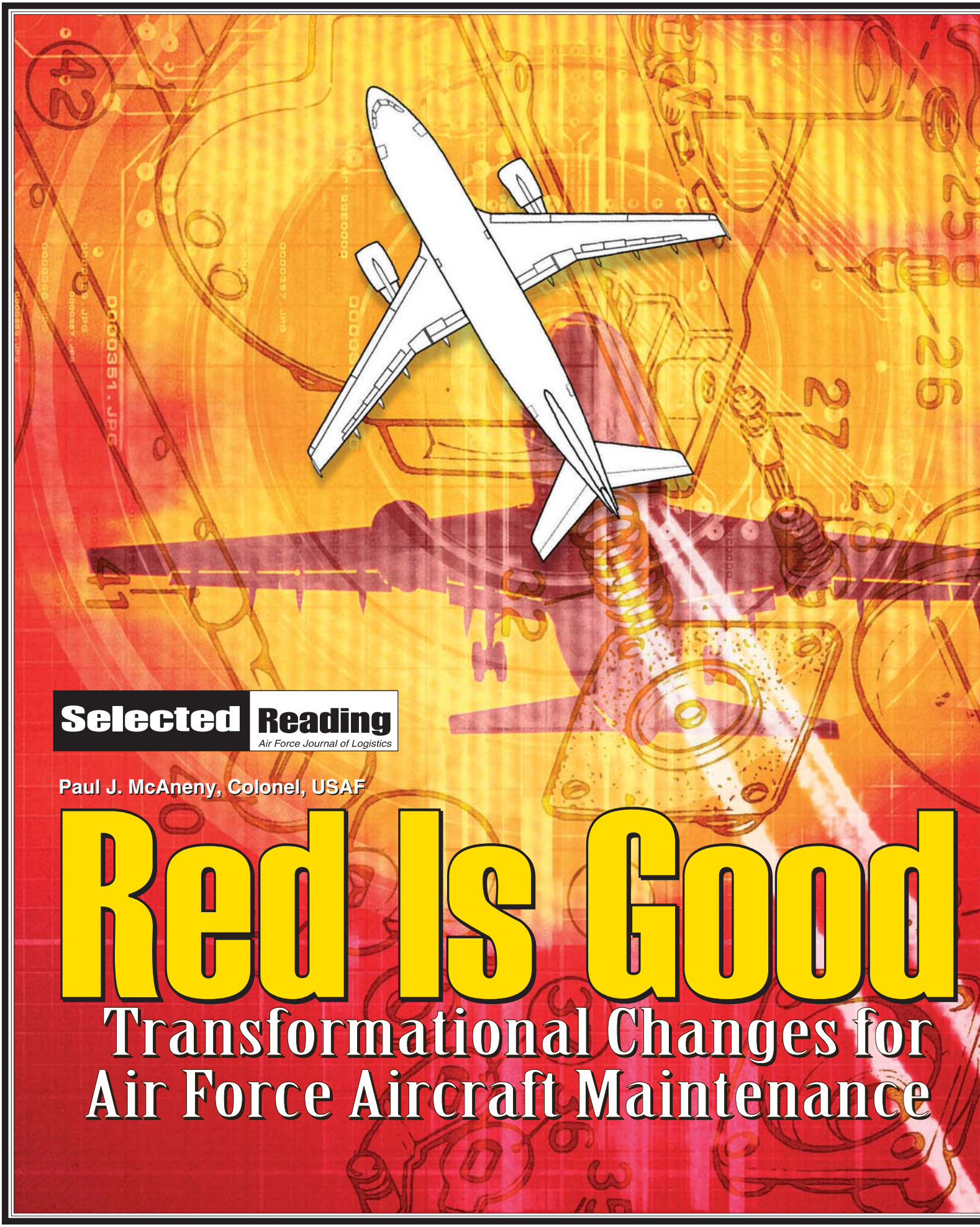
JL★

I knew full well that the maintenance I was going to get would determine the success or failure of the operation. I must get the maximum performance out of the planes assigned to my command, or I would fail to do the job.

—Lt Gen William H. Tunner, USAF

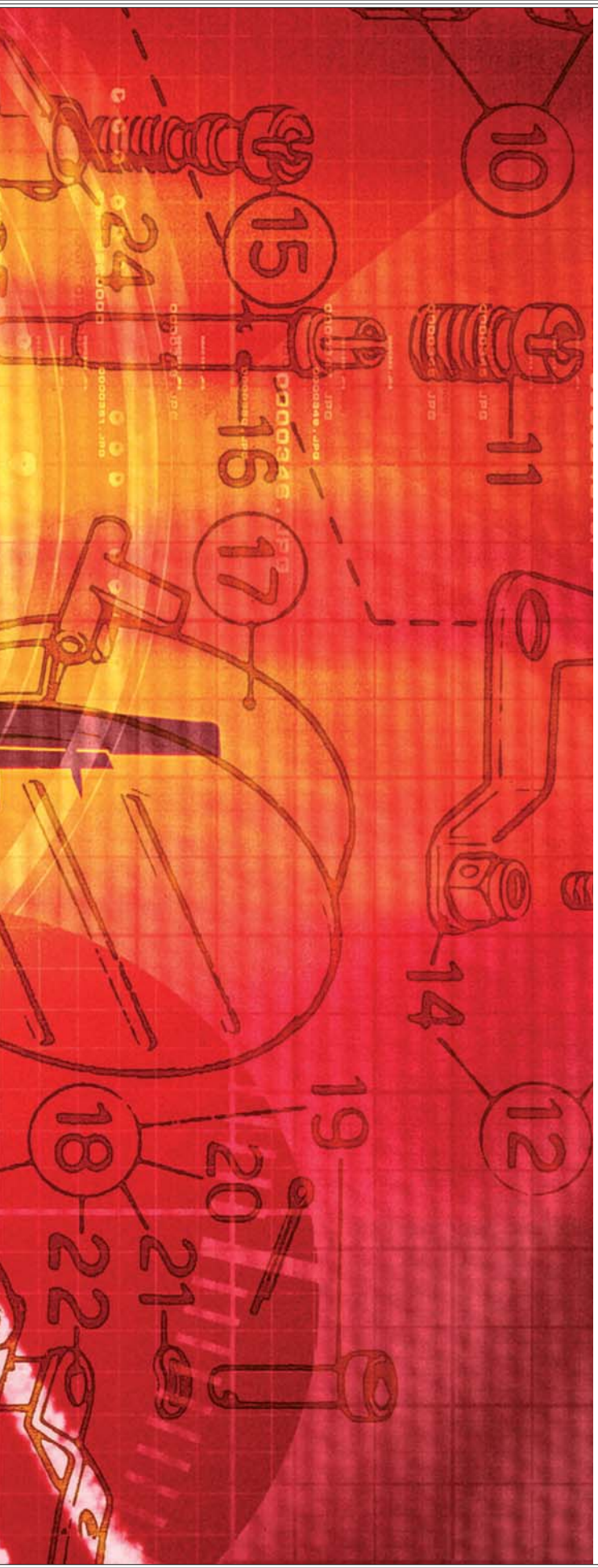


Selected Reading
Air Force Journal of Logistics

Paul J. McAneny, Colonel, USAF

Red Is Good

Transformational Changes for Air Force Aircraft Maintenance



If it ain't broke, don't fix it. True but … if you don't know it's broke, it don't get fixed.

—Bill Creech (Gen Wilbur L. Creech, USAF, Ret),
The Five Pillars of TQM

Introduction

Special Feature

Over the last 20 years, the US Air Force has seen a 40 percent reduction in the size of its air fleet, while the average inventory age has gone from 8 years in 1973 to 24 years in 2008. The negative trend is expected to continue to a projected average age of 26.5 years by 2012.[1] On any given day, 14 percent of the remaining fleet (about 800 aircraft) is either grounded or operating with age-related flight restrictions.[2] Since the end of Operation Desert Storm, the Air Force has maintained an average rate of 2.3 million flight hours per year with a fleet that is much smaller and older than the one fielded during the first Gulf War.[3] Operations Iraqi Freedom (OIF) and Enduring Freedom (OEF) have put further stress on the fleet; thus, aircraft will reach their projected service life much sooner than planned or budgeted for.

Within this challenging environment of flat or decreasing budgets, limited manpower, and a rapidly aging air fleet, the Air Force sought a way to transform its culture not only to survive but to remain the world's premier force in the domains of air, space, and cyberspace. The Air Force transformation initiative, called Air Force Smart Operations for the 21st Century (AFSO21), began after considering only the effects desired, not the organizational level changes required to successfully implement the transformation. The desired effects of AFSO21 are as follows:

- Increasing Airman productivity
- Improving readiness and availability of critical equipment
- Increasing responsiveness and agility
- Sustaining and improving operational safety and reliability
- Increasing energy efficiency[4]

This article focuses on the necessary conditions to realize the desired AFSO21 effects. Specifically, service-wide changes are required if the Air Force hopes to achieve the envisioned benefits within the aircraft maintenance community. These include becoming a learning organization, developing organizational level leaders able to visualize and manage entire enterprise value streams, and finally, facilitating an environment where metrics drive transformational change and the relentless pursuit of continuous process improvements.

Successful, valid, reliable, and continuous process improvement is only possible in an environment that tolerates, encourages, and promotes the public airing of dirty laundry. Others have labeled this a *Red is Good* mentality, from the well-known construct of PowerPoint metrics briefings using red, yellow, and green stoplight charts to depict established target status.[5] In a Red Is Good transformation, problems are viewed as great opportunities to improve, rather than failures or threats.

Article Highlights

Successful, valid, reliable, and continuous process improvement is only possible in an environment that tolerates, encourages, and promotes the public airing of dirty laundry. In a Red Is Good transformation, problems are viewed as great opportunities to improve, rather than failures or threats.

In "Red Is Good: Transformational Changes for Air Force Aircraft Maintenance" Colonel McAneny makes the case that service-wide changes are required if the Air Force hopes to achieve envisioned transformation benefits within the aircraft maintenance community. These include becoming a learning organization, developing organizational level leaders able to visualize and manage entire enterprise value streams, and finally, facilitating an environment where metrics drive transformational change and the relentless pursuit of continuous process improvements.

Specific suggested changes to achieve simultaneous efficiency and effectiveness targets for aircraft readiness and reliability are as follows:

- First, metrics do drive transformation and influence behavior. The best metrics are those developed with an eye toward worker involvement that ties value directly to an organization's customer by ensuring end products are delivered on time with the right quantity and quality. The ultimate goal is to create a *Red Is Good* Air Force transformation, where problems are viewed as opportunities and the bearer of bad news is lionized rather than ostracized. In this cultural transformation, metrics are not pass/fail indicators but instead measure process efficiency and effectiveness and identify trends.
- Second, for the Air Force maintenance community to successfully attain a Red Is Good transformation, current enterprise-level metric deficiencies must be addressed. Recent Air Force Logistics Management Agency and General Accountability Office research studies raise questions about the validity of aircraft maintenance data as well as the associated goals set by higher headquarters. Studies also demonstrate how nonaligned metrics suboptimized enterprise-level performance in the Air Force. In too many organizations constant deficiency identification through metrics remains the exception rather than the norm. Instead, a *Green Only* mentality permeates wing leadership who, often because of their own self-preservation instinct, has a low tolerance for items marked red for noncompliance.

Toyota Corporation is recognized globally as a benchmark for fostering a Red Is Good transformation, demonstrated by Toyota president Katsuaki Watanabe's visit to one of his US manufacturing plants. When shown that the plant met the metric targets (all green) for its most recent reporting period, Watanabe observed, to the dismay of his US managers, "Ah, no problems, must need no managers."[6] Watanabe curtly and elegantly conveyed that metrics and goals were useless if leaders weren't using them as tools to find process problems and waste that could be eliminated. Unfortunately, many current Air Force leaders look at metrics from the exact opposite point of view—as an opportunity to show others that they are on top of their game and meeting or exceeding all expectations.[7] In other words, they have a *Green is Good* mentality. This analysis will examine metrics and their impact on transformational culture change and evaluate Air Force aircraft maintenance community initiatives. Several recommended Air Force enterprise level changes are proposed for the Service to achieve simultaneous efficiency and effectiveness targets for aircraft readiness and reliability—a desired effect of AFSO21.

Culture Change and Transformation

Most transformation programs start on the wrong foot. And because they often follow in the wake of failed restructuring efforts that have left indelible scars on the workforce, they are seen as just another attempt at cost reduction.

—Tony Hope and Jeremy Hope,
Transforming the Bottom Line

What is organizational culture? How should the Air Force be categorized as an organization? What are the common characteristics of successful cultural change agents in large organizations? Where does the current AFSO21 (Lean) transformation fit into this discussion? Edgar Schein defines culture as "a pattern of shared basic assumptions learned by a group as it solved its problems . . . [and] taught to new members as the correct way to think and feel in relation to those problems."[8] By Schein's characterizations, today's Air Force is a mature organization where culture defines leadership rather than leadership defining culture. Mature organizations can function successfully for many years, so long as their cultural assumptions remain relevant to the external environment. However, if the environment changes and the organization cannot adapt, that inflexibility leads to a period of rapid decline.[9] Furthermore, if mature organizations have a long history of success grounded in certain core assumptions about themselves and the environment, they are unlikely to challenge or reexamine those assumptions because they remain a significant source of pride and self-esteem. This reluctance can act as a filter (or blinder) and prevent key leaders from recognizing alternative, but necessary, means of survival.[10]

Successful cultural transformation starts with a well constructed vision instilling a forward looking mindset that positions the organization to move confidently and aggressively toward bold objectives.[11] Further, the vision of transformational leaders must consistently and clearly communicate organization priorities, goals, and assumptions throughout the workforce. This is known as organizational alignment. If ignored, workers become preoccupied with their individual task stovepipes and procedural

details.[12] But when a company has synergistic and mutually supportive metrics, goals, and objectives at all organizational levels, a complete organizational alignment—true change and transformation—is possible. Aligned organizations have clear objectives, a common language, and a trust-based, open information system.[13] Once these conditions for success have been set, a culture of excellence where great ideas flourish from the bottom up is truly possible. The trick, and the problem, is successfully converting these ideas from concepts to actions. Transformational leaders can break through corporate cultural inertia by seeking, promoting, and celebrating progressive thinking.[14] Jim Collins, author of *Good to Great*, says, on the other hand, that it is just as important to avoid demotivating people by failing to deliver results on their progressive thinking. Instead, change agent champions "point to tangible accomplishments—however incremental at first—and show how these steps fit into an overall concept that will work. When leaders do this in such a way that people see and feel the buildup of momentum, they will line up with enthusiasm."[15]

Organizational culture analysis demonstrates that it takes anywhere from 3 to 10 years to successfully change the fundamental culture of a large organization.[16] Unfortunately, the AFSO21 Lean transformation efforts were flawed from the start, following the very pattern criticized by Hope and Hope in *Transforming the Bottom Line*. The Service programmed major budget cuts (primarily personnel accounts) between 2007 and 2011 to save $21B while assuming risk until transformational capabilities were identified.[17] Instead, successfully transforming organizations must first reduce the workload, not the work force.[18] The Air Force did the exact opposite. It cut manpower budgets while assuming that workload reductions, speed, and quality improvements would follow. Air Force leaders must reevaluate their basic assumptions about service transformation to attain the effects desired with AFSO21. Only then will the Air Force be capable of the bold policy and organizational changes necessary to facilitate transformation.

Metrics, Goal Setting, and Cultural Connections

Goals without metrics are more of a hallucination than a vision.

—Alex Miller, Chuck Parke, and Harry Gregory, *Leading for Results* course University of Tennessee

What gets planned, gets measured. What gets measured, gets done.

—Wayne Turk, *Is Your Project on Track?*

Metrics can and do influence corporate culture, whether by intention or not. To be effective, metrics must flow from a clearly defined strategy. An organization that fails to measure itself correctly will not know how or where it falls short.[19] Metrics, when properly developed and utilized, provide leaders with valuable tools to measure progress and lead change across all organizational levels. The most effective metrics are customer focused and capture the entire value stream. However, a misapplied focus on metrics can be a powerfully counterproductive force in corporate culture and actually hinder organizational progress.

Article Highlights

- Finally, only by becoming a true learning organization can the Air Force maintenance community hope to advance its transformation towards a permanent, Red Is Good, continuous process improvement culture. The Air Force needs to create an environment that breeds chief process officer leaders. These leaders must be capable of establishing the right process-performance metrics, devising improvements—or if a process is clearly broken, reengineering it—and establishing a continuous program of process optimization. Air Force level policies must be changed in order to grow these enterprise value stream leaders and enable a service-wide continuous process improvement environment. These changes include overhauling the century-old Air Force personnel management system to support a culture of learning among aircraft maintenance leaders. For starters, a personnel evaluation system supportive of risk-taking, outside-the-box thinkers needs to be introduced. A method of rewarding these learning leaders with advancement and responsibility should replace the current system, which rewards leaders naturally driven to become risk-averse careerists. Furthermore, the Air Force needs to move away from an assignment process that overwhelmingly results in maintenance leaders becoming airplane generalists. Rather, maintenance officers and senior NCOs should be permanently tied to specific aircraft models in order to become expert-level value stream leaders.

Article Acronyms

AFB – Air Force Base
AFLMA – Air Force Logistics Management Agency
AFMC – Air Force Materiel Command
AFSO21 – Air Force Smart Operations for the 21st Century
ALC – Air Logistics Center
CEO – Chief Executive Officer
GAO – General Accountability Office
HSLDR – Home Station Logistics Departure Rate
MAJCOM – Major Command
MC – Mission Capable
NCO – Noncommissioned Officer
NMCM – Not Mission Capable Maintenance
NMCS – Not Mission Capable Supply
OAS – Office of Aerospace Studies
OEF – Operation Enduring Freedom
OIF – Operation Iraqi Freedom
PDCA – Plan Do Check Analyze
PDM – Programmed Depot Maintenance
TQM – Total Quality Management
US – United States
UTE – Utilization Rate

First and foremost, metrics should always reflect the value of the organization's product to the customer, ensuring delivery at the right place, time, quantity, quality, and price.[20] In developing metrics, the core questions should be, "Where are we going?" and "How do we get there?"[21] Value-stream visible metrics have the following attributes:

- Accurate (reliably measures the phenomenon being measured)
- Objective (not subject to dispute)
- Comprehensible
- Timely
- Robust (resistant to being gamed and hard to manipulate)[22]

Another important point for leaders to consider in metrics development is unity of focus for the best return on investment. Leaders should personally champion no more than five of the highest level critical end product metrics and cascade responsibility for supporting metrics downward through the organization. Goal setting is also a critically important leadership task and is linked directly to encouraging team members to achieve higher levels of performance than they might have thought possible. Incremental and realistic increases in goal difficulty raise the level of effort required to achieve goals while simultaneously expanding the performance envelope of the entire enterprise stream.[23] Metrics are worthless unless the results are critically reviewed on a regular basis, with the target being complete process improvement. Good metrics should allow target setting, identify issues and problems, and provide feedback on process efficiency and effectiveness.[24] Metrics displayed in simple and visible scoreboards let all personnel know how they are doing—as the simple stoplight chart does, using red (significant problems that could impact success), yellow (correctable problems), and green (everything is on time, on budget) indicators.[25]

Good customer-focused metrics encompass the entire value stream. Rather than using traditional metrics just because they are "what's always been tracked," an organization should consider eliminating metrics that don't create value as perceived by the customer. Once set and focused on key high-return processes, value stream ownership should be assigned to a specific individual or small group. That person or persons are empowered with total responsibility and authority to improve performance within the value stream.[26] This is much more effective than isolated attempts to maximize stovepipe performance, because ultimately final output is constrained by the lowest level of support, or bottleneck, in any component of the value stream.[27] To summarize, there are four guiding principles of metrics for value stream teams:

- Targets should be aligned with strategy.
- Teams play a role in choosing targets.
- Focus on the customer including possible development of new metrics.
- Measures should influence behavior.[28]

Assigning team empowerment to value streams is the most powerful tool at any leader's disposal. While leaders are solely responsible for setting strategy—owning the process—teams should be the primary unit of execution and do all the real value-creating work.[29] Teams at Toyota Corporation take ownership of the entire value stream and use the plan-do-check-analyze (PDCA) cycle to achieve process improvement where it can be most effective.[30] The PDCA cycle is a systematic method that codifies the continuous in continuous process improvement. Planning involves analyzing the value stream, finding the areas with the most waste, and deciding what adjustments to make in order to remove that waste from the process. The do step involves carrying out the corresponding plans of action. Checking means judging results of actions (feedback) taken against predetermined targets in the do step—in other words, comparing what should have happened with what actually happened in order to make further refinements. Good checking requires an atmosphere friendly to peer- and self-criticism. Otherwise, if personnel sense that failed attempts at process improvement are perceived negatively by leadership, honest feedback will be lost. Progress is impossible without an atmosphere where mistakes can be freely reported. Finally, the analyze step is as simple as it sounds: reflect on the results of the check step. If the results from the check step meet the target, then standardize. If not, find the root cause and restart the PDCA cycle.[31] Two critical questions are as follows:

- Does the organization have a culture that supports and encourages systematic problem solving?
- What really happens when people report problems?[32]

Creating a culture where the bearer of bad news is lionized rather than ostracized is one of the most difficult things for any leader to achieve. The 2008 resignations of the secretary of the Air Force and the Chief of Staff are illustrative. While the Secretary of Defense's official statement said that these resignations were specifically related to recent Air Force missteps involving custody of nuclear weapons and components, many inside and outside the Air Force believed otherwise. Michael Dunn, Air Force Association president, recently summed it up by stating, "Secretary Wynne and General Moseley have been outspoken in pointing out the Air Force needs to recapitalize and modernize the fleet. . . . It is apparent to us that the Department of Defense did not appreciate the military advice nor the warnings they were getting."[33] This effectively signaled to the entire Air Force that our organization maintains a *Red Is Bad* culture. In a Red Is Good culture, problems are viewed as opportunities for systematic problem solving.

A Red Is Bad culture is not unique to the Air Force. There are numerous instances of many working in service and maintenance type industries where the only experience with metrics and data is negative. In some production environments, metrics are used to punish low performers, justify cutbacks, and support dubious arguments that foster an environment of distrust and wariness.[34] This leads to inaccurate or inflated job completion estimates to create a buffer in order to minimize reprimands for not meeting the schedule. On the other hand, reporting realistic estimates and system problems would allow leaders to have full and accurate process visibility to better manage uncertainty and risk in the daily schedule.[35]

Rather than being a pass or fail indicator, metrics should instead be used to judge process efficiency and effectiveness as well as identify trends.[36] Furthermore, metrics should be constantly refined to ensure that leaders and process owners can get to, and remain focused on, the heart of the issue.[37] No leader wants to be in a situation where process owners are reluctant to

provide data that reflects negatively on the process. This human tendency must be overcome, or else it creates a false reading of current project status.[38] It is important to remember what should be the true purpose of all good metric rating systems: to help tell a story and gain a shared understanding of what's important. Effective rating systems should lead to problem discovery and result in solutions.[39]

This discussion of metrics leads to the cultural connection question: Can metrics influence culture? W. Bruce Chew, a Harvard expert on factory productivity in America, believes metrics do influence behavior if they are properly created. Chew states, "When the primary goal is to influence behavior, the simpler the better must be the rule. If the people who use an index can't understand it at a gut level, it probably will not affect their decisions and priorities."[40]

In fact, measurement systems drive behavior at all levels and the choice of measures is critical to the behavior to be influenced.[41] Therefore, it is critical that managers consider who and what will be influenced by the metrics they choose to track.[42] Enterprise metrics, those specifically designed with the intention of aligning incentives and behavior across the entire organizational value stream, ensure that both individual and corporate goals are synchronized.[43] Truly transformational metrics discourage personnel from focusing only on their individual production stovepipes and instead, encourage them to think about the value, quality, quantity, and timeliness of the final output product.[44] Simultaneously, keeping internal process metrics in perspective is important to prevent an overemphasis from suboptimizing real customer value.[45] Ultimately, behavior guided by consistent application of metrics and goals over time leads to a real and permanent culture change that successfully considers the entire value stream process. When a leader has accomplished that, the corporate culture has taken a major step towards successful, long-term, continuous process improvement.

Current Air Force Aircraft Maintenance Metrics

Choosing metrics for metrics' sake is a bad thing and really proves nothing. A good maintenance manager will not strive to improve a metric but will use it to improve the performance of the organization.

—Brig Gen Terry L. Gabreski, USAF, Foreword to *Maintenance Metrics U.S. Air Force*

The Air Force flies 430 sorties per day in support of OIF and OEF. In fact, the Air Force airlift fleet averages a takeoff every 90 seconds, every day, 365 days a year.[46] Reams of data on operational tempo, flight hours, and so forth are collected by Air Force maintenance data analysts. These measurements enable predictive estimates of structural fatigue, system performance, and airframe service life. Research shows cost per flying hour increases significantly during the first 12 years of aircraft service life, so it is important to collect and track these metrics for predictive analysis.[47] The most recent version of the *Maintenance Metrics U.S. Air Force* handbook lists 34 primary maintenance metrics to track.[48] These are used not only for predictive analysis, but also for trend analysis and progress checks. Recent independent research studies by the Air Force Logistics Management Agency (AFLMA) and the Office of Aerospace Studies (OAS) highlighted problems with aircraft maintenance data validity as well as the absence of a systematic method for goal setting at higher headquarters. Likewise, other studies have shown how nonaligned metrics suboptimize, or undermine, the desired enterprise-level performance for some weapon systems. Finally, a Green Is Good/Red Is Bad culture still permeates the aircraft maintenance community.

The metrics used to reflect fleet health at both wing and enterprise level for the aircraft maintenance community are mission capable (MC) rate, aircraft (sometimes called fleet) availability, home station logistics departure reliability rate (HSLDR) for mobility air forces, and utilization rate (UTE) for combat air forces. MC rates are simply determined by the number of aircraft that can fly at least one assigned mission divided by the number of aircraft possessed by the entire wing. Aircraft availability is the metric for determining health of the inventory and is dependent on the MC rate as well as the number of aircraft across the entire enterprise (possessed, backup, depot).[49] This measure is useful for determining if the total logistics enterprise is capable of providing sufficient aircraft to accomplish mission requirements. A certain percentage of the fleet must always be available on any given day in order to execute the Air Force's flying program.[50] HSLDR metrics judge operational effectiveness based on customer needs in the mobility air forces and are determined by comparing ontime takeoffs to deviations from the flying schedule.[51] For the combat air forces, UTEs are the local measure of effectiveness, counting the number of flying hours an aircraft is utilized during a given month, quarter, or year.[52]

Traditionally, MC rates have been a common benchmark. A typical unit would compare its MC rate against established major command (MAJCOM) standards or against the rates of similar units. Units that were lower in comparison to these benchmarks would then try to identify the influencing factor (process, policy, or resource) and seek remedies.[53] More recently, enterprise leaders have preferred to focus on aircraft availability because it best articulates systemic fleet stress levels and overall combat capability. Aircraft availability provides a direct answer to the question: How many aircraft are ready right now?[54] Aircraft availability is impacted by MC, not mission capable for maintenance (NMCM), and not mission capable for supply (NMCS) rates as well as factors such as aircraft in depot or undergoing modifications.

The Air Force has been collecting maintenance data for decades but suffers from three data collection problems common to service environments:

- There is so much data that it is difficult to separate the wheat from the chaff.
- For various reasons, some collected data is no longer available.
- The data often does not measure what it purports to measure.[55]

These problems violate the guiding principles for value stream team metrics. Recently, the AFLMA and OAS collaborated on a study of C-5 maintenance data. They discovered that much of the data on past C-5 modifications were lost when C-5 depot responsibilities transferred from Kelly Air Force Base (AFB), Texas, to Robins AFB, Georgia.[56] The AFLMA also found that aircraft maintenance metrics were inaccurate and vulnerable to both intentional and unintentional manipulation. Researchers

uncovered delays in recording aircraft status changes to not mission capable, after aircraft status had already changed.[57] AFLMA also discovered systemic problems involving maintenance metrics. Procedural methods for reporting broken aircraft systems obfuscated the actual cause. Ultimately, lack of input control and discipline in following electronic data reporting procedures injected doubt into the entire maintenance data collection process.[58] On top of doubts about the actual data, AFLMA also found no formal methodology or analysis involved in determining the metric goals for C-5 MC, NMCM, or NMCS rates.[59] Likewise, a separate Government Accountability Office (GAO) study found that Air Combat Command has no historical record of any process establishing most of the metric goals for its primary aircraft maintenance metrics.[60] GAO investigators suggest "the lack of documentation in setting the goals ultimately obscures basic perceptions of readiness and operational effectiveness" while wasting the time of wing aircraft maintainers who attempt to meet standards having no basis in actual organizational performance.[61]

Air Force maintenance metrics also have alignment issues. Proper organizational alignment is present where, with all other variables held constant, improvement in lower-level metrics leads to improvement in the higher-level metrics.[62] While it is common to see different metrics at different organizational levels, this split focus can be problematic when local goals are not aligned with the overall enterprise strategy.[63] This results in suboptimization or an overemphasis on a particular metric that ignores the actual root cause of the core problem and may in fact exacerbate the problem.[64] An AFLMA study revealed misalignment between the primary wing-level leadership C-5 metric, HSLDR, and the Air Mobility Command's primary metric of aircraft availability. The study demonstrated that these metrics were not aligned, with the result that wing-level maintainers were focused on maximizing local operational effectiveness while the MAJCOM was concentrating on improvements in overall strategic readiness.[65]

Furthermore, the Air Force still lacks the ability for constructive self-criticism, an essential ingredient of continuous process improvement. Metrics must be looked at as tools for fixing problems affecting the process; otherwise their value is questionable. In fact, metrics that show the pain best have the greatest value.[66] The Air Force has an *Only Green Is Good* mentality whereby leadership, often due to a strong self-preservation instinct, has no tolerance for items marked red for noncompliance.[67] An environment where constant deficiency identification is the norm must be the goal. While the Air Force aircraft maintenance community has the obsessive desire to measure just about everything, the wrong things are often measured, and a negative stigma exists against taking the time to study a process closely enough to actually improve it.[68] Only when this paradigm is changed can the Air Force expect sustained operational improvements.[69]

When Air Force maintenance organizations combine effective metrics with a Red Is Good mentality, true long-term improvements will be realized. A dynamic relationship between analysts and maintenance leaders must exist in which the analysts are fully integrated partners with the leaders' agenda of long-term process improvement.[70] Good analysis remedies the tendency to focus on final results rather than the critical factors that drive those results. Lean organizations find ways to measure the independent variables, such as resources, funding, manpower, or programming data that have the greatest effect on fleet readiness.[71] Many units are discovering there are better measures than MC rates to assess how a wing meets sortie production and long-term fleet health requirements. A more effective approach may be increased emphasis on the scheduling process to maintain a balance between daily sortie production for the near term and future fleet health for the long term.[72] Significant transformational process improvement will begin only when wing-level maintenance organizations focus on using metrics for true root cause analysis to achieve enterprise-level aligned, requirement-driven goals.

Facing restricted budgets, limited personnel, and dwindling financial resources, the aircraft maintenance community needs to fundamentally change its culture to improve mission effectiveness. Real cultural change can only be achieved if the Air Force learns and applies the right lessons from observing the Toyota production system and other successful Lean organizations in implementing transformational continuous process improvement.

The Toyota Production System and Air Force Aircraft Maintenance

You can't tell the winners without a scorecard, or tell the losers either. And without a scorecard, neither winners nor losers will know which they are. No one will know how to get better, either.

—Bill Creech (Gen Wilbur L. Creech, USAF, Ret),
The Five Pillars of TQM

The success of the Toyota production system and its foundational culture is well known. Facing restricted budgets, limited personnel, and dwindling financial resources, the aircraft maintenance community needs to fundamentally change its culture to improve mission effectiveness. Real cultural change can only be achieved if the Air Force learns and applies the right lessons from observing successful Lean organizations in implementing transformational continuous process improvement.

The Toyota cultural model of a learning organization is the construct many organizations strive to emulate. The core of the Toyota production system is an attitude of self-reflection and self-criticism together with a burning desire to improve. Toyota leaders at all levels are encouraged to openly address things that don't go right and then take responsibility and propose countermeasures to prevent these things from recurring.[73] The difference between Toyota and many other companies is Toyota's fanatical process orientation. Less successful companies have results-oriented leaders or a Green Is Good mentality. Process-oriented leaders are more patient, believing that investments in the people and the process lead to the desired results, while Green Is Good managers want to immediately measure the bottom-line performance of any attempted continuous improvement programs.[74] Many companies and leaders are unable to accept the paradox that by continually surfacing problems and stopping to fix them as they occur, waste is eliminated and productivity soars. Instead, assembly lines are run continuously and problems accumulate, eventually causing lower quality and increased delays.[75] Toyota also ensures that all leaders clearly understand the company's core value stream. Likewise, all internal service operations view their role as supporting the core value stream. The leaner the core value stream, the leaner the supporting operations can be.[76] Toyota leaders are commonly described as focused on the long term, dedicated to the company's core values, and possessed with detailed, hands-on value stream knowledge. At Toyota, problems are seen as opportunities to train and coach other employees.[77] Unfortunately, for many organizations the essence of building in quality has been lost in bureaucratic and technical details. This is why Toyota incorporates their PDCA cycle into four easy-to-understand steps:

- Go and see.
- Analyze the situation.
- Use one-piece flow and visual signals to surface problems.
- Ask Why? five times.[78]

The most important metrics to Toyota leaders are those driving problem solving and supporting process orientation. These value stream measures test everything from lead time to first-pass quality to cost. Aggressive goals begin at the executive level, and each lower level develops measurable annual objectives designed to support those leadership goals. These metrics are updated daily and become more specific lower down in the process hierarchy.[79] Of note, metrics having no influence on improving core value stream operational excellence or those enabling suboptimization are eliminated.[80]

How can the Air Force maintenance community emulate Toyota's effective continuous process improvement culture? Achieving the Toyota level of transformation requires both patience and perseverance—organizational culture is both the creation and product of a learning organization. It has taken Toyota well over a decade to build a North American organization that resembles the learning enterprise it built over the course of several decades in Japan.[81] The challenge is in creating an aligned organization of employees who share the organization's core beliefs and continually learn together.[82] To learn means to have the capacity to build on the past and incrementally move forward, rather than starting over and reinventing the wheel with each new leadership change. This is the fulcrum point of the Air Force's challenge. To build a learning organization, it is necessary to have stability of personnel, slow promotion, and carefully planned succession systems to protect organizational knowledge bases.[83] Successfully transforming culture takes years of applying consistent approaches and principles. To its credit, the Air Force has made attempts to become a learning organization but has fallen far short of the Toyota model.

As commander, Tactical Air Command, General Creech instituted senior officer immersion programs. General Creech rightly believed that "it's when leaders do not understand the challenges—and the real problems and issues—that they give direction that adds to the problem rather than to the solution."[84] In General Creech's program, wing senior officers (normally colonels and above) were required to spend 2 weeks working side by side with Airmen as they went about their daily routine. The purpose was for wing senior leaders to gain a deeper understanding of the environment, challenges, and demands faced by Airmen on a daily basis. At the end of the 2 weeks, these leaders were required to provide a written report to General Creech with insights and recommendations. Since General Creech's retirement over 20 years ago, less ambitious incarnations of this program continued sporadically. While the benefits of the Creech immersion program are intuitively obvious, they pale in comparison to the learning organization model at Toyota, where value stream managers understand virtually every facet of the process they lead. This problem is particularly acute in aircraft maintenance, where officers and senior noncommissioned officers (NCO) are frequently rotated and often have little or no experience with the weapon system they are charged with supporting.

A transformed learning organization would enable the Air Force to empower a new breed of wing-level leaders: a chief process officer who takes ownership of understanding, tracking, measuring, and optimizing crucial end-to-end aircraft maintenance business practices. These leaders must establish the right maintenance process metrics, measure performance, devise improvements—or reengineer a process that is clearly broken—and establish a continuous program of process optimization, as Toyota's four keep-it-simple steps force managers to do.[85]

The chief process officer must have a firm grasp on enterprise thinking. This grasp is defined as a discipline for seeing the whole, recognizing patterns and interrelationships, and learning how to structure these interrelationships in more effective, efficient ways.[86] Toyota, for most of its history, has achieved a culture of stopping or slowing down to fix problems to get quality right the first time. While this may sound simplistic, countless organizations have tried to emulate Toyota and failed. The company philosophy of getting quality right first enhances long-term productivity. Toyota developed visual systems to alert teams or project leaders when a machine or process needs assistance.[87]

Metric data are used to learn and monitor process performance, not as a method for punishing or rewarding people. Dr W. Edwards Deming, the famous American engineer who led the quality movement in Japan and later in America, stated that 96 percent of quality problems were built into the work system while only 4 percent were due to individual employee performance.[88] The great majority of experts agree that process rather than people offers the greatest opportunities for continuous improvement.[89] For a variety of reasons, service processes such as aircraft maintenance are full of waste. Service processes are as follows:

- By their nature slow processes which drive up expense
- Tend to have far too much work in progress, often as the result of extreme complexity in the service itself
- Flush with nonvalue-added (to the customer) work typically comprising 50 percent of the total service cost[90]

These processes represents a huge potential for enterprise thinkers to achieve significant improvements in speed, quality, and cost. According to Lou Giuliano, chief executive officer of ITT Industries, in an organization full of leaders who are enterprise thinkers, "everybody's number one task becomes improving the processes for which they have the responsibility."[91]

Today, the Air Force remains stuck in the nascent stages of its cultural transformation. The initial attempt to transform the Air Force in the early 1990s using Total Quality Management (TQM) principles popularized by Deming was generally recognized as unsuccessful and aborted by Service leadership within the decade. More recently, the Air Force made a spirited attempt to embrace quality with its AFSO21 program, vowing not to repeat the mistakes of past transformation efforts. While some high profile successes have been achieved, most notably at the air logistics centers (ALC), the contention that the Air Force has embraced partial quality holds true for others. This partial quality is characterized by a lack of mission focus with the emphasis on efficiency overshadowing effectiveness, leaving many Airmen with the impression that customer service-oriented functions like finance and personnel have been degraded. If AFSO21 initiatives don't ultimately lead to improved operational effectiveness, then Airmen have every reason to question their overall utility. Partial quality also drives the impression that AFSO21 is overly focused on management versus leadership, with NCOs viewing it as just another level of micromanagement.[92] Becoming a learning organization and creating empowered chief process officer leaders are significant steps towards a permanent, long-term cultural transformation.

Transforming the Culture in Aircraft Maintenance at the Enterprise Level

If you don't know what you are doing, you keep making the wrong mistakes.

—Yogi Berra, Quoted in Bill Creech (Gen Wilbur L. Creech, USAF, Ret), *The Five Pillars of TQM*

In the 1990s, the failure of Air Force TQM programs to approach the lofty goals promised by their most vocal advocates resulted in waning support from military leaders and professional educators. Airmen who saw the quality movement as a way to increase our military edge and improve efficiency were eventually outnumbered by those who saw it as just another square to fill.[93] The Air Force is now several years into its second attempt at transformational culture change. While there have been several well publicized AFSO21 success stories, a true Air Force transformational culture change remains an unsettled issue. The aircraft maintenance community has served as a test bed for many successful AFSO21 initiatives. To lock in these initial successes and support continued growth, changes in leadership methodology, management, and service policies are required—not just in Air Force aircraft maintenance, but at the Air Force enterprise level. These changes include instilling a Red Is Good culture and ensuring that Airmen leading steady process improvement are rewarded and promoted ahead of their peers. Finally, the human resource management system for aircraft maintenance leadership should be completely overhauled to grow true learning organizations.

Changing the culture of any mature organization the size of the Air Force is a daunting challenge. Organizational change management is a disciplined process—guiding an organization and its stakeholders through significant organizational change, addressing the people issues of transformation, and mobilizing individuals and groups at all levels of the organization to support the transformation.[94] In today's Air Force, an appropriate response to ongoing skepticism at all ranks, due to the failures of previous TQM and other transformation initiatives, should be constantly considered. Air Force leaders must understand legitimate skepticism and accept personal responsibility to positively work through it. Successful leaders deeply understand AFSO21 issues and opportunities and forcefully present the case for change.[95] Overcoming cultural norms is a bigger challenge than just mitigating AFSO21 skepticism. The Air Force made rational appeals to Airmen on the importance of a continuous process improvement culture, declaring that money and manpower pools are drying up. The problem is that Airmen at the local operating level don't perceive they are affected. Therefore, saving programmed Air Force dollars is not an attractive selling point. The question, "What is in it for me and why should I care?" is never really answered.[96] In aircraft maintenance this could be as simple as asking a technician, "When was the last time someone asked you how the job should be done?"[97] In the past, when operational requirements or problems somewhere else in the value stream caused a workload spike, the traditional solution was 12-hour shifts and work through the weekend. Instead, a new Lean Air Force paradigm needs to be mutually beneficial at all levels. Enlightened self-interest is a very good motivating force. As Colonel Robert Hamm, the Headquarters Air Education and Training Command deputy director for logistics, states,

> Let's use our heads and these new Lean tools to fix our processes because, in my opinion, we won't see the major increases in manpower or money necessary to repair our aging aircraft . . . it's just not realistic. Everybody can get behind 'Let's not work overtime through the weekend to fix this.[98]

Ultimately, any successful cultural transformation is going to be leadership driven. Executive level leaders are the principal source for the generation and reinfusion of an organization's ideology, articulation of core values, and specification of norms.[99] These leaders, or change agent champions, are the ones whose ideas and initiatives must be rewarded through performance reports, compliments, and formal recognition.[100] In

the earliest stages, process improvement groups will be led from the top down because the pressing need is to change the way employees think by direct demonstration of a better way. By the second stage, however, the process improvement group will focus more on making leaders into teachers, and Airmen will become not just technicians but process engineers. This is critical mass for Lean transformation—a point where leaders become coaches rather than dictators and Airmen become proactive learners. This transition is the key to a self-sustaining Lean learning organization.[101] The vast majority of Air Force units have yet to attain this critical transition point.

Air Force maintenance leaders can begin to make the transition by managing for bottom line results in the organization's value stream. The ultimate goal for any flying wing is increased combat capability. Leaders need to determine the local measurements, goals, and objectives reflected in combat capability and define the end-to-end core value streams impacting those measurements. When value streams or processes that improve combat capability are identified, maintenance leaders must align goals strategically across the entire enterprise and assign specific value stream managers. The challenge for senior maintenance leadership is finding objective metrics to put the true bottom line output products in clear focus. When performance is measured correctly, it improves. When performance is correctly measured and compared to goals, historical trends, and like units, it improves more. When significant improvement is recognized and rewarded, productivity soars.[102]

Well constructed value stream metrics are used by leaders to manage processes and drive culture change. Leaders must approach metrics as a tool to fix processes rather than a way to assign blame.[103] This is the essence of the Red Is Good culture. In the past the Air Force set out to change culture when instead it should have let culture change come naturally through adherence to metrics and standards. The point is to create a cultural climate where the truth is heard and where red metrics drive questions, dialogue, and debate, not answers. In such a climate, real and intense debate is desired, as opposed to translucent dialogue that lets Airmen have their say so we can all get buy in to some predetermined decision. Finally, red metrics must create a climate where bad news can't be ignored because it illustrates the very core problems of the value stream output.[104] There are two possible interpretations of a red metric: a signal of failure to reach targeted value stream performance or a request for help. In a Red Is Good climate, the focus must be on the requests for help. It is crucial that senior maintenance leaders ensure their entire organization understands that red, yellow, and green stoplights are signals and not grades.[105] A major step the Air Force needs to take to create a Red Is Good culture is a reevaluation of its entire inspection culture. To ensure fidelity and execution following a major inspector general visit, a fix phase should be incorporated to allow inspectors and units to interact and correct discrepancies before the inspection team departs the base.[106]

The Air Force Materiel Command (AFMC) ALCs are good models to emulate for wing-level flying organizations. The ALC turnaround over the last decade has been well documented. From fiscal year 1999 to 2002, AFMC's programmed depot maintenance (PDM) ontime delivery rate, one of the organization's primary value stream measures, was no better than 81 percent. In other words, the warfighter could count on at least one in five aircraft being returned late from PDM. After AFMC's Lean initiatives, the ontime delivery rate showed dramatic improvement. By fiscal year 2004 it was 92 percent, and in 2005 it reached 99 percent, with one ALC achieving 100 percent. In the A-10 aircraft PDM line, the 120-day total cycle time was reduced 60 percent to just 51 days.[107] So what differentiates ALC maintainers from those in a flying wing maintenance organization? Many note that ALC depot maintenance work does resemble a commercial production process and therefore is more conducive to waste reduction through Lean principle application. While that may be correct, the biggest difference between the ALCs and flying wing maintenance is that ALCs most closely approximate what Toyota labels a learning organization. The ALCs have civil servants in senior production management positions with many years of experience and genuine hands-on knowledge of all the processes in the value streams they manage and lead. This is not the case in a flying wing, where maintenance leaders at both the officer and senior NCO levels often find themselves managing systems with which they have inadequate hands-on experience. If the Air Force truly hopes to transform wing-level aircraft maintenance into a Lean

Today, the Air Force remains stuck in the nascent stages of its cultural transformation. The initial attempt to transform the Air Force in the early 1990s using Total Quality Management principles popularized by Deming was generally recognized as unsuccessful and aborted by Service leadership within the decade. More recently, the Air Force made a spirited attempt to embrace quality with its AFSO21 program, vowing not to repeat the mistakes of past programs.

organization, major changes in the current personnel system must be addressed.

A survey on change management published by the American Management Association and Deloitte & Touche had the following conclusion:

> It seems that many organizations have to change in order to change. Their **present structures and cultures** tend to disallow the successful implementation of change initiatives (emphasis added).[108]

The Air Force military personnel system is one of those present structures and must change as it currently exists to support maintenance leadership if the Air Force has any hope for true transformational breakthroughs in its flying wings. The basic personnel system in use today is essentially the same system that was adopted from the Army in 1947, when the Air Force became a separate Service. That Army system was originally developed in 1890 by the secretary of war, Elihu Root.[109] The core tenets of our personnel system—top-down evaluations in a hierarchical bureaucracy and frequent moves for career development—are nearly 120 years old![110] So today we have a century-old system that prepares Airmen to function in a vertical, hierarchical bureaucracy that stifles innovation and actually works against the creation of learning organizations.

The first personnel issue that must be addressed is performance evaluation. While the Air Force has tinkered through the years with minor changes, such as required evaluation comments, rating categories, and endorsement levels, the system is essentially unchanged. Performance reports are based purely on an evaluation by an Airman's rater and the rater's rater.[111] The Air Force needs risk-taking, out-of-the-box thinkers to succeed in a Lean AFSO21 transformation, but our actual performance evaluation system supports a hierarchical, risk-averse bureaucracy. In this system, red continues to be bad. A single evaluation report that uses moderate praise rather than enthusiastic endorsement will kill an officer's or senior NCO's career. An innovative, out-of-the-box-thinking officer need have only one risk-averse, control-oriented boss, and his or her career is essentially finished.[112] The Air Force needs to move forward in the 21st century by considering performance evaluation alternatives that support a transformed Lean organization. The answer may be 360-degree system or some other method of rewarding risk takers rather than leaders who are naturally driven to become risk-averse careerists. There are many large organizations using similar, successful systems to benchmark. The time is right for Air Force senior leadership to tackle this contradictory, outmoded evaluation system.

The second personnel policy requiring reform is the assignment policy for maintenance officers and senior NCOs. In the current Air Force model, frequent moves and a wide variety of duties are required in the name of career development. The goal is to grow leaders with a wide variety of skills to function at the top of the hierarchical pyramid. This has created a host of officers and senior NCOs who are aircraft maintenance generalists rather than experts. A typical officer's career includes maintenance management on a variety of aircraft, from heavy lift transportation to high-demand, low-density reconnaissance aircraft to small fighters, alternating between staff assignments at the field grade level. The same happens, though not as frequently, to NCOs once they reach the grade of master sergeant and join the senior NCO corps. While the basic maintenance organization, procedures, and policies are the same for all these kinds of aircraft, the aircraft-specific processes are considerably different. Most maintenance officers and many senior NCOs are, in effect, amateurs by profession. They never get the chance to spend enough time on one aircraft or in one job to become true experts.[113] This is no way to create a learning organization where value stream leaders are expert level at every process they control.

The Air Force needs to create an environment that breeds chief process officer leaders. These leaders must be capable of establishing the right process-performance metrics, devising improvements—or if a process is clearly broken, reengineering it—and establishing a continuous program of process optimization. Air Force level policies must be changed in order to grow these enterprise value stream leaders and enable a service-wide continuous process improvement environment.

Again, the Air Force needs to redesign present structures in order to change. Aircraft maintenance officers and senior NCOs should be closely tied to the aircraft they maintain. While this is currently done very loosely with special experience identifiers, there is no governing policy that states, for example, once assigned as a career C-5 maintenance officer, an Airman will remain a C-5 maintenance officer. Ideally, a typical active duty maintenance officer would rotate among C-5 bases in the continental United States as well as overseas enroute locations primarily supporting C-5s. If assigned to a MAJCOM or Air Force staff, his or her focus would be the C-5 if at all possible. Staff tours would be followed by a rotation back to a C-5 field unit. Permanent change-of-station assignments to primarily maintain other aircraft for career broadening would be the exception rather

than the rule. This may sound like a radical change, but in reality it mirrors how personnel are currently managed in the rated community. The Air Force would never consider taking a pilot with 3 years of experience flying the U-2, send him for 1 year to fly F-16s in Korea, and then rotate him back to the United States to fly KC-135s in North Dakota. Conversely, this is routine for Air Force maintenance officers and senior NCOs. More often than not, the resulting outcome at wing level is field grade aircraft operators with vastly superior system knowledge compared to their aircraft maintenance counterparts on the other side of the table. Toyota and other mature Lean firms get brilliant results by giving expertly trained value stream managers complete responsibility for end product success.[114] If the Air Force hopes to break through and do the same, it needs leadership at the highest levels to consider bold changes to our outdated personnel system and create learning organizations in wing-level aircraft maintenance.

Summary and Recommendations

By 2012 the average Air Force aircraft is projected to be more than 26 years old. Simultaneously, as this indefinite trend continues, support funding and manpower are expected to stagnate. The Air Force has no choice but to mitigate the aging air fleet's impact on readiness by transforming to an environment where continuous process improvement is the accepted way of doing business. Already there have been noteworthy process improvement successes at the ALC depots as well as some flying wings. However, the Air Force enterprise has yet to truly transform so that all Airmen actively seek to improve their value stream processes. In the aircraft maintenance community, service-wide changes must be incorporated to enable a metrics-driven transformational change supporting continuous process improvement. These include significant changes in the personnel evaluation system, assignment process, and rotation policy for all officer and NCO maintenance leaders.

First, metrics do drive transformation and influence behavior. The best metrics are those developed with an eye toward worker involvement and that tie value directly to an organization's customer by ensuring end products are delivered on time with the right quantity and quality.[115] The ultimate goal is to create a Red Is Good Air Force transformation, where problems are viewed as opportunities and the bearer of bad news is lionized rather than ostracized. In this cultural transformation, metrics are not pass/fail indicators but instead measure process efficiency and effectiveness and identify trends.[116]

Second, for the Air Force maintenance community to successfully attain a Red Is Good transformation, current enterprise-level metric deficiencies must be addressed. Recent AFLMA and GAO research studies raise questions about the validity of aircraft maintenance data as well as the associated goals set by higher headquarters. Studies also demonstrate how nonaligned metrics suboptimize enterprise-level performance in the Air Force. Finally, in too many organizations constant deficiency identification through metrics remains the exception rather than the norm. Instead, a Green Only mentality permeates wing leadership who, often due to their own self-preservation instinct, has a low tolerance for items marked red for noncompliance.[117]

Finally, only by becoming a true learning organization can the Air Force maintenance community hope to advance its transformation towards a permanent, Red Is Good, continuous process improvement culture. The Air Force needs to create an environment that breeds chief process officer leaders. These leaders must be capable of establishing the right process-performance metrics, devising improvements—or if a process is clearly broken, reengineering it—and establishing a continuous program of process optimization.[118] Air Force level policies must be changed in order to grow these enterprise value stream leaders and enable a service-wide continuous process improvement environment. These changes include overhauling the century-old Air Force personnel management system to support a culture of learning among aircraft maintenance leaders. For starters, a personnel evaluation system supportive of risk-taking, outside-the-box thinkers needs to be introduced. A method of rewarding these learning leaders with advancement and responsibility should replace the current system, which rewards leaders naturally driven to become risk-averse careerists. Furthermore, the Air Force needs to move away from an assignment process that overwhelmingly results in maintenance leaders becoming airplane generalists. Rather, maintenance officers and senior NCOs should be permanently tied to specific aircraft models in order to become expert value stream leaders.

Significant enterprise-level changes are required by the Air Force for a true continuous process improvement culture to take hold. To continue effective maintenance of the total force in this era of declining resources, there is no choice but to seek out and implement the changes required to enable lasting and significant transformation.

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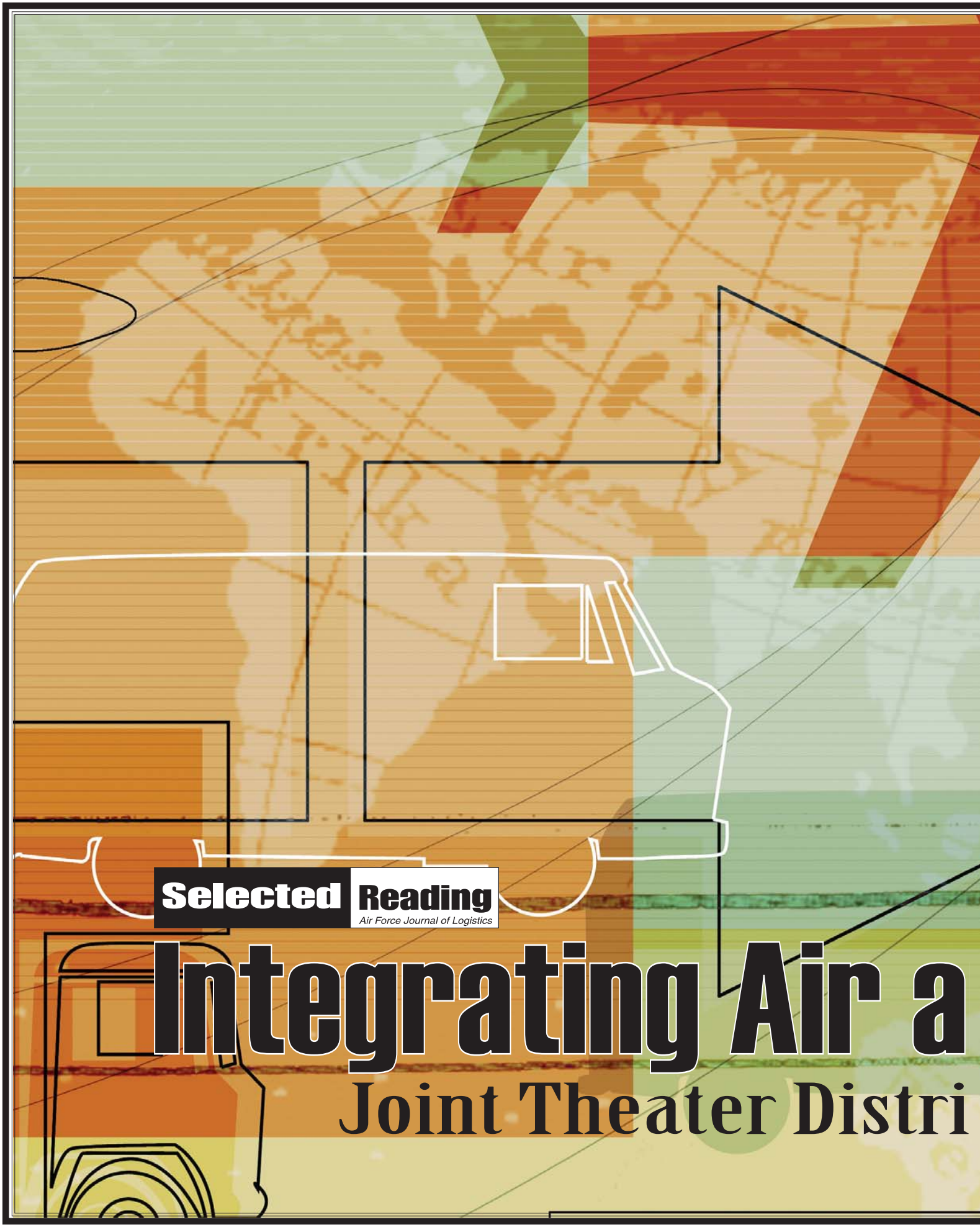

Selected Reading
Air Force Journal of Logistics

Integrating Air a

Joint Theater Distri

nd Ground bution System

David Anderson, DBA
Timothy W. Gillaspie, Major, USAF

Introduction

Logistics is the lifeblood of all combat operations.

Lt Gen Henaidy, Royal Saudi Air Force

Special Feature

During the early phases of Operation Iraqi Freedom and Operation Enduring Freedom, the establishment of a multimodal distribution network was fraught with problems. The organizations required to establish the Joint theater distribution network did not exist or function as required in the case of the Joint Movement Center. Each Service established a portion of the network, but by itself did not establish the entire network. This division of labor caused seams in the Joint theater distribution network. These seams caused dramatic delays and variability in cargo and personnel delivery. V Corps had so many problems with transportation assets that the deputy commander personally approved the allocation of trucks daily. The origin of the delays was doctrine and organization centric: "Current logistics doctrine and systems do not support offensive operations across the distributed battle space."[1] Some doctrinal changes occurred in the following years, such as the creation of the Joint deployment distribution operations center (JDDOC); however, current theater organizations, information systems, and doctrine do not meet the requirements for a seamless Joint theater distribution system.

Our exhaustive research, which included a thorough review of existing distribution literature, multiple interviews, and analysis of air and ground movement data, highlight the magnitude of the problem. The reviewed literature identified a multitude of gaps in doctrine, organizations, and command and control between the Joint community and Services concerning management and execution of the distribution system, to include responsible parties and tasks. Interviews with individuals of varying ranks (captain through major general) who are engaged with theater distribution systems in multiple theaters also identified the seams created by organizations and doctrine. Their experience, coupled with analysis of movement data between locations with aerial ports in the Iraq theater of operations, further support the concept of a single command and control structure for the management of the distribution system.

Furthermore, the JDDOC, supported by Joint movement control battalions (MCB), should become the centerpiece for the management of the distribution system. The Services should retain execution responsibilities for their areas of expertise, but should make every effort to remove the need for ad hoc organizations. The ad hoc organizations typically have inadequate staffing as well as inadequate planning and assessment processes.[2]

The creation of a JDDOC for every combatant commander addresses the issue of coordinating

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.

A single command structure responsible for the movement control of the theater could better utilize available assets to meet mission requirements by selecting the mode that would be most effective for the mission. The data analysis indicated that a single Joint theater distribution, operating with true unity of effort in the management of the system, could meet the objectives of the Joint force commander—in this case, the reduction of the number of convoys conducted. For example, minimum requirements for the use of a C-130 prevent organizations from submitting cargo for air transportation, but a single organization responsible for mode selection could make decisions based on availability of all assets above echelon to use a C-130 for the movement of less than the normal requirement for use of a C-130. The single organization could also reroute cargo to an Army sherpa designated for above echelon support to meet the requirement. These decisions made by a single organization would require changes to the processes for management of the system.

Changes to the processes currently used for the management of the Joint theater distribution system need to occur. Analysis of the interviews concluded that a single or integrated information

intertheater and intratheater movement; however, this organization does not address all of the issues associated with the distribution delays identified in after action reports and RAND research.[3] Current research has shown that gaps still exist between air and land components of the Joint theater distribution system. These gaps are not only organizational, but also technological. The information systems that exist today do not meet the needs of the Joint theater distribution system. We propose a plausible way ahead in closing the gaps and seams that exist in the information network and physical network of the Joint theater distribution system between air and land components.

Detailing the Problem

The literature addressing Joint theater distribution is extensive. It includes works on the establishment and processes of a distribution system, Joint and Service doctrine, research articles, after action reports, briefings on the shortfalls of the current execution of the Joint distribution system, the command, and control of Joint theater logistics, and optimization of a specific portion of the theater distribution system. Major works from organizations and authors such as RAND, the Government Accountability Office (GAO), Colonel Fontenot, in *On Point*, *V Corps as Multi-National Corps – Iraq,* and the Joint Chiefs of Staff in their *Joint Distribution Deployment Enterprise* concept paper; all identify problems with the distribution system. Of the many problems identified, several deal with the air and ground interaction. In-theater experiences and observations identified the largest seams in the theater distribution systems. The seams highlighted in the interviews were the air and surface theater boundary, lack of common systems for managing requirements and capabilities, managing of modes separately, the point of interaction between aerial ports and the movement control team (MCT) and arrival/departure airfield control group (A/DACG), and finally, the managing of priorities for movement. While the creation of the JDDOC addressed some of these problems, several other problems require attention. In *Mending a Seam: Joint Theater Logistics,* several historical examples outline the continuing problems with Joint theater distribution and the capability to get large quantities of material to the theater of operations, but an inability to move that material forward.[4] In 2003, the GAO issued a report describing Department of Defense (DoD) distribution in Operation Iraqi Freedom as inefficient and ineffective.[5] Of the multitude of problems identified in the report, United States Central Command (USCENTCOM), United States Transportation Command (USTRANSCOM), and Defense Logistics Agency could only provide fixes to a few, such as cargo arriving in-theater and requiring repackaging for forward movement. Pure pallets reduced repackaging by shipping complete pallets from the depot to the end user.[6] The GAO also identified the problems that DoD—and specifically USTRANSCOM—encountered with obtaining information systems that communicate with each other to provide intransit visibility (ITV) and asset visibility.[7]

Several authors address the systematic problem the DoD has continued to experience since the Korean War: the transition from intertheater lift to intratheater movement.[8] Inability to smoothly transition from intertheater to intratheater movement creates backlogs at ports and delays the arrival of badly needed resources to frontline units. To improve some of these areas, the

Joint community is working to update Joint distribution doctrine. The doctrine requires updating to capture the considerable changes to the Joint distribution system since early 2003. The draft update to Joint Publication 4-09, *Global Distribution*, incorporates changes such as the JDDOCs, located on the combatant commander's staff to replace the function of the Joint Movement Center. The capstone logistics doctrine, Joint Publication 4-0, update will reflect several of the changes as well.

Doctrine presents several ways for the geographic combatant commander (GCC) to support theater distribution. One way to support theater distribution would be for the GCC to direct the most capable Service to provide the required capabilities and assets.[9] Under this arrangement, the GCC usually delegates operational control (OPCON) of other Service assets to the most capable Service.[10] Joint Publication 4-01.3, *Joint Tactics, Techniques, and Procedures for Joint Theater Distribution,* identifies two positive aspects of the most capable Service concept as "it satisfies requirements at the lowest level possible, and it frees the geographic combatant commander to focus on theater-wide critical issues."[11] Unfortunately, using the most-capable-Service concept does not support a seamless distribution system. The arrangement creates disconnects between air and surface movement because the most capable Services are different. The Air Force provides the most capability to command and control airlift and the Army provides the most capability to command and control ground lift. In very few circumstances would this division not be the case. To create an integrated distribution system, Joint Publication 4-01.3 recommends assigning responsibility to the Joint Movement Center, recently replaced by the JDDOC.[12] The selection of the best method for supporting the Joint team is also difficult because the Services have different concepts of support.

The Services have major differences in concepts of support and the command and control of the support forces, which include the Air Force's concept of agile combat support, the Navy's Sea Based Logistics, and the Army's Modular Force Logistics Concept. These different concepts of support, infrastructure, and force structure that the Services have developed to support them ensure that any solution to distribution problems must address these organizational structures. For example, the design of brigade support battalions (BSB) and logistics readiness squadrons (LRS) supports only their assigned brigade or wing. The BSB or LRS requires significant increases in resources if a Joint force commander (JFC) plans to increase these units' responsibility for supporting other forces. Additionally, the brigade and wing commanders have trained and planned with OPCON of the BSB or LRS, so command and control of these units at the brigade and wing levels must remain intact to ensure effective combat operations.

According to Joint doctrine, the geographic combatant commander (GCC), Service component staffs, and Service component operational units are required to run the theater distribution system and must link together for the system to work.[13] The Air Force was designated the lead Service for common user airlift and the Army was designated the lead Service for common user ground transportation, but no Service has responsibility for integration of the two modes. The designation of USTRANSCOM as the distribution process owner (DPO) and the creation of the JDDOC were a starting point; however, an organization with command and control authority is needed to bridge the gap. The JDDOC derives its authority from the JFC as a part of his Joint Logistics Directorate but does not have command authority over

Article Highlights

technology system for the management of the distribution system, as a single process for requesting movement and monitoring available capability, would dramatically improve an integrated organization's capability to manage the distribution system. The ability to compare all available capabilities and all requirements immediately is key to making good mode decisions in the distribution system.

Distribution system management should occur under a single manager, when possible, to reduce the impact of the natural seams caused by switching between modes.

Article Acronyms

A/DACG – Arrival/Departure Airfield Control Group
AMD – Air Mobility Division
APOD – Aerial Port of Debarkation
BCS3 – Battle Command Sustainment Support System
BSB – Brigade Support Battalion
CJTF – Commander Joint Task Force
CTC – Cargo Transfer Company
DPO – Distribution Process Owner
ESC – Expeditionary Support Command
FWD – Forward
GAO – Government Accountability Office
GCC – Geographic Combatant Commander
IT – Information Technology
ITARS – Intratheater Airlift Request System
ITV – Intransit Visibility
JDDOC – Joint Deployment Distribution Operations Center
JFC – Joint Force Commander
JFSCC – Joint Force Support Component Commander
JOPES – Joint Operational Planning and Execution System
JTF – Joint Task Force
JTF-PO – Joint Task Force-Port Opening
MCB – Movement Control Battalion
MCT – Movement Control Team
TSC – Theater Sustainment Command
USA – United States Army
USCENTCOM – United States Central Command
USJFCOM – United States Joint Forces Command
USMC – United States Marine Corps
USPACOM – United States Pacific Command
USTRANSCOM United States Transportation Command

any forces. The Joint community created Joint Task Force-Port Opening (JTF-PO) to solve the initial short-term problem of opening a Joint theater distribution network. However, JTF-PO does not support beyond 60 days for the sustainment of the Joint theater distribution network.[14]

The most recent draft Joint publication on global distribution calls for an end-to-end distribution system run as a Joint enterprise with sufficient authority to control the flow of materiel and personnel through the distribution pipeline.[15] Currently, only portions of the distribution pipeline run as Joint enterprises. These sections are the ones controlled by USTRANSCOM. In a theater of operations below the Joint task force (JTF) staff level, there are no Joint organizations to reduce the seams in the theater distribution system. So even though the GCC has the authority to control the flow of materiel and personnel through the distribution system, the lack of operational coordination between air and surface components and integration of Service tactical distribution units hampers the GCC's ability to seamlessly control the flow.

Many of the problems with Joint theater logistics stems from the ad hoc nature of the organizations identified to coordinate and control Joint theater logistics.[16] Army and Joint doctrine recognize that ad hoc organizations are required for logistics to operate in a theater of operations. These ad hoc organizations operate at the operational and tactical levels. In Afghanistan, an ad hoc Joint logistics command managed logistics for forces in country.[17] Throughout the USCENTCOM area of responsibility, A/DACGs operate as ad hoc organizations according to Field Manual Interim 4-93.2.[18] There are multiple ad hoc organizations in the USCENTCOM area of operations. Besides the A/DACG, forces in Afghanistan operated with a Joint logistics command and Joint movement control battalion. In Iraq, a Joint distribution center managed the distribution processes. These ad hoc organizations suggest the requirement for standing Joint units to meet the ongoing and future requirements. The Joint force support component commander (JFSCC) concept attempts to address this ad hoc nature of organizations at the operational level.

US Joint Forces Command (USJFCOM) in their Joint Experiment Distribution system covers the Joint Force Support Component Command (JFSCC) and other organizational options. USJFCOM identified that a major push for strategic and operational commands occurred because of the Services' failure to address seams in the distribution system, but an equal push to address the seams at the tactical level has not occurred.[19] Additionally, the creation of the JFSCC does not resolve the central problem—lack of visibility of capabilities and requirements. Only changes to processes and information technology can correct these deficiencies completely.

The processes that are central to distribution occur in the multiple organizations. In general terms, the organizations can be described as execution units and management units. The execution units handle personnel and cargo as they move through the Joint theater distribution system. Most of these units participate in terminal or port operations, or are the airlift squadrons or truck companies executing the movement. Joint Publication 4-01.5 outlines terminal processes as follows:

> Terminal operations involve receiving, processing, and staging passengers. It also includes receiving, loading, transferring between modes, and discharging unit and nonunit equipment and cargo. The main activities executed at terminals are loading and unloading modes of transport, marshalling, manifesting, stow planning, and documenting movement through the terminal.[20]

The MCB and JDDOC are management units that integrate the actions of the execution units to smooth the flow of personnel and materiel in the theater distribution system. The processes that they execute are movement control and distribution management.

In the air to surface interface of the distribution system, terminals are the key nodes.[21] These key nodes, when linked by transportation modes with the right personnel, material-handling equipment, and ITV systems, are the transportation structure in the distribution system.[22] Changes in the mode of transportation create the most visible seams. Every time a passenger or cargo passes between modes of transportation, there is a seam in the transportation system.

The Service organizations create seams in the system at their intersection because of different chains of command. Besides the natural seams between Services, the relationship between organizations in the system creates seams. The interviews raised concerns about the separation between the modes of transportation and the division of responsibilities of the theater distribution system between Services. The command and control relationships that exist according to doctrine for the theater distribution system are different from the command and control relationships executed in the United States Pacific Command (USPACOM) and USCENTCOM.

USPACOM and USCENTCOM do not have any theater ground capability integrated into the JDDOC. All the responsibilities for the ground movement are located in the Army component command. Without the capability to execute complete movement control through all modes of transportation, the JDDOC's effectiveness is hampered with regard to management of the complete theater distribution system. For example, in USCENTCOM the Theater Sustainment Command (TSC) sets and executes the priorities for ground movement and the CENTCOM Deployment Distribution Operations Center sets and executes the priorities for air movement. While the JFC has overarching priorities, the day-to-day execution of these priorities is not linked through unity of command and effort due to the seam created by the division of organizational responsibilities for management of the theater distribution system. This division highlights the problem of using the most capable Service to manage only portions of the Joint theater distribution system.

Service organizations create seams as cargo or passengers pass between organizations from different Services. At the operational level, validated requirements pass between the Services and the JFC, and then back to the Services for execution of the requirement. Seams have developed because of different processes and systems being used for managing requirements and capabilities for a mode. A large seam occurs during the transfer between JTF-PO and the Service organizations that must execute the long-term mission. The limited period for the JTF-PO to provide support at the deployed location creates a problem for the GCC for operations that last longer than the JTF-PO deployment period. The follow-on organizations do not fall under the same chain of command as the JTF-PO and are not

integrated into a single organization with a single command. For example the command and control for the Joint aerial port complex, which under JTF-PO has a single commander, reverts to a two-command system, as highlighted in Joint doctrine. The divided command and control for an aerial port of embarkation starts with the Air Force component having responsibility for the ready line and loading ramp area, the Air Force and United States Marine Corps (USMC) or United States Army (USA) components sharing responsibility for the call forward area, and the USMC or USA components operating the alert holding area and marshalling areas.[23] For an aerial port of debarkation (APOD), the Air Force operates the off-loading ramp area. The holding area responsibilities are split between Air Force forces and USMC or USA forces. The USMC and USA forces control the marshalling area. Doctrine acknowledges the difficulty of operating in this two-command system in a single process.[24] The USMC and USA further complicate the process by making one of the key organizations, the A/DACG, an ad hoc organization. Army doctrine, while highlighting the ad hoc nature of the A/DACG organization, does state that the organization should be composed of cargo transfer company personnel.[25]

To bridge the natural seams that exist in any distribution system, the Joint community and Services developed several organizations. The multitude of organizations created overlaps the command and control issues. For the Joint theater distribution to meet the objectives of the JFC, the organizations that manage and execute the system must provide the capability to coordinate and synchronize the multiple facets of the system with unity of effort. Most of the overlaps in capabilities exist so each Service does not have to depend on another Service to provide the common user logistics capability. The overlaps between the various organizations with the capability to provide common user support indicate areas where possible integration of units may exist. The integration could be in the form of training, organization, operating instructions, or doctrine. The TSC and JDDOC have overlap in roles and responsibilities as defined by their concepts. The major area of overlap is the capability to coordinate with USTRANSCOM representatives and integrate distribution across the modes of transportation. The overlap of responsibilities has created different documents for requesting transportation support.

The current processes reflected in the transportation request process and command and control are not conducive to supporting the principles of theater distribution—specifically, centralized management and continuous, seamless, two-way flow of resources. There are multiple systems used to identify movement requirements with the Services using multiple processes to identify the movement requirements. The Air Movement Request, Transportation Movement Request, and Joint Movement Request are one set of processes for supporting the identification of requirements. In addition to using multiple systems to identify movement requirements, the Services and Joint community use multiple systems to identify the movement capabilities available. These multiple systems create a lack of integration in the management of movement requests as identified in our interviews. In general, the idea of combining the multiple forms into a single process received positive responses from the interviewees. To highlight the utility of the single requirements system, the interview responses reflected a desire for a single ticket process for the shipper. The single ticket process allows cargo or passengers to receive end-to-end scheduling of transportation without the need for additional transportation requests as modes of transportation change. The capability for intermodal management was a primary reason identified for combining the forms. Additionally, the interviewees agreed that the capability to receive a requirement and centrally manage the best mode for that movement was highly beneficial. However, most felt that without the single process owner merging the request forms, they would be ineffective because of the lack of command and control for the requirements.

All ten of the general officers and colonels interviewed supported the management of requirements by one theater organization. They felt consolidation was a positive development for the theater distribution, which, given the proper information technology (IT) capability and a well-defined command and control structure, could be successful. The major concerns expressed were as follows.

- Maintaining the capability of the tactical commander to weigh efforts for lift assets above the echelon supporting his unit
- Lack of IT to make the organization successful
- The ability of Services to maintain assets for their internal support

Data analysis confirmed that the creation of a single structure for the management of requirements, combined with a reduction in the multiple processes and information systems (which hamper the effective and efficient use of the distribution system) could greatly improve the performance of the Joint theater distribution system.

The data analysis further supports that a single organization, given the correct responsibilities and tools, can improve the management of the theater distribution system to meet mission requirements. A comparison of movement data for city pairs during the first 20 days in August 2006 and August 2007 gave a basic picture of a change the MCB made with the handling of cargo for movement between locations in Iraq. A city pair was a match between a mode originating location and a mode destination. Changes made between 2006 and 2007 created a more integrated system to take advantage of space available on aircraft moving between locations in Iraq. One notable change included air marshalling yards controlled by MCTs for cargo that had a long lead time for its required delivery data, and could move via air or ground.[26] This change allowed the MCTs to pick the best way to move the cargo based on requirement, threat, and available assets. While not an entirely Joint approach, the MCTs could not have started this process without the support of the Air Force aerial ports. This change in the handling of cargo played a role in the reduction of air and ground missions in Iraq 1 year later. The reduction occurred even with an increase in the number of combat troops by at least 21,000 in 2007 over 2006,[27] and the number of locations with air missions increasing from 20 locations in 2006 to 23 locations in 2007.

The management of the different modes of transportation in the distribution system by different organizations, tied with the lack of a common IT system to gather and share requirements and capabilities, proved to be the largest seams in the distribution system. In addition to the divided management of requirements

and capabilities, the interviews raised concerns about divided execution at the seams between Service organizations such as the aerial port and A/DACG. The interview responses showed concern with the integration of the distribution system between modes and organizations. They felt the entire system lacked personnel with the required training so prioritization within the system was a problem. The lack of training and poor visibility of the requirements and capabilities in the system also prevented the echeloning of capability to allow for a prioritization and tasking at lower levels. Additionally, the interviewee felt that the lack of training for personnel executing the distribution created a large negative impact on the system and the modes of the distribution system. The individuals were unable to execute the system effectively and efficiently because they did not have the knowledge required to do so.

The following conclusions and recommendations were derived from literature review, interviews, and data analysis. They provide one path to improved performance of the distribution system. One item of interest from the responses received is the lack of a common understanding of what comprises the theater distribution system. This problem highlights the need for increased Joint training on the operation of the Joint theater distribution system starting at the lowest levels.

Conclusions

The normal seams that one would expect to find were identified by the literature review and the interview analysis. These traditional seams included locations where cargo or personnel change modes of transportation, and at the organizations that operate these nodes in the distribution system. The interviews and literature also identified additional seams at areas where information systems do not exchange data. Finally, the exchange between intertheater and intratheater transportation management and execution created the most significant seam in the distribution system because of cargo and personnel change modes, information systems, and organizational management. Doctrine provided additional insights into the Joint theater distribution system.

Doctrine provides a wide range of views on the organization and management of the Joint theater distribution system. Joint doctrine provides an overarching view of the strategic, GCC, and the JTF levels of command and management for the Joint theater distribution system. However, portions of the operational, and most of the tactical, levels of the theater distribution system are divided by Service doctrine. The division inhibits the capability of the system to operate seamlessly by creating gaps between tactical and operational level distribution perception and operation. This is especially troublesome when a Service makes assumptions about the capability of another Service to support a multimodal location such as an aerial port. Movement control doctrine in general does not address how the various forces work together to bridge the seams.

After action reports, RAND, doctrine, and interviews provided detailed insight into the organizations of the current distribution system. These sources identified that the integration of the organizations in the theater distribution system must occur. Additionally, they provided multiple views on how the integration should occur at the operational level of logistics, ranging from a single JFSCC to executing doctrine as written for the JDDOC. At the tactical level, these same sources suggest integration of the organizations that operate multimodal hubs at the Joint aerial port complex and Joint Theater Distribution Center. Some authors suggested an increase in Joint training of the current organizations that operate in those environments and the merging of the Service organizations into Joint organizations to decrease the size of the seam that occurs between air and ground at these points in the distribution system. The Services have integrated their internal distribution systems, whether it is the TSC Distribution Management Center, the Air Force's LRS or Global Logistics Support Center, or USMC's Marine Logistics Group. The strength of these units to respond and provide logistics support for both their own Services and a common user logistics environment show the strength of integrated logistics. Our analysis showed the Joint community beyond the DPO has failed to integrate Joint theater distribution under a single commander or organization. The distribution system management should occur under a single manager, when possible, to reduce the impact of the natural seams caused by switching between modes.

A single command structure responsible for the movement control of the theater could better utilize available assets to meet mission requirements by selecting the mode that would be most effective for the mission. The data analysis indicated that a single Joint theater distribution, operating with true unity of effort in the management of the system, could meet the objectives of the JFC—in this case, the reduction of the number of convoys conducted. For example, minimum requirements for the use of a C-130 prevent organizations from submitting cargo for air transportation, but a single organization responsible for mode selection could make decisions based on availability of all assets above echelon to use a C-130 for the movement of less than the normal requirement for use of a C-130. The single organization could also reroute cargo to an Army sherpa designated for above echelon support to meet the requirement. These decisions made by a single organization would require changes to the processes for management of the system.

Changes to the processes currently used for the management of the Joint theater distribution system need to occur. Analysis of the interviews concluded that a single or integrated IT system for the management of the distribution system, as a single process for requesting movement and monitoring available capability, would dramatically improve an integrated organization's capability to manage the distribution system. The ability to compare all available capabilities and all requirements immediately is key to making good mode decisions in the distribution system. The work USTRANSCOM is conducting on information systems, if supported by the Services, could quickly fix the asset visibility problems.

Recommendations

A single organization responsible for consolidating requirements and committing the Services' capabilities in accordance with Joint doctrine organizations (such as the Joint movement control center) would increase the flexibility of the GCC and JTF commanders to meet movement requirements with the best mode of transportation. The JDDOC provides the capability to execute this organization, if Army personnel dealing with ground

transportation requirements are assigned to the surface cell of the JDDOC. The requirement for a forward JDDOC element stationed with the JTF could meet the need for an organization familiar with local requirements to validate, prioritize, and forward requirements to the Service for execution. The forward element would coordinate all intratheater movement requirements, with the main JDDOC responsible for integration of intertheater movement within the theater distribution system.

Consolidation of cargo yards for ground and air distribution would allow maximum flexibility for transfer between modes and a single authority controlling mode selection ensures the most effective and efficient use of available transportation assets based on the priority of the JFC. Instead of cargo being placed in the aerial port marshalling yard, or in the ground marshalling yard, the cargo should be placed in a general marshalling yard until the mode is decided based on availability of resources, priority, threat, and timing, and then moved to the correct mode for final preparation and Joint inspection. These yards should be collocated for enhanced communication between mode operators.

Management, Organizational, and Process Changes

The organizational structure and division of responsibilities recommended below are in agreement with RAND's most recent publication dealing with the Joint multimodal distribution system.[28] The JDDOC provides the capability necessary to manage the theater distribution system, if properly staffed and resourced according to doctrine. The TSC must give up its capability to manage ground requirements to the JDDOC so that the management of all modes of transportation in the distribution system can be integrated across all Services and at all levels. To integrate across all levels, the JDDOC must utilize the JDDOC forward (FWD) capability to support JTFs for the GCC.

The JDDOC should also change from a center to a command organization for the management of the requirements in a theater distribution system. To provide capability to the lowest levels, MCBs should be assigned to the JDDOC. MCBs provide the management capability required to manage the theater distribution system if they become Joint organizations. Our research has shown that in the current conflict, many MCBs have Air Force liaison officers embedded within the organizations. Instead of making this organization an ad hoc organization, the MCBs should re-flag as Joint organizations and transfer from Army ownership to direct reporting units to the JDDOC at USTRANSCOM. The units should remain at their current home stations for training purposes and for development of the necessary relationships with Expeditionary Support Command (ESC) and sustainment brigades. Additionally, the command relationship with units deployed in an MCB's area of operations should be one of direct support, the same relationship that exists today. MCBs, when deployed, should receive operational command and control from the JDDOC FWD, providing theater management capability from top to the bottom. Each MCB should provide direct support to an ESC or sustainment brigade, depending on the size of the deployment. The MCT relationship should remain as it is today. This organizational structure provides an honest broker capability at all echelons of distribution. The MCBs can maintain their current structure with the addition of Joint personnel with specific Service capabilities for the management of the system. Figure 1 outlines the organizational relationship for the management and execution of the Joint theater distribution. There would be no change in the command relationships for Army organizations as identified in current doctrine and organizational relationships. This figure also represents the execution side of the theater distribution system with the TSC, ESC, and sustainment brigades. These organizations have the responsibility to execute the identified transportation requirements in coordination with the management portion of the theater distribution system.

The Air Force command relationships identified in Figure 1 show no change from current doctrine. The Air Force forces component has OPCON over all assigned Air Force forces and the Joint force air component commander (JFACC) has tactical control (TACON) over those forces provided. The air mobility division (AMD) as the JFACC's airlift controlling authority has a TACON relationship with the air terminal operations center through the layers of command. The Air Force command relationships are for the air execution portion of the distribution system.

The recommendations for changes in the Joint theater distribution system are to the management organizations and their command relationships with each other, and with the execution portion of the theater distribution system. The change of the MCB to a Joint organization assigned in an OPCON relationship with the JDDOC creates a single organization for the management of the theater distribution system at the operational and tactical levels of command. In addition to this change, the TSC and AMD should have direct support relationships with the JDDOC. The JDDOC, through the MCBs and MCTs, should have direct support relationships to the various levels of the execution portion of the distribution system. The direct support relationship of the TSC and AMD to the JDDOC allows the JDDOC to provide management of the execution of the movement requirements and priorities. The JDDOC, as a command organization, must reorganize its structure from a mode driven structure to an operational structure with a current and future operations cell. The manpower for the Joint manning document of the organization exists currently with the exception of the theater ground piece. These manpower billets currently reside in the TSC and ESC. The management portion of these billets (those that handle requirements, allocation, and commitment) should be moved to the JDDOC with the TSC and ESC retaining the billets to execute the ground transportation system. The JDDOC FWD provides the commander Joint task force (CJTF) a direct element into the Joint theater distribution system. The JDDOC FWD, while assigned to the JDDOC, provides direct support to the CJTF. The JDDOC FWD also has OPCON over MCBs assigned in its area of responsibility. The JDDOC retains its current alignment assigned to the GCC. Figure 1 outlines these command relationships.

The removal of the theater designation of what can and cannot move via air would give the flexibility to the movement control organization to use all the modes of transportation available to meet the JFC priorities. The processes necessary for the management of the movement control system at all levels include properly identifying requirements and providing visibility on modal decisions to all organizational levels.

An overarching description of the proposed request and execution systems provides insights into the streamlined nature

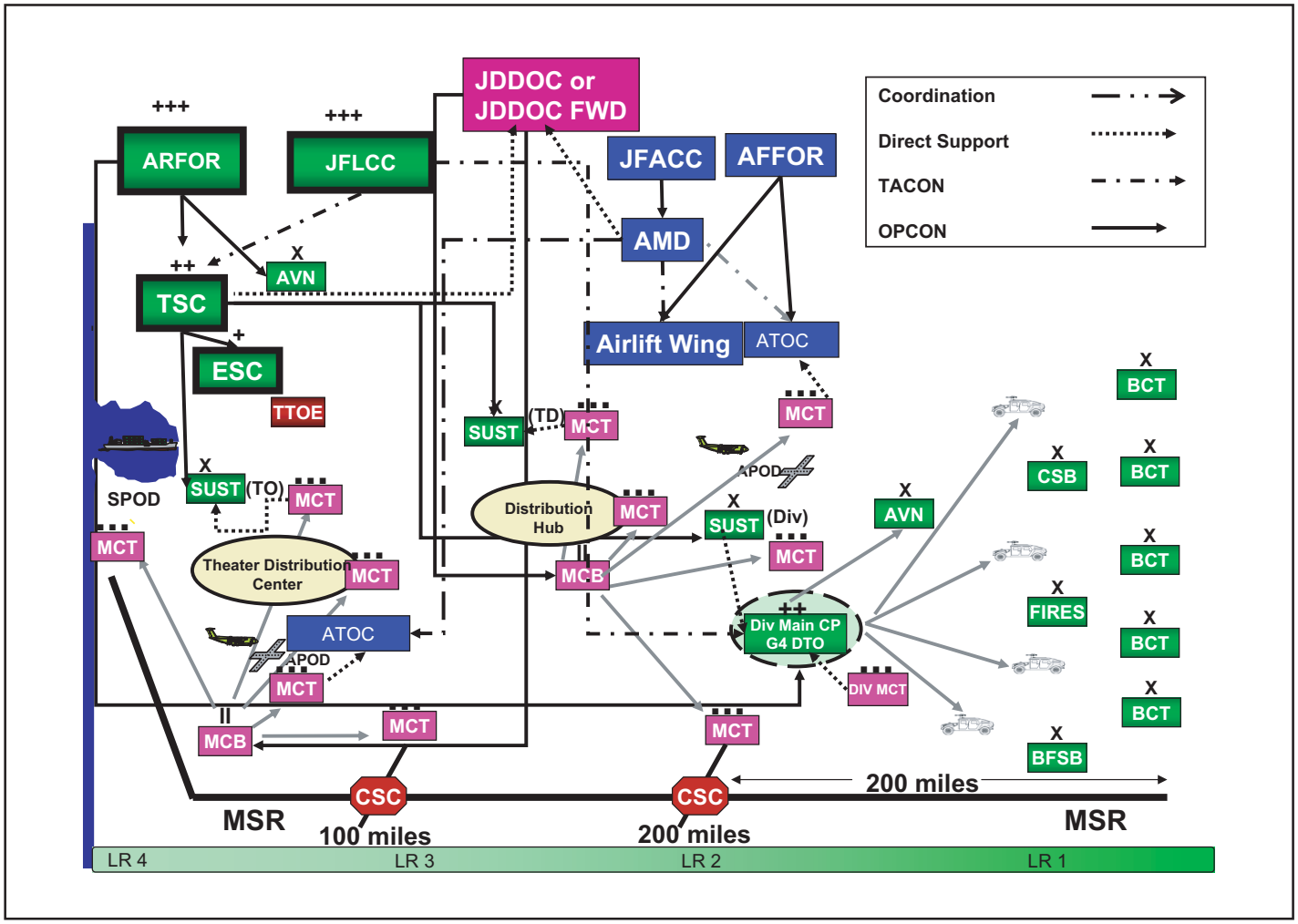

Figure 1. Recommended Organizational Relationships[29]

required to operate a Joint theater distribution system. Starting at the beginning with requirements definition outside of division capabilities (lower right of Figure 2), the division staff coordinates its movement requirements with the Corps Staff in the event that the division MCT does not have the assets available to it for commitment. The MCT forwards the request to the area MCT, normally collocated with a sustainment brigade, for support. The MCT with a support relationship to the sustainment brigade has the ability to commit its transportation assets and provide support to other MCTs in its area of operation. Requests for transportation that are above the MCT's capacity should be forwarded to the MCB for routing to other MCTs for support, or forwarded to the JDDOC FWD. At the division level, the aviation unit assigned to the division can identify assets for the division MCT to commit for movement requests. MCTs can also push cargo to Army aviation units for movement on previously scheduled airlift missions or regularly scheduled lift missions (channel missions) for space available movements. For successful use of channel missions, the MCTs require visibility over all cargo requiring movement at the aerial port so the Joint MCT can better prioritize all cargo for air movement—not just Army cargo.

One area not represented in the figure is the continuous coordination between MCTs. Movement requirements are not all met with formal movement requests, as shown in Figure 2. Some requirements are met by pushing smaller amounts of cargo to a port or terminal for movement on air channel missions or on a space available basis.

Above the division level, the Army Forces Component may designate some aviation assets to support the distribution system. The JDDOC FWD should have responsibility for managing these resources in the same manner as Air Force lift assets. If an MCB cannot support a request from one of its MCTs, the request moves to the JDDOC FWD. The JDDOC FWD reviews and validates the request and forwards the request to the appropriate mode for execution through either the AMD or the ESC. If the JDDOC FWD does not have the assets available for commitment, the request is forwarded to the JDDOC. If the JDDOC determines that ground movement will best support the requirement, the commitment is sent to the TSC. If it determines that airlift best supports the requirement, the commitment is sent to the AMD or to USTRANSCOM for support.

With the management of the request process conducted by a single command and control structure with Joint capabilities, the Services can concentrate on meeting the requirements given to them to execute. Additionally, the parochial concerns of the Services about the fairness of a system managed by one Service or another can be overcome. The changes also ensure that the tactical units are able to influence the Joint theater distribution

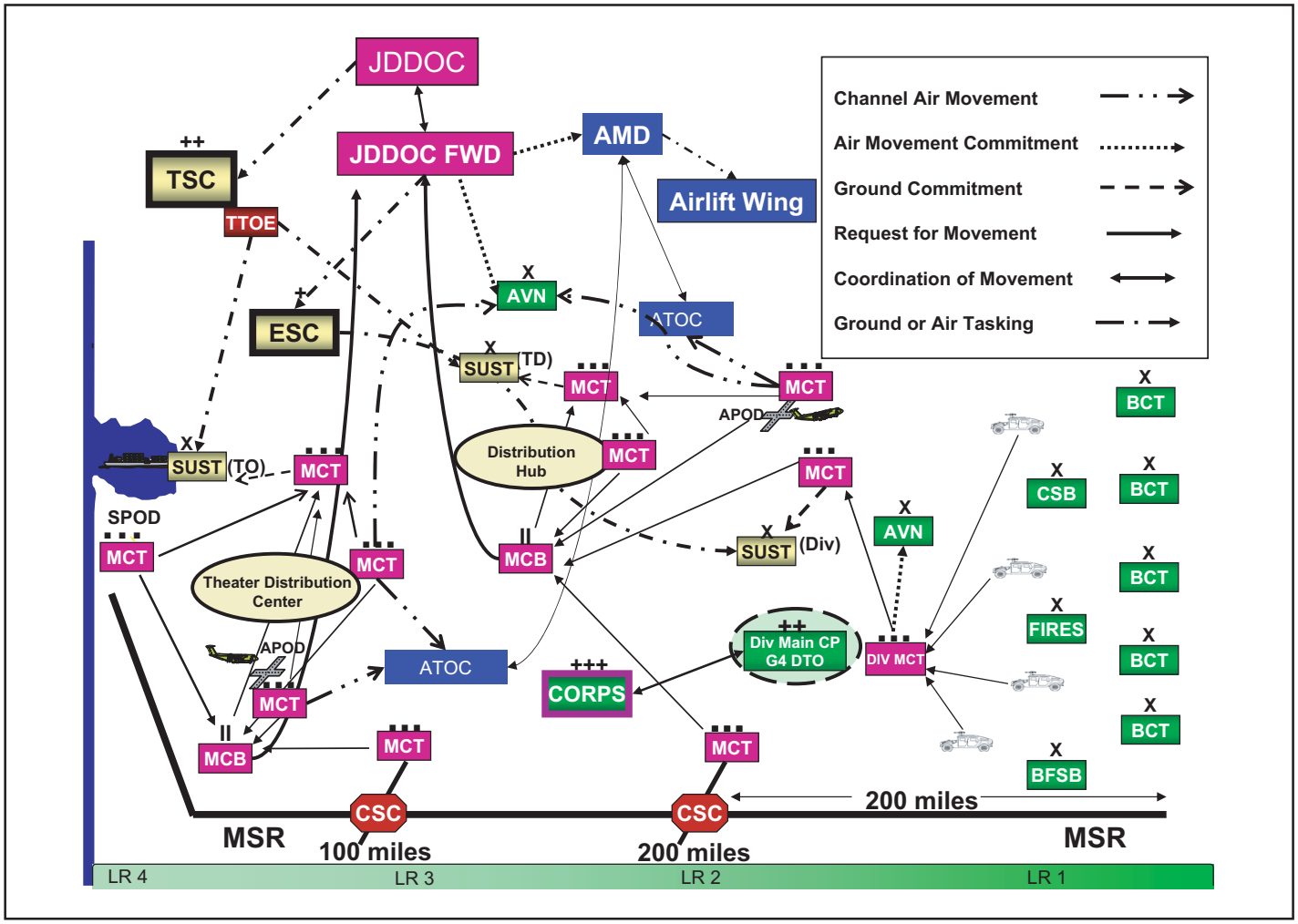

Figure 2. Recommended Joint Movement Request Process[30]

system to the level they require to meet their requirements, as well as the GCC and JTF priorities. The current system's failure to address the tactical commander's concern for airlift due to GCC imposed priorities and limited tactical level system management capabilities creates friction between tactical and operational objectives. Placing management of the system under a single chain of command for unity of effort—with well-defined support relationships of that management system—addresses these concerns.

Execution, Organization, and Process Change

The execution organizations from the Services require little change, with the exception of the Joint aerial port complex. To improve the flow of cargo through the Joint aerial port complex, the A/DACG must cease to be an ad hoc organization. The Army must assign this responsibility to one of the cargo transfer company's platoons or entire cargo transfer companies (CTC), as necessary. To improve execution of the system, these CTCs should be collocated and teamed with Air Force units for training purposes at locations such as McChord Air Force Base and Ft Lewis, Washington. In addition, the Joint movement control teams should be further integrated into the training of the Joint aerial port complex so a single set of instructions can be developed for the execution of aerial port activities and reduce the seam created by personnel in an ad hoc organization unfamiliar with the aerial port system.

The Joint community should seek to link existing aerial port squadrons and logistics readiness squadrons with existing movement control battalions and cargo transfer companies for training and experience exchange, especially at locations with collocated Army and Air Force units. This enhanced training would greatly increase the capability of units to function as a team in-theater when they move to replace JTF-PO for sustainment operations at the APOD or intratheater terminals and increase the number of units capable of providing JTF-PO type functions. If Services are unwilling to integrate training and positioning of forces as ready tailored teams to meet the needs of the GCC, the Air Force should explore training the Air Force Traffic Management career field personnel to carry out the MCT port clearing duties. The training of traffic management airmen to execute these responsibilities would create a team capable of meeting the need to integrate theater ground and air within a single tactical organization at the aerial port.

Information Technology Systems

USTRANSCOM's Theater Enterprise Deployment Distribution project identifies the gaps in IT systems. This USTRANSCOM project must be successful at providing one-stop shopping for the planner to see all requirements and all capabilities including ITV to allow for dynamic rerouting of theater capabilities and requirements. The effort should consolidate the Intratheater

Airlift Request System (ITARS), Global Air Transportation Execution System (GATES), Cargo Movement Operations System (CMOS), Transportation Coordinator's Automated Information for Movement System II, Battle Command Sustainment Support System (BCS3), and Transportation Logistics (TRANSLOG) Web data to provide complete requirements to the distribution planner and user. While not discussed in detail in this article (because it often involves intertheater movement), the data for movement requirements from the Joint Operational Planning and Execution System (JOPES) should be incorporated into the system, because the deployment and redeployment of forces places large requirements on theater distribution. The combined system should also pull the data from JOPES for deployment and redeployment requirements. Additionally, ITV systems for ground (MCT, BCS3) and air must be incorporated into the structure. In the short term, the combining of ITARS and TRANSLOG Web to create a single system for requesting lift would increase visibility of all requirements and aid in the management of the current organizational structures.

The ad hoc nature of the processes and organizations in current doctrine and theater distribution—mainly along Service lines—creates a less than seamless theater distribution system. The result of failing to improve the theater distribution processes is the continued poor effectiveness and efficiency experienced during Operation Enduring Freedom and Operation Iraqi Freedom. The Services must overcome their parochialism toward Service capabilities and integrate these capabilities through information systems and integrated management of the system.

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***Major Timothy W. Gillaspie** is currently the Commander, 375th Logistics Readiness Squadron, Scott Air Force Base, Illionis. At the time of writing this article, he was a student at the Army Command and General Staff College, Fort Leavenworth, Kansas.*

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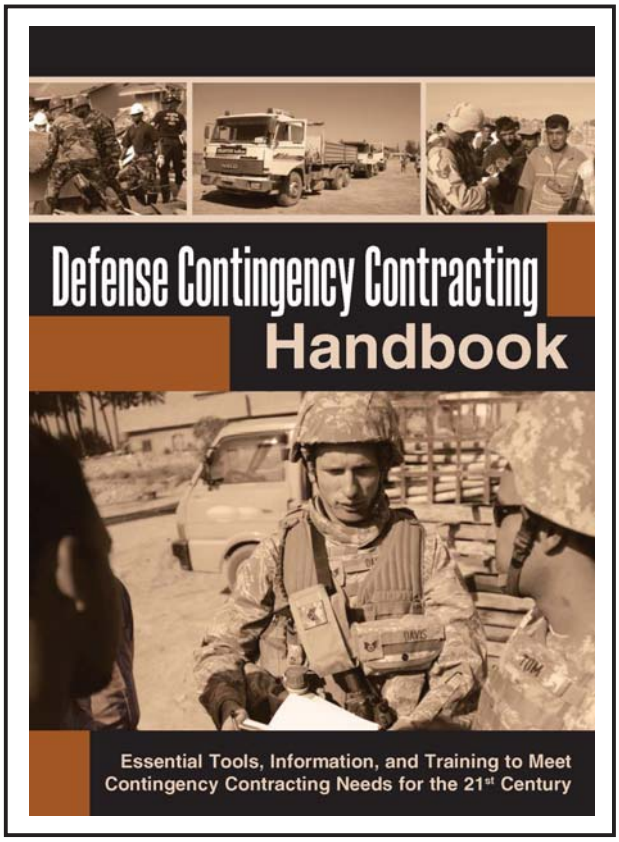
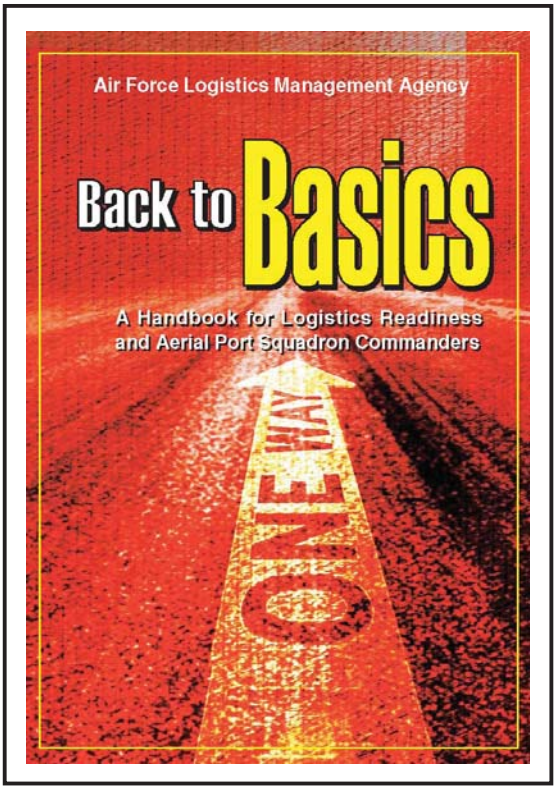


contingency contracting

Contingency contracting support has evolved from purchases under the simplified acquisition threshold to major defense procurement and interagency support of commodities, services, and construction for military operations and other emergency relief. Today, this support includes unprecedented reliance on support contractors in both traditional and new roles. Keeping up with these dramatic changes, while fighting the Global War on Terror, is an ongoing challenge. This pocket-sized handbook and its accompanying DVD provide the essential information, tools, and training for contracting officers to meet the challenges they will face, regardless of the mission or environment.

back to basics

This handbook is designed to serve as a quick reference functional guide. It is broken down by process, similar to the current logistics readiness squadron and proposed aerial port squadron structures. The areas covered include deployment and distribution, fuels management, materiel management, vehicle management, traffic management, and aerial port. The handbook also contains quick facts on high-profile logistics areas such as nuclear weapons-related materiel and the Air Force Global Logistics Support Center.



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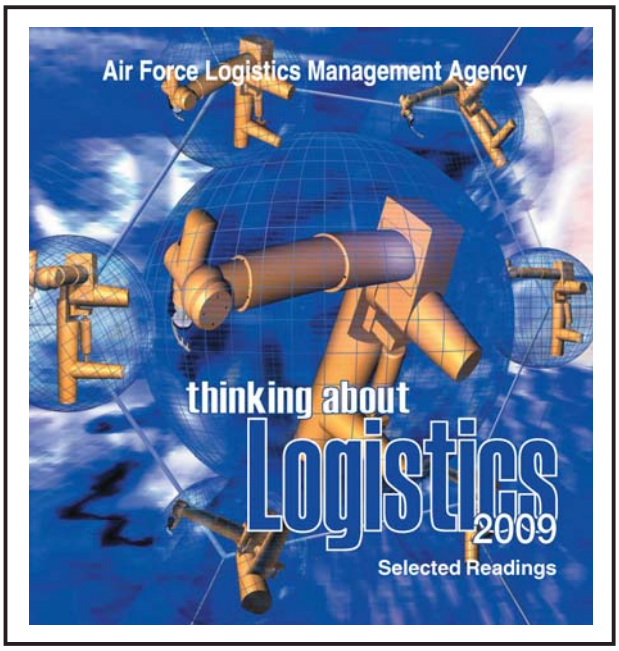
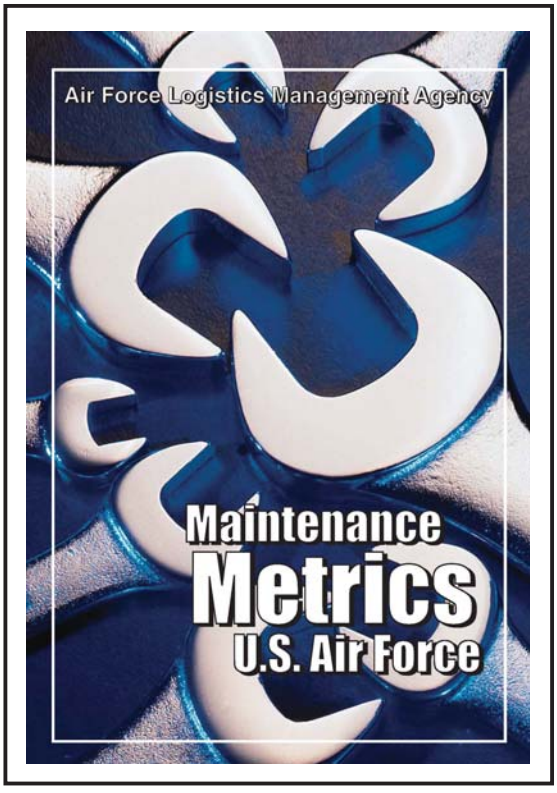


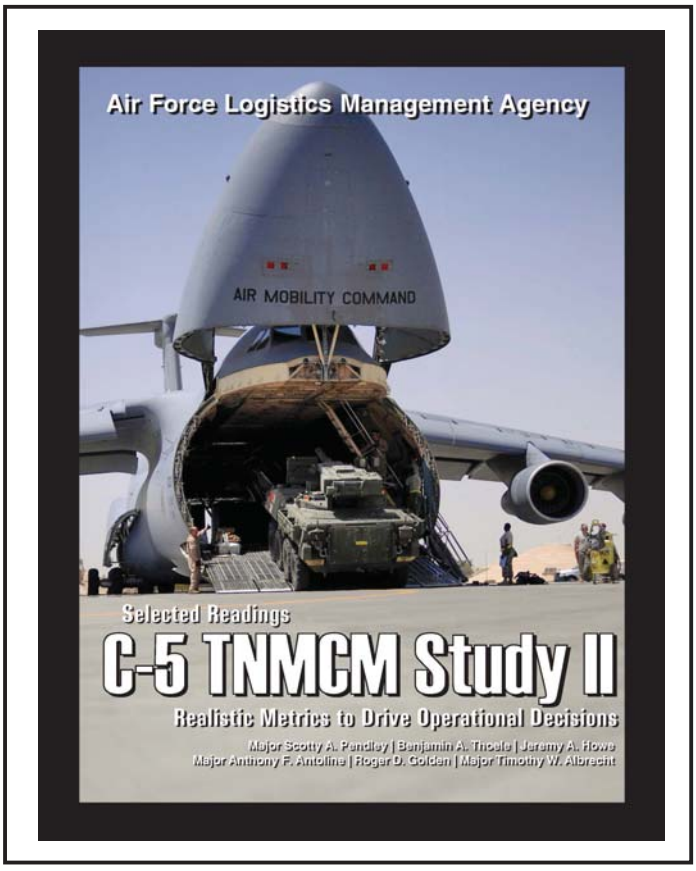
thinking about logistics 2009

Thinking About Logistics 2009 is a collection of 37 essays and articles—in three sections: Historical Perspective, Contemporary Thought and Issues, and Studies and Analyses—that lets the reader look broadly a variety of logistics areas. Included in the volume is the work of many authors with diverse interests and approaches. The content of ***Thinking About Logistics 2009***, ranging across approximately 10 years, was selected for two basic reasons—to represent the diversity of the ideas and to stimulate thinking.

maintenance metrics

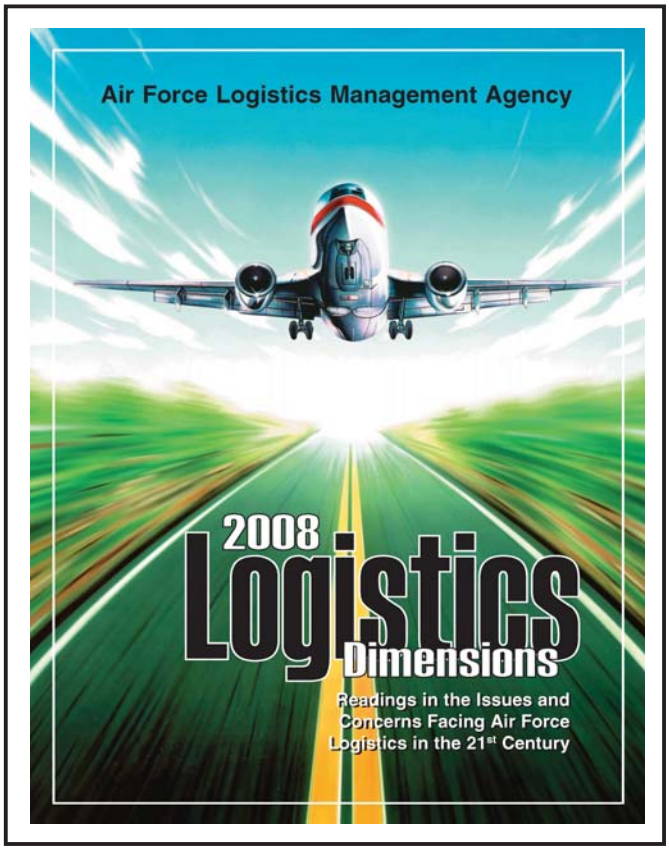
This handbook is an encyclopedia of metrics and includes an overview to metrics, a brief description of things to consider when analyzing fleet statistics, an explanation of data that can be used to perform analysis, a detailed description of each metric, a formula to calculate the metric, and an explanation of the metric's importance and relationship to other metrics. The handbook also identifies which metrics are leading indicators (predictive) and which are lagging indicators (historical). It is also a guide for data investigation. Limited quantities. New version in development.





C-5 TNMCM study II

The ***C-5 TNMCM Study II*** proved to be a stern test of AFLMA's abilities and perseverance. The research addressed areas of concern including maintaining a historically challenged aircraft, fleet restructuring, shrinking resources, and the need for accurate and useful metrics to drive desired enterprise results. The study team applied fresh perspectives, ideas and transformational thinking. They developed a new detailed methodology to attack similar research problems, formulated a new personnel capacity equation that goes beyond the traditional authorized versus assigned method, and analyzed the overall process of setting maintenance metric standards. A series of articles was produced that describes various portions of the research and accompanying results. Those articles are consolidated in this book.



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Logistics Dimensions 2008 is a collection of 19 essays, articles, and vignettes that lets the reader look broadly at a variety of logistics concepts, ideas, and subjects. Included in the volume is the work of many authors with diverse interests and approaches. The content was selected for two basic reasons—to represent the diversity of the ideas and to stimulate thinking. That's what we hope you do as you read the material—think about the dimensions of logistics.

Have you noticed there seems to be a void when it comes to books or monographs that address current Air Force logistics thought, lessons from history, doctrine, and concerns? We did, and we're filling that void. Our staff produces and publishes selections of essays or articles—in monograph format—on a quarterly basis. Each has a theme that's particularly relevant to today's Air Force logistics. Informative, insightful, and in many cases, entertaining, they provide the Air Force logistics community the kind of information long taken for granted in other parts of the Air Force.

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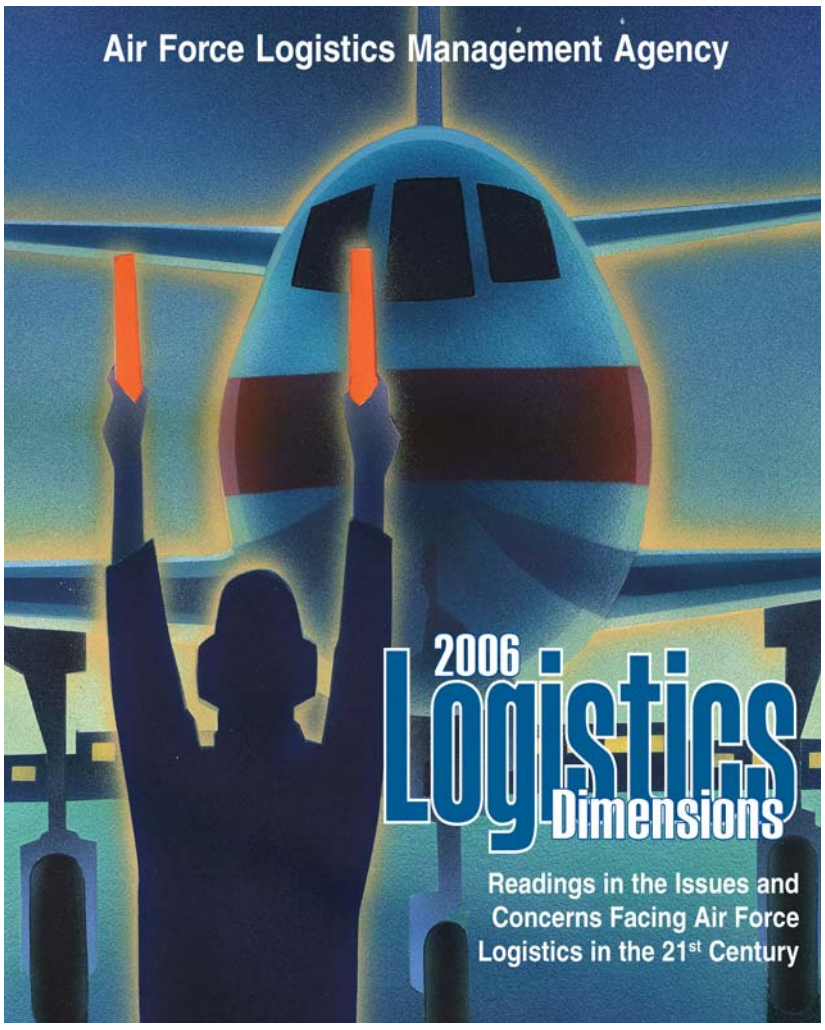
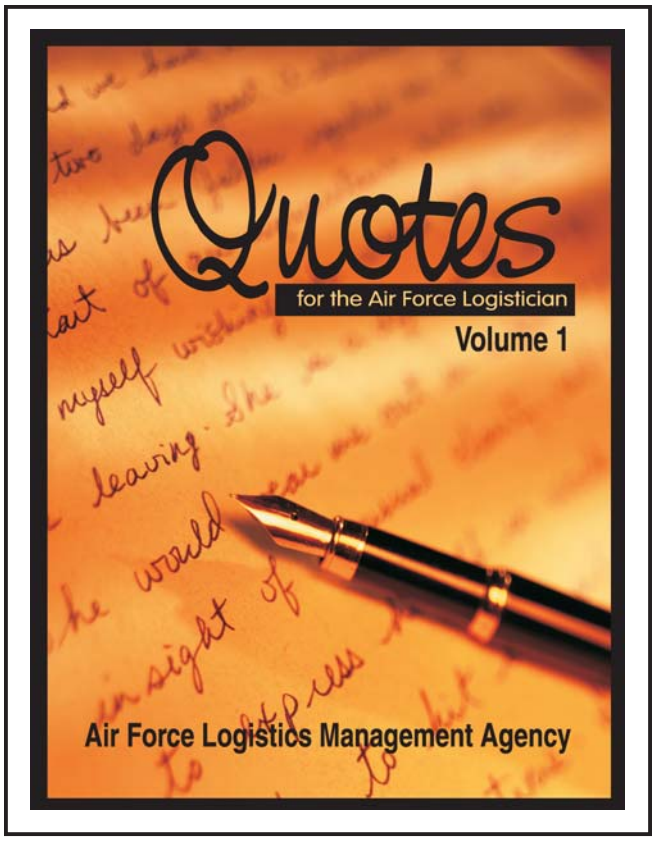


2006 logistics dimensions

Logistics Dimensions 2006 is a collection of 25 essays, articles, and vignettes that lets the reader look broadly at a variety of logistics concepts, ideas, and subjects. Included in the volume is the work of many authors with diverse interests and approaches. The content was selected for two basic reasons—to represent the diversity of the ideas and to stimulate thinking. That's what we hope you do as you read the material—think about the dimensions of logistics. Think about the lessons history offers. Think about why some things work and others do not. Think about problems. Think about organizations. Think about the nature of logistics. Think about fundamental or necessary logistics relationships.



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Quotes for the Air Force Logistician, Volume 1 is a teaching resource that can be used in classroom, education, training, and mentoring programs for Air Force logisticians. It is a tool that can be used by instructors, teachers, managers, leaders, and students. It is also a tool that can be used in research settings and a resource that should stimulate comment and criticism within educational and mentoring settings. Copies of the book are provided free of charge to any Air Force logistician, educational institution, teacher, instructor, commander, or manager. ***Quotes for the Air Force Logistician, Volume 1*** is packaged with ***Quotes for the Air Force Logistician, Volume 2*** as a boxed set.

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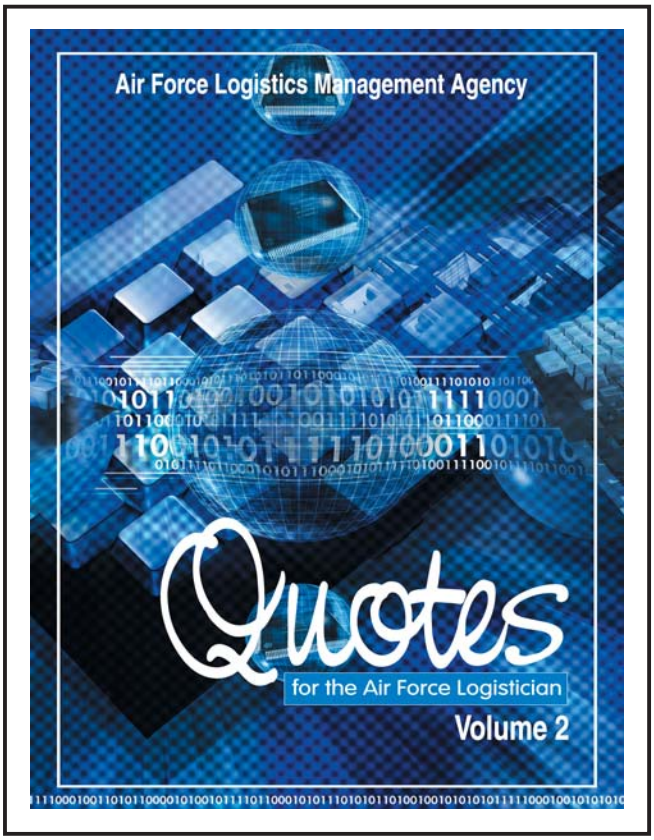

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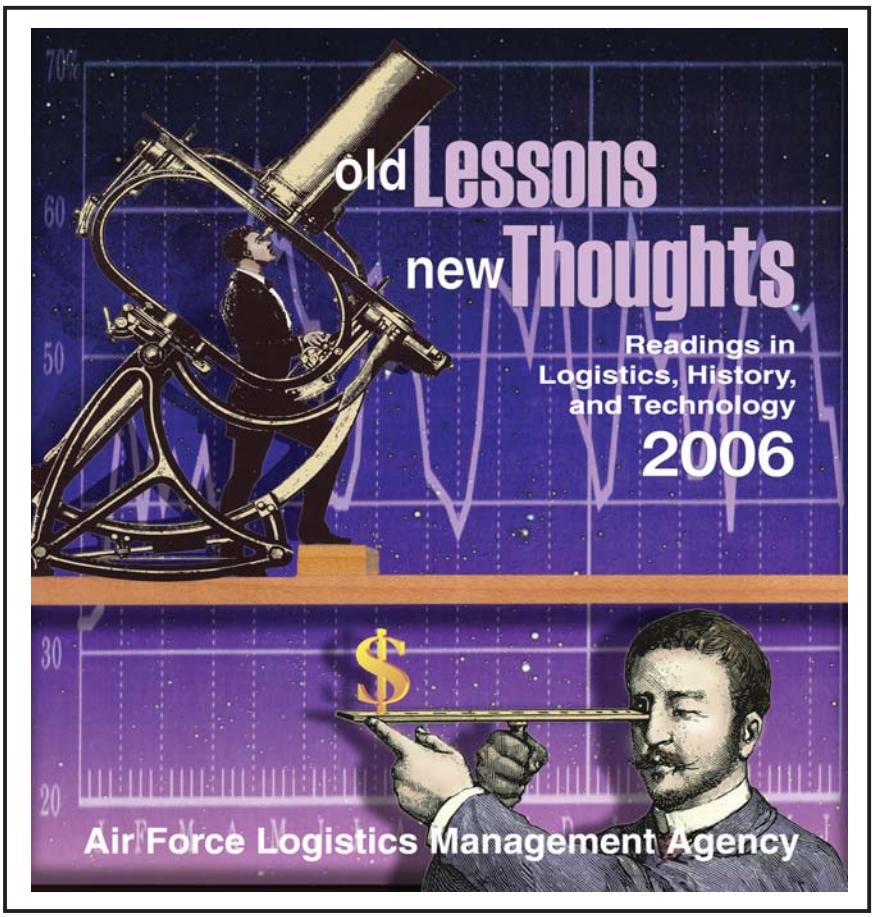

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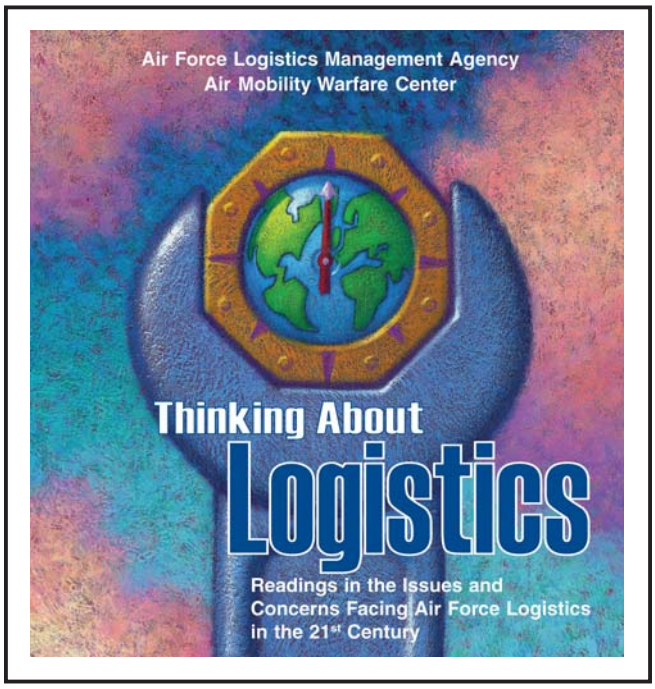
Old Lessons New Thoughts 2006 **is a collection of 28 essays, articles, and vignettes that lets the reader look broadly at a variety of logistics and technological areas through the lens of history. Included in the volume is the work of many authors with diverse interests and approaches. The content was selected for two basic reasons—to represent the diversity of ideas and to stimulate thinking.**



thinking about logistics

Thinking About Logistics is a collection of papers written by students taking the Advanced Logistics Readiness Officer Course at the Air Mobility Warfare Center, Fort Dix, New Jersey. The focus of the work is on issues facing Air Force logistics in the 21st century, particularly supporting expeditionary airpower.

aef fuels management pocket guide

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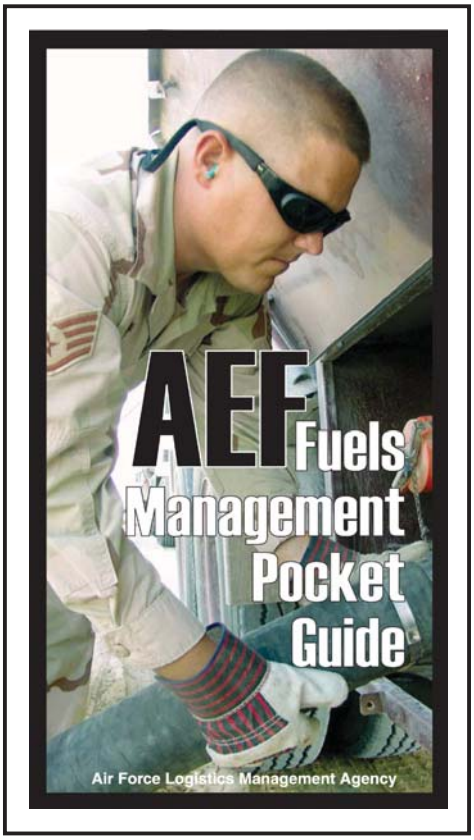

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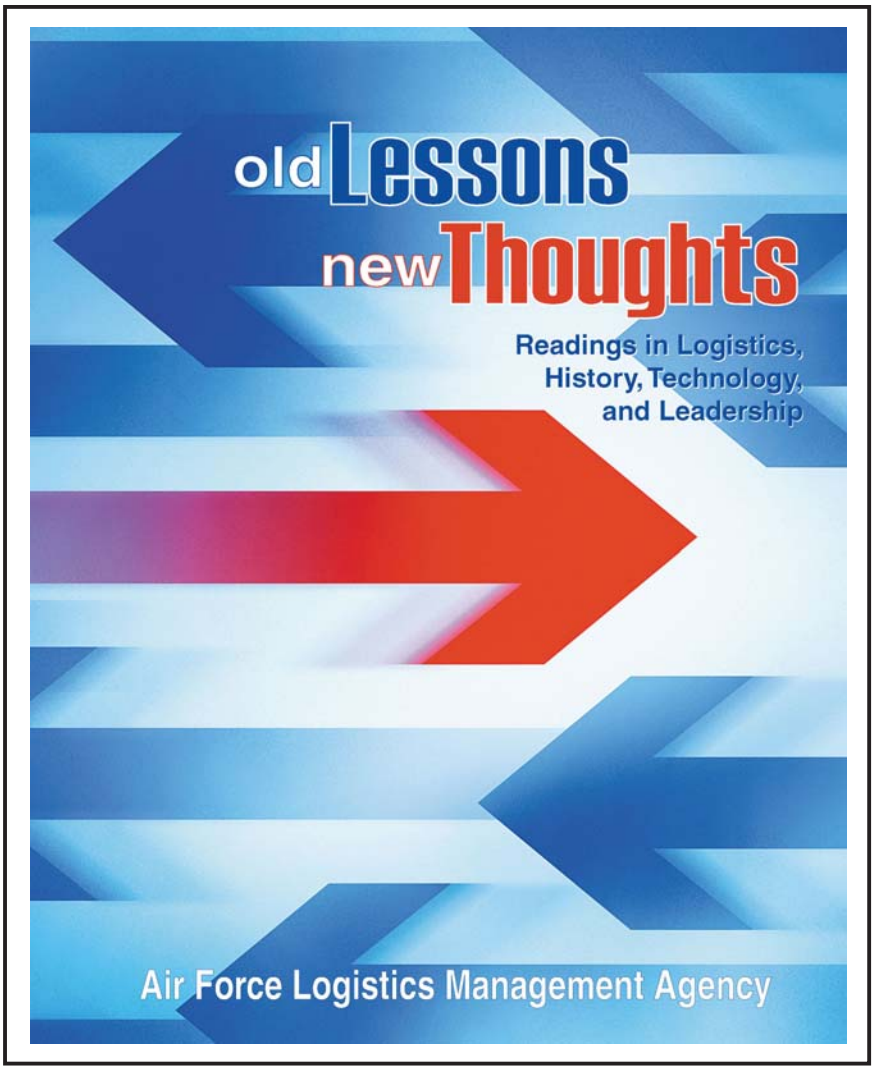
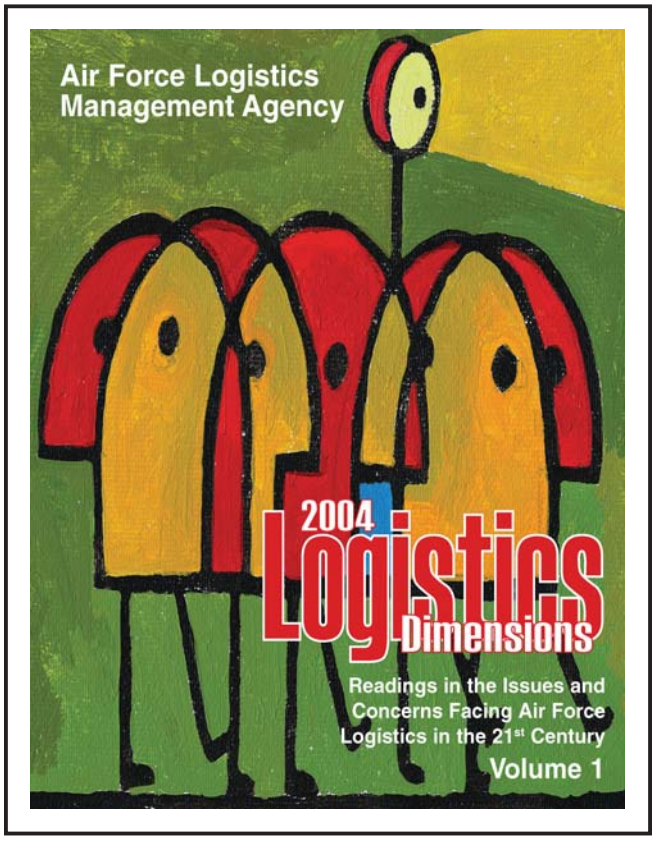


old lessons, new thoughts

Old Lessons, New Thoughts is a collection of seven essays or articles that lets the reader examine logistics and technological lessons from history that are particularly applicable in today's transformation environment. The majority of the articles and essays are the result of work done at the Air Command and Staff College during 2002 and 2003. Specific subject areas include oil logistics in the Pacific during World War II, German wonder weapons and logistics failings, advanced technology and modern warfare, leading the "nexters" generation, and Allied failings during the battle of the Kaserine Pass.

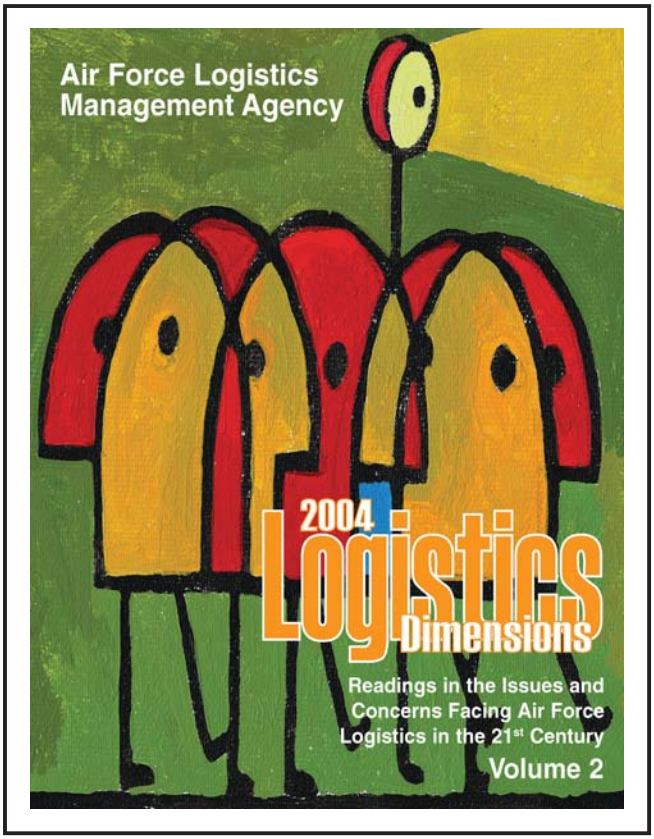


2004 logistics dimensions, volume 1

is a two-volume collection of essays and articles that looks at a broad range of logistics challenges facing the Air Force in the 21st century. Four major themes dominate the work presented—agile combat support (ACS), global support and mobility, supporting and maintaining aircraft, and contractor support and its implementation and implications. All the major articles and essays are the result of work done at the Air War College during 2003 and 2004. Specific subject areas included in Volume 1 include ACS, bare-base support in the ACS framework, global combat support systems, reducing the logistics footprint within the ACS framework, transformation, defense industrial base, global and theater mobility, and transportation technology implementation.

2004 logistics dimensions, volume 2

Logistics Dimensions 2004 **is a two-volume collection of essays and articles that looks at a broad range of logistics challenges facing the Air Force in the 21st century. Four major themes dominate the work presented—agile combat support, global support and mobility, supporting and maintaining aircraft, and contractor support and its implementation and implications. All the major articles and essays are the result of work done at the Air War College during 2003 and 2004. Specific subject areas included in Volume 2 include supporting aging aircraft, integrating active Air Force and Reserve units, recapitalizing tanker aircraft, aircraft modification versus new aircraft procurement, contractor support and contractors on the battlefield, and financial management as a force multiplier.**



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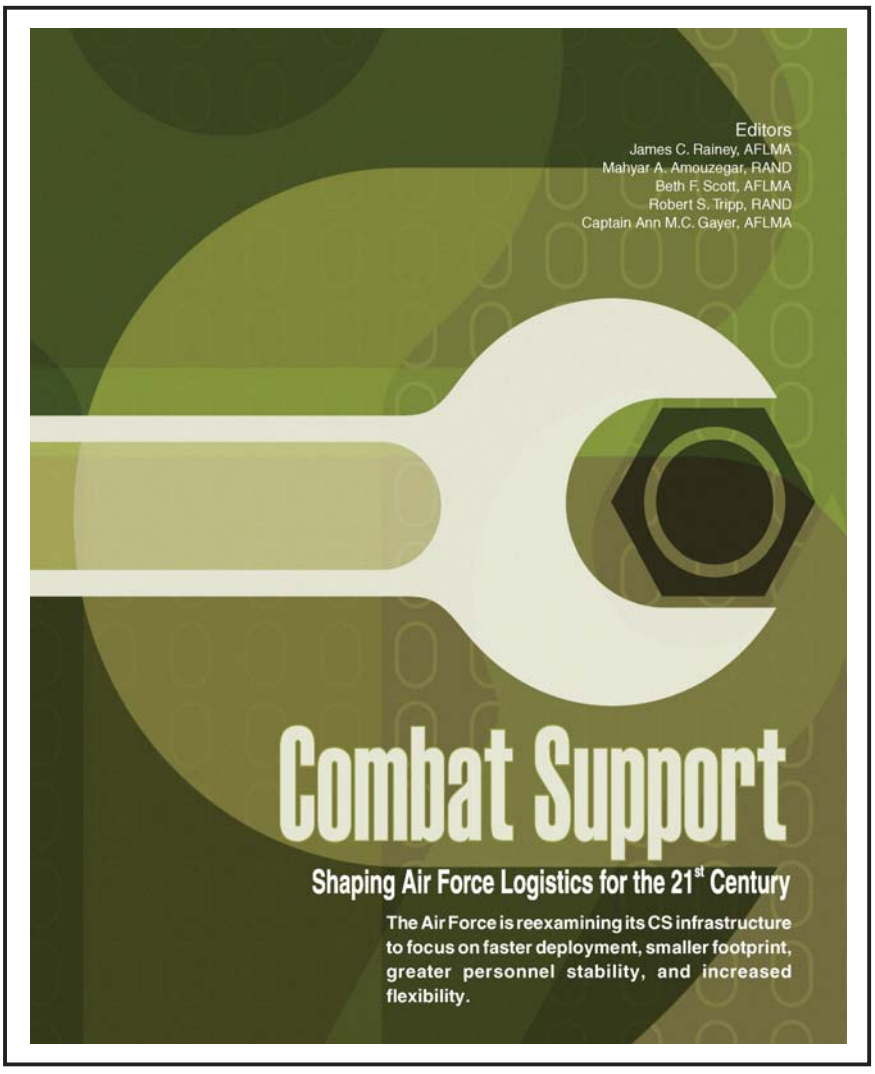
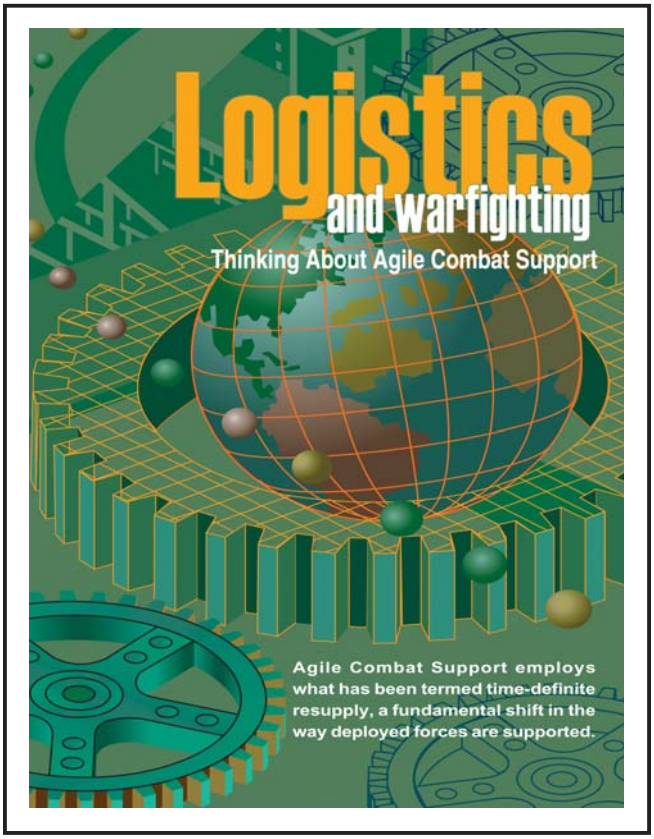


combat support

This publication communicates the essentials of the combat-support analyses completed by the Air Force Logistics Management Agency and RAND. The research was conducted to help the Air Force configure the agile combat support system in order to meet expeditionary airpower goals. These articles also illustrate how analysis can, when properly accomplished, influence Air Force policymaking. Additionally, the book can be used as a teaching document, illustrating the complexity of Air Force logistics systems and processes, as well as an archive of analytic methodology applied to military policy analysis. As a whole, the book can serve as a history of logistics during this 6-year period of extensive change, detailing where the Air Force has come from and why. Further, an examination of the entire collection can serve as an example of how to manage complex change and how to study large complex issues. Limited quantities.

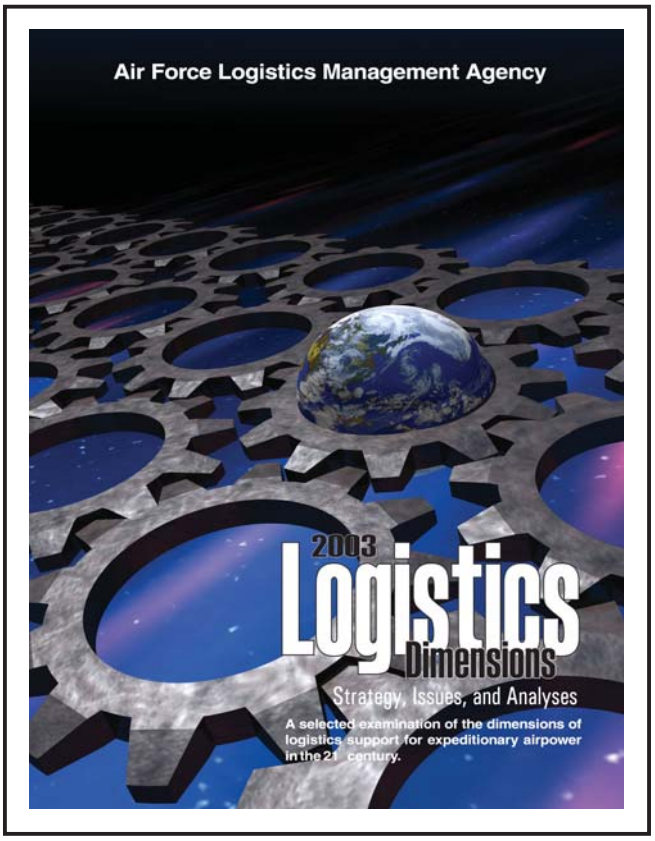


logistics and warfighting

This small book is a collection of essays, articles, and studies that lets the reader look broadly at many of the issues associated with agile combat support. The content was selected to both represent the diversity of the challenges faced and stimulate discussion about these challenges. Also included is a short history of transporting munitions. Limited quantities.

2003 logistics dimensions

Logistics Dimensions 2003 is a collection of seven essays, articles, and studies that lets the reader look broadly at many of the issues associated with the expeditionary air force of the 21st century. While small, ***Logistics Dimensions 2003*** addresses several of the major issues or challenges facing Air Force logistics. The content was selected to represent the diversity of the challenges faced and stimulate discussion about these challenges. Limited quantities.



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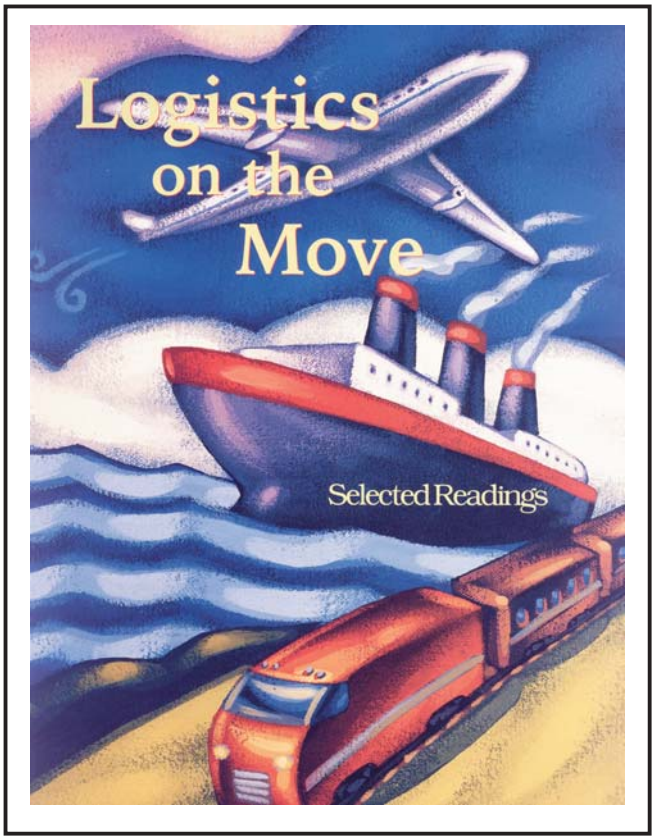
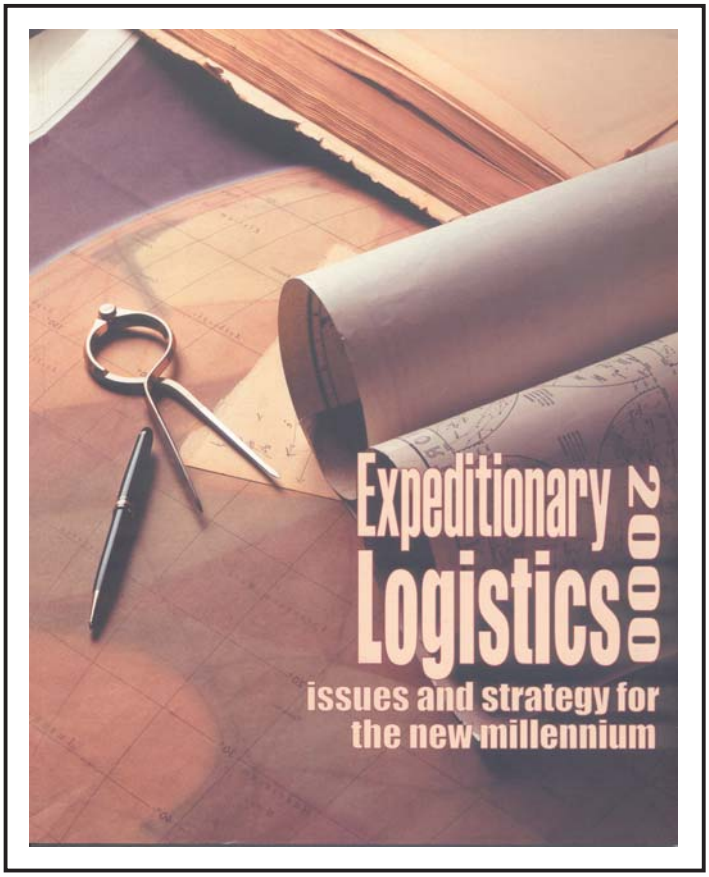


logistics on the move

Logistics on the Move **is a collection of essays and articles that looks broadly at five areas of significant interest to logisticians—logistics thought, competitive sourcing and privatization, lessons from history, international logistics, and technology.**

expeditionary logistics 2000

The force being molded today differs drastically from its predecessors. Rather than being reactive, airpower must now be proactive to meet the needs of a rapidly changing world. Today's definition of expeditionary airpower means a rapid response force that is light, lean, and tailored to mission needs. What are the challenges, opportunities, and initiatives that need examination? And perhaps more important, how do existing logistics concepts and principles need to change to support expeditionary airpower. ***Expeditionary Logistics 2000: Issues and Strategy for the New Millennium*** **examines a number of these questions through a collection of selected readings.**



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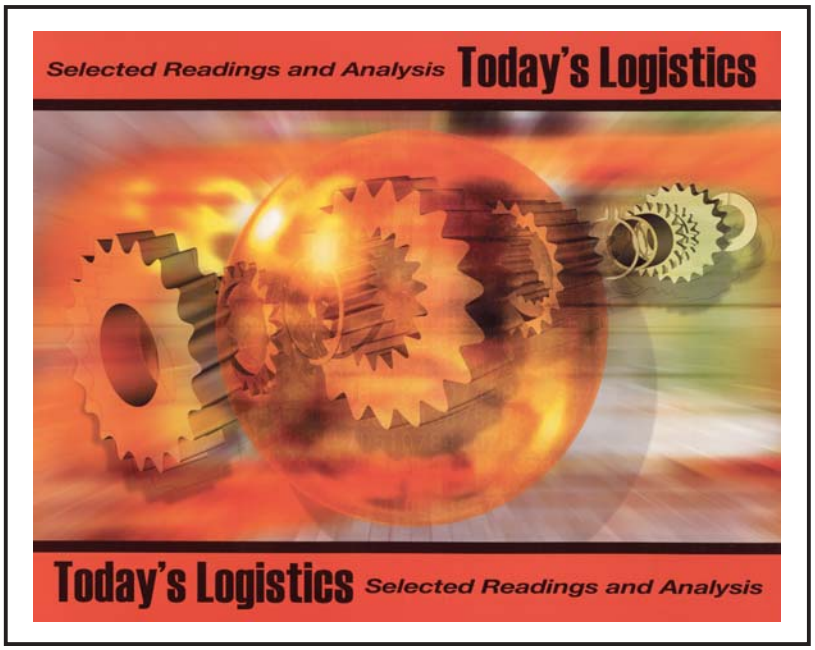
Two of our most popular handbooks or guidebooks—*Maintenance Metrics U.S. Air Force* and *Contingency Contracting: A Handbook for the Air Force CCO*—are also available in electronic format. As with our other books or monographs, they may be downloaded from the AFJL WWW site (http://www.aflma.hq.af.mil/lgj/Afjlhome.html) in portable document format and can be viewed online or downloaded.

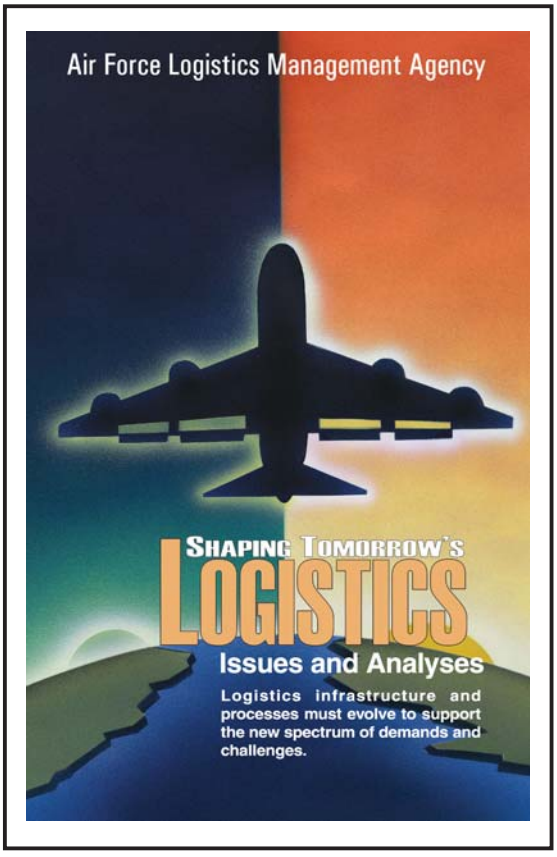


today's logistics

Today's Logistics **is a collection of essays, articles, and studies that are very much about change, innovation, and finding ways to improve processes and products. The majority of the writings deal with improving specific facets of Air Force logistics: supply, transportation, maintenance, contracting, and prepositioning. However, other works have been included that focus on logistics thought, theory, crime, and history. Much of the material is based on work performed by the staff at the Air Force Logistics Management Agency.**

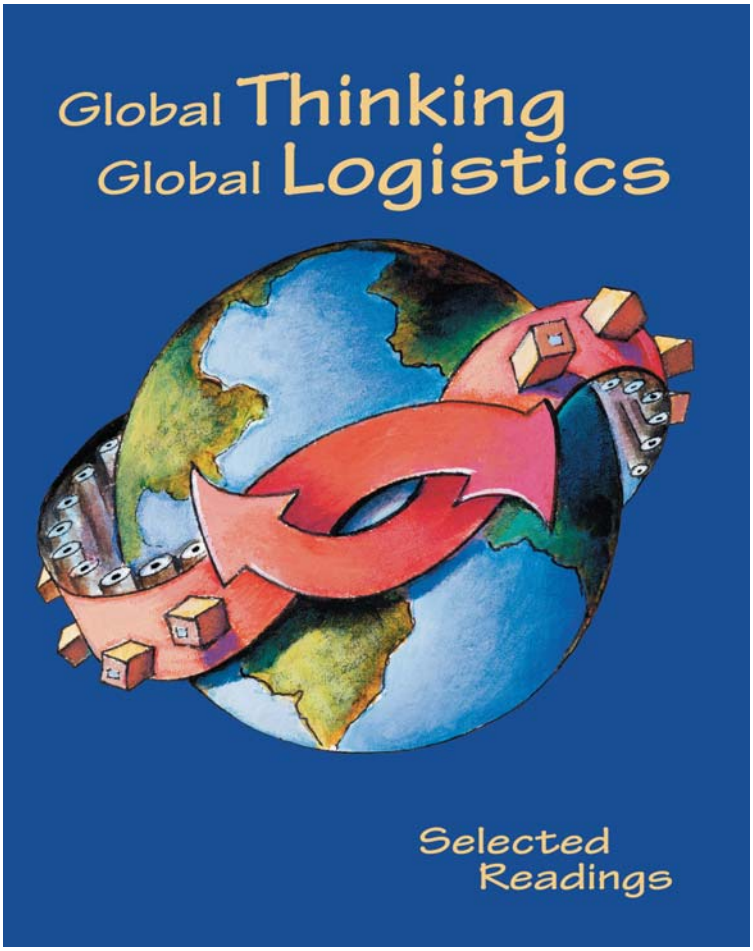
shaping tomorrow's logistics

Shaping Tomorrow's Logistics **is a collection of 12 essays, articles, and studies that lets the reader examine a variety of research and thought that speaks to shaping and changing tomorrow's Air Force logistics. Included in the volume is the work of many authors with diverse interests and approaches. Much of the research discussed herein was conducted at the Air Force Logistics Management Agency.**



global thinking, global logistics

Global Thinking, Global Logistics is a collection of articles and essays by many authors with diverse interests and approaches. However, it contains four distinct areas of interest or issues that face the military as we enter the 21st century: competitive sourcing and privatization, logistics support, logistics history and doctrine, and current challenges. The content was selected for two reasons: to represent the diversity of global logistics issues facing the military of the next century and stimulate thinking about these issues.



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education, training, and mentoring

education, training, and mentoring

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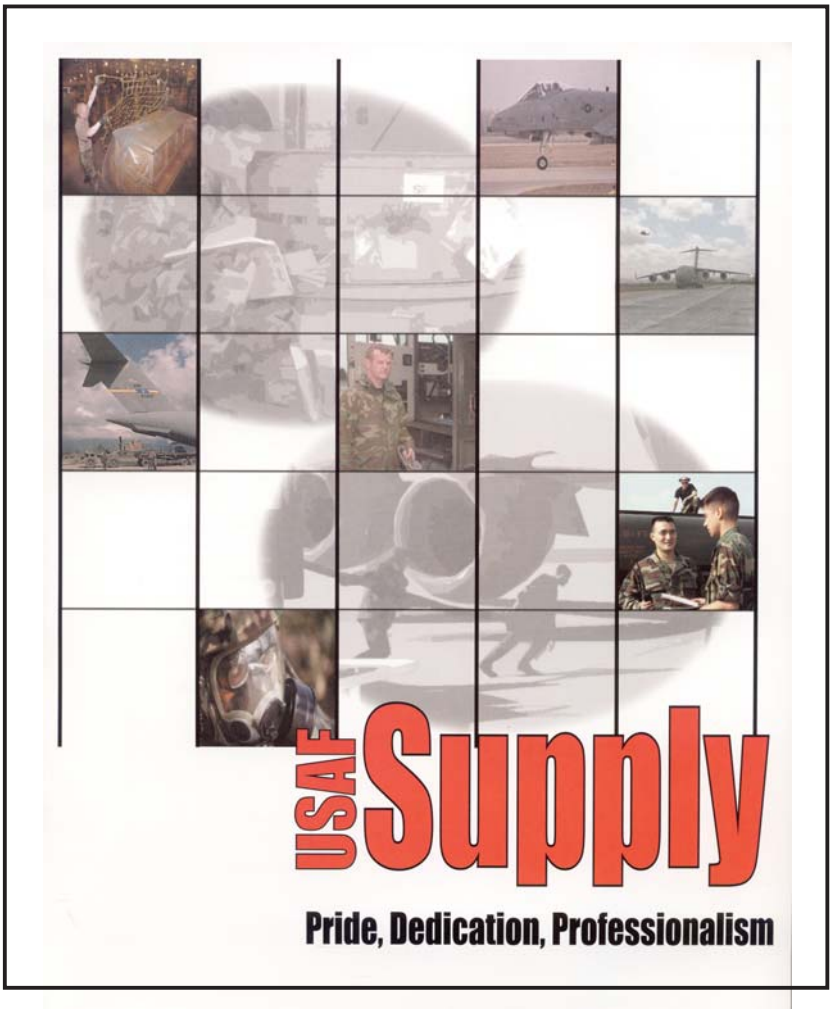
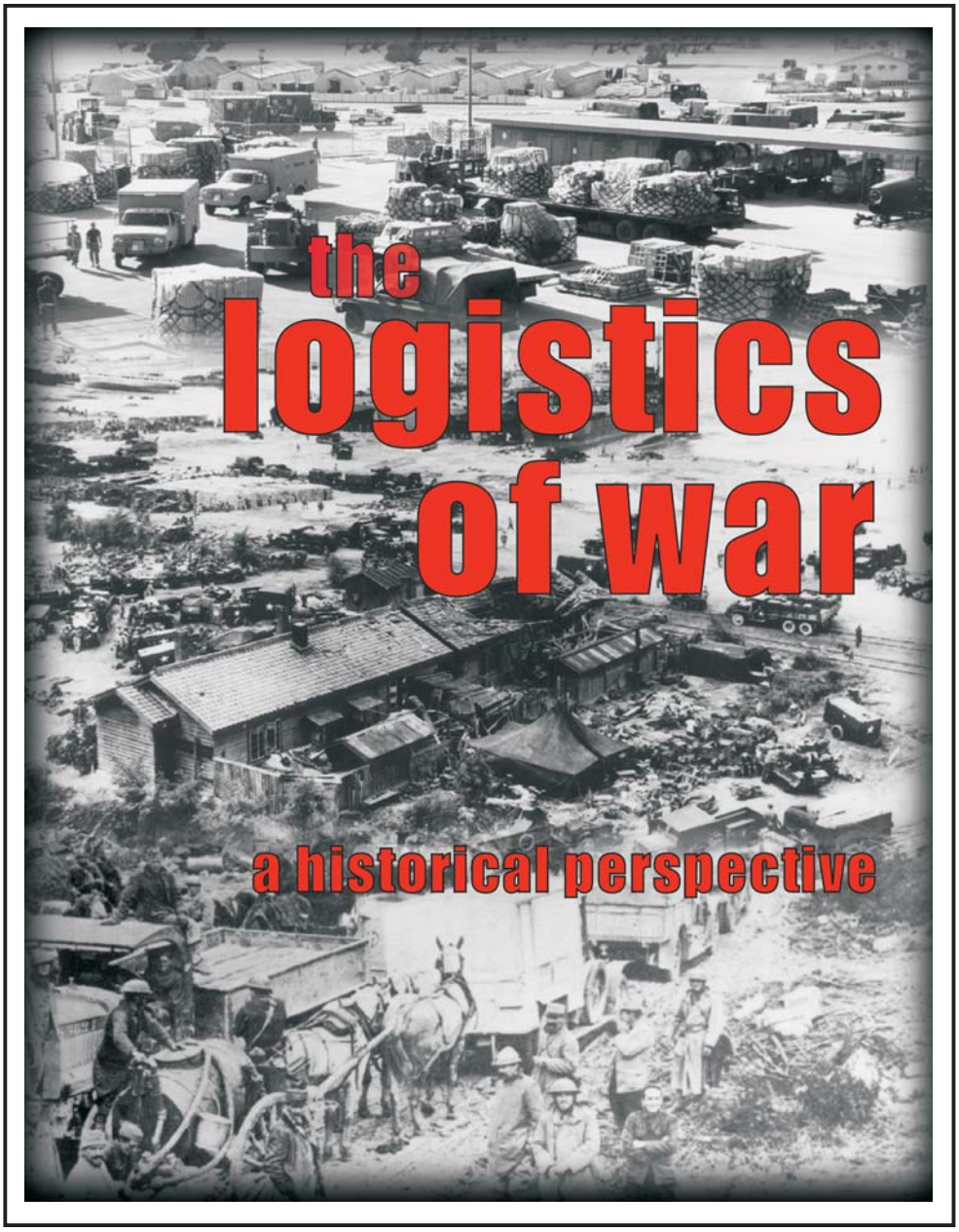


usaf supply

USAF Supply: Pride, Dedication, Professionalism highlights the past and future of Air Force supply. As a community, Air Force supply has much to be proud of. They were there when the Berlin Wall came down. They were there when the Cold War ended. And they are there today. As a community, they also have a lot to look forward to. New initiatives, new programs, and new challenges exist that will carry the supply-fuels family well into this century.



the logistics of war

The Logistics of War is a collection of three works that examines both broadly and specifically the history of US military logistics: ***The Logistics of Waging War—American Logistics, 1774-1985—Emphasizing the Development of Airpower; The Logistics of Waging War—US Military Logistics 1982-1993—The End of Brute Force Logistics***; and the ***History of US Military Logistics: 1935-1985, A Brief Review. The Logistics of Waging War—American Logistics, 1774-1985—Emphasizing the Development of Airpower*** was originally published by the Air Force Logistics Management Agency as part of Project Warrior. While retaining its original character, this work has been extensively edited and reorganized, and two new sections were added: "The Logistics Constant Throughout the Ages" and "General Logistics Paradigm: A Study of the Logistics of Alexander, Napoleon, and Sherman." Readers of the old work will find this new version easy to navigate and a bit more user friendly. ***The Logistics of Waging War—US Military Logistics 1982-1993—The End of Brute Force Logistics***, also originally published by the Air Force Logistics Management Agency, has likewise been extensively edited and updated. The final work is Jerome G. Peppers' seminal work on the history of US military logistics.

We produce and publish a variety of high-impact publications—books, monographs, reading lists, and reports. That's part of our mission—address logistics issues, ideas, research, and information for aerospace forces.

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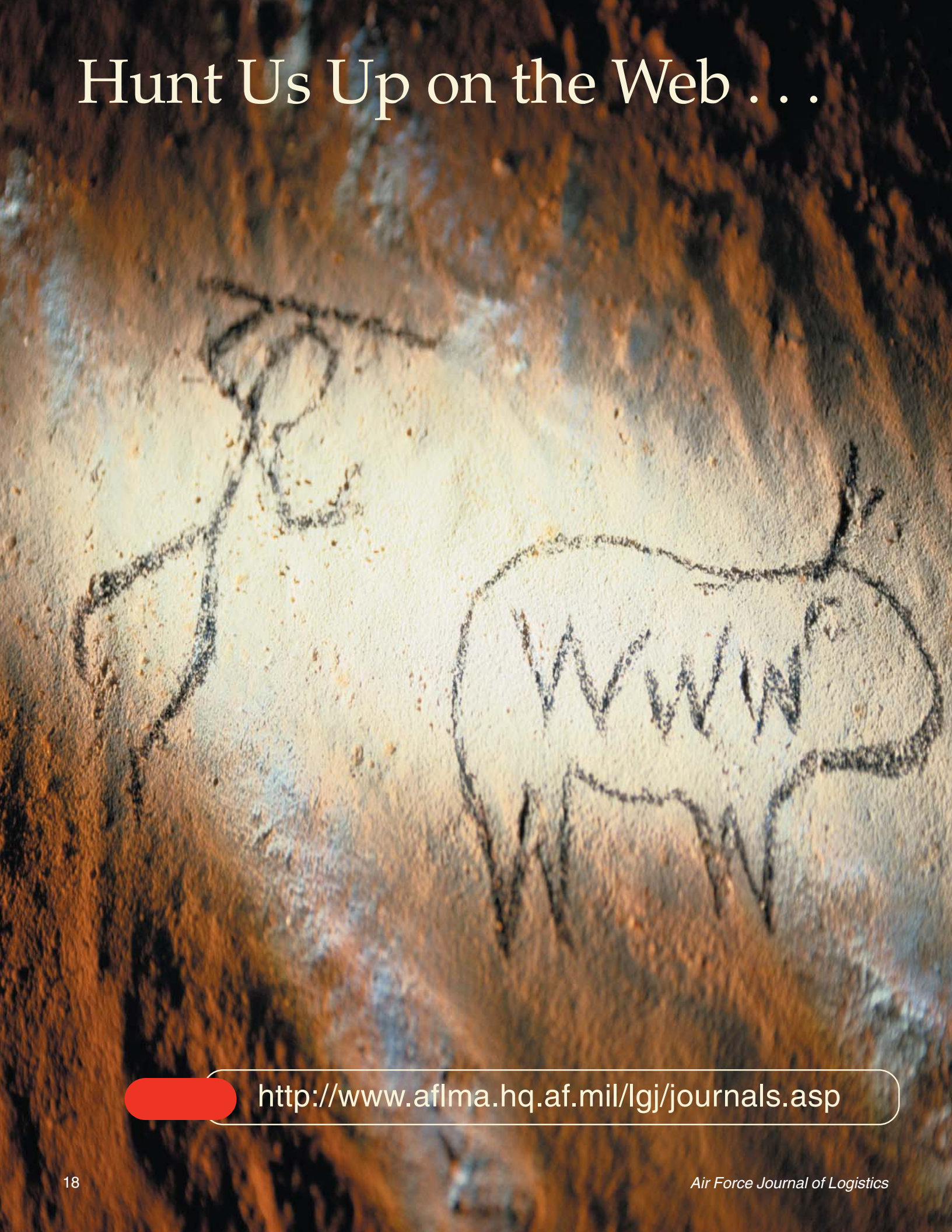

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