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The Myth of Strategic and Tactical Airlift

Jacob D. Maywald
635th Supply Chain Operations Wing

Adam D. Reiman
Air Force Institute of Technology

Alan A. Johnson
USAF Retired

Robert E. Overstreet
Air Force Institute of Technology

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Capt Jacob D. Maywald, USAF
Col Adam D. Reiman, USAF
Dr. Alan W. Johnson, Lieutenant Colonel, USAF, Retired
Lt Col Robert E. Overstreet, USAF

> *I don't understand tactical or strategic. The words have now become meaningless and dysfunctional. In fact, in modern military speech, they are more often used to divide people and frustrate efforts than to illuminate and facilitate.*
>
> —Gen Charles A. Horner

In the 21st century, our ability to quickly and decisively deliver combat forces and equipment is of the utmost importance in achieving our national security objectives. The swiftness and flexibility of the US Air Force's mobility airlift fleet is the key to executing a rapid global mobility strategy. The operational effectiveness and efficiency of military air transportation relies on the expertise and intuition of Air Mobility Command's (AMC) mobility planners. Working in coordination with the United States Transportation Command (USTRANSCOM) and geographic combatant commands (GCC), AMC is responsible for the tasking and tracking of almost 900 daily mobility sorties worldwide. Using a hub-and-spoke model, mobility planners conceptualize airlift requirements and routes as either tactical or strategic in nature. Airlift assets are also considered this way. Tactical aircraft (usually C-130 variants) are smaller and are used primarily for intratheater airlift within a defined area of responsibility (AOR). Strategic aircraft (C-5B/M, C-17A) have larger payload capacities and extended ranges, making them useful for intertheater transportation between two different AORs or GCCs. Similarly, Air Force doctrine describes air mobility operations as either "intertheater or intratheater in nature."[1]

Throughout the history of the mobility air forces, planners tried various initiatives to centralize control of both airlift types. Ultimately, though, the doctrinal tenet of centralized control and decentralized execution resulted in an airlift system in which tactical assets and operations are parceled out or chopped to regional commanders, while strategic assets remain under the control of AMC. Consequently, only a portion of the service's C-130 fleet is available to be tasked by planners as part of the global air mobility system under the operational control of USTRANSCOM/AMC. We argue that this asset categorization can inhibit the appropriate distribution of airlift and result in a less effective airlift system.

The Air Mobility Context

The distinction between strategic and tactical operations has endured since World War II, although the lines between the two are often blurred. After the initial drafting of Air Force Manual (AFMAN) 1-1, *United States Air Force Basic Doctrine*, in 1964, the Military Airlift Transportation Service (MATS) submitted a manual that attempted to outline a unified airlift system. It recognized that the differences between strategic and tactical airlift had become negligible with the advent of modern aircraft. Included with the submission were the ideas of Gen Howell Estes Jr., MATS commander, who discussed airlift unity based on 25 years of evolution in airlift thinking and capability. In his opinion, the dual airlift system approach "perpetuates post–World War II thinking and fails to acknowledge and exploit the full capability of the modern transport aircraft in its primary role." He further believed "that the full functional capability of airlift must be addressed as an entity in order to exploit the flexibility of airlift forces . . . [and that] such capability cannot in any way be considered divisible." However, senior leaders disagreed with this assessment and ordered the publishing of two separate manuals—one produced by MATS (AFMAN 2-21, *Strategic Airlift*) and a second produced by Tactical Air Command (AFMAN 2-4, *Tactical Airlift*).[2] While the basic idea of a segregated airlift system endures, its application in modern air warfare has periodically been challenged. General Horner, the coalition forces air component commander during Operation Desert Storm, argued in his book *Every Man a Tiger* that the strategic versus tactical planning model was obsolete. He felt that these terms are "a heritage" from previous wars where strategic attacks were directed at the enemy's heartland while tactical assaults were targeted at forces in the field. He viewed airpower as "essentially very simple: aircraft can range very quickly over very wide areas and accurately hit targets very close to home or very far away. Nothing more. Nothing less."[3]

The USAF's modern hub-and-spoke system—similar to the one employed in the commercial aviation industry—allows maximum opportunity for aggregation at major aerial port hubs and promotes increases in efficiency versus a simple point-to-point delivery method.[4] It also seemingly necessitates the segregation of Air Force mobility aircraft into strategic airlift for long-haul distances and tactical airlift for the "spoke" routes. However, while the planning model remains somewhat static, improvements in aircraft technology increase the flexibility, speed, and range of modern USAF airlifters and blur any tactical or strategic distinction. These advances present an opportunity to challenge the current model by using a holistic approach in the aircraft selection process.

Regardless of a route's or requirement's designation as strategic or tactical, all airlift fleet assets should be analyzed to maximize efficiency and minimize fuel consumption and cost while still meeting the overall objective of fulfilling the war fighter's requirement. Flexible aircraft like the C-17A, with its direct delivery capability and recent upgrades to the USAF's primary tactical airlifter, the C-130J, present the prospect of exploring and exploiting these aircraft beyond their simple application as inter- or intratheater assets.[5] Furthermore, empirical evidence suggests that increasing delivery method diversity will add efficiency and reduce operations costs. Studies examining airframe and route optimization indicate that costs and efficiency can improve with a more diverse airlift fleet.[6]

The Air Mobility Fleet and Evolution of the C-130

The Lockheed C-130 "Hercules" has been a staple of the USAF's air mobility fleet for nearly 60 years. The original C-130A entered the Air Force inventory in December 1956. Since then, this flexible platform has been periodically upgraded and improved and is still the most capable aircraft for its specific mission set. In 1999 the Air Force introduced the C-130J model, which incorporated state-of-the-art technology that significantly increased performance in range and fuel efficiency and reduced manpower requirements and operational and life-cycle costs. Also, Lockheed developed a stretch version of the aircraft, the C-130J-30, which added 15 feet to the fuselage and extended its payload capacity and range. The newest C-130J upgrades represent an evolution of the airframe with dramatic increases in fuel efficiency, extending the aircraft's range at 35,000 pounds (lb.) of payload to 2,100 nautical miles (nm)—an improvement of nearly 62 percent compared to the older C-130H.[7] Its new Rolls-Royce turboprop engines also markedly improved the aircraft's power and top speed—from 366 to 410 mph. Greater speed, capacity, and range allow the C-130J-30 to blur the capability distinction and give it greater parity with the larger, strategic mobility aircraft. Table 1 compares AMC's strategic airlift fleet with its newest tactical airlifter.

Table 1. USAF mobility aircraft comparison

	Tactical Airlift			*Strategic Airlift*		
	C-130H*	C130J*	C130J-30*	C17A*^	C-5A/B/C*	C-5M^
Speed	366 mph	417 mph	410 mph	450 mph	518 mph	586 mph
Max Payload	42,000 lb.	42,000 lb.	44,000 lb.	170,900 lb.	270,000 lb.	285,000 lb.
Range (Unrefueled)	1,300 nm	1,800 nm	2,100 nm	2,400 nm	4,350 nm	5,250 nm
Max Load (Pallet Positions)	6	6	8	18	36	36

*(*Source*: See the following fact sheets at http://www.af.mil/AboutUs/FactSheets.aspx: "C-130 Hercules," 1 September 2003; "C-17 Globemaster III," 1 October 2015; and "C-5 A/B/C Galaxy and C-5M Super Galaxy," 15 May 2006.)
^Manufacturer's specifications

While the C-17A and the C-5 clearly enjoy distinct advantages in speed, payload, and range over the C-130 in their application as long-range airlifters, the newest C-130J excels in its extremely low relative cost to operate. Per hour of flight and the cost metric analyzed, the C-130J is between 66 percent and 70 percent less expensive to operate than the C-17A and costs between 74 percent and 78 percent less than the C-5M.[8] Much of the variable cost savings results from superior fuel efficiency.

Depending on the length of the city pair—the combination of origin and destination airfields—the C-130J consumes only about a quarter of the C-17A's fuel per hour and less than one-fifth of the fuel consumed by the C-5M. Energy market volatility and disruptions in the energy supply chain can create substantial pressures on mobility aircraft fuel budgets. Within the Department of Defense (DOD), the USAF uses more than 60 percent of all fuel, and AMC consumes more than half of that.[9] Therefore, if the C-130J can adequately perform even a small part of the intertheater airlift missions currently flown almost exclusively by the C-17A and C-5B/M, the resulting impact could be significant.

Increased Fuel Efficiency through "Hopping"

A precondition for consideration of smaller aircraft into the strategic mobility mix is the reality that they have reduced ranges relative to their larger counterparts. When flying missions over great distances, smaller aircraft will likely need to stop more often to refuel. Extra stops often add both fuel and time penalties, although these can be offset by the increased fuel efficiency associated with flying smaller aircraft. When hopping from point to point, an inherent trade-off must be made between performance and number of stops. Table 2 illustrates this concept.

Table 2. Dover to Ramstein stop/performance trade-off

	C-130J-30		*C17A*		*C-5B*		*C-5M*	
Stops	Max Payload (klb)	Weight/ Pallet Allowed	Max Payload (klb)	Weight/ Pallet Allowed	Max Payload (klb)	Weight/ Pallet Allowed	Max Payload (klb)	Weight/ Pallet Allowed
0	Unable		85.38	4.74	123.41	3.43	179.19	4.98
1	42.96	5.37	142.36	7.91	177.88	4.94	232.04	6.45
2	53	6.63	156.71	8.71	234.47	6.51	270	7.5

*Klb represents thousands of pounds.

As Table 2 shows, making a stop en route to a final destination considerably increases the maximum allowable payload and weight per pallet allowed. These effects on overall efficiency and fuel consumption are not trivial. For example, a 230,000 lb. cargo requirement when flying from Dover AFB, Delaware, to Ramstein AB, Germany, without an en route stop would require two aircraft. However, a single C-5M (assuming the volume constraint is satisfied) making a single stop can execute this cargo requirement in one mission.

The focus of increasing cargo aircraft productivity historically emphasized improvements in payload capacity and speed. Accordingly, aircraft subsequently became larger and faster, adding the benefit of extending their operational range. This advantage has largely driven an upward trend of ever-increasing stage lengths, especially for passenger airlift. However, the trend of increasing cruise speeds for conventional aircraft designs is beginning to plateau and is unlikely to grow appreciably anytime soon. Therefore, designers now build larger aircraft with greater payload capacity to obtain productivity increases.[10] The unfortunate side effect of this approach is that large aircraft pay a stiff penalty in fuel consumption and efficiency. Analytical work by John Green and Raj Nangia shows that using today's technology, the most fuel-efficient passenger aircraft design is optimized at a range of approximately 3,000 nm.[11] They hypothesize that sizeable fuel savings could be realized by using either in-flight refueling or segregating long routes into a set of smaller legs with aircraft designed for shorter flights. Similar analysis by Andrew S. Hahn in 2007 shows that in a commercial passenger setting, a conservative estimate of fuel savings of approximately 29 percent is achievable. Realizing such efficiencies would require breaking up longer routes of 15,000 kilometers into three stages of 5,000 kilometers each and redesigning aircraft for this specific type of operation.[12] While these studies primarily apply to commercial passenger airlift, the principle of hopping with smaller, capable aircraft should be explored within the context of military cargo airlift operations.

Reducing Airlift Inefficiency through Aircraft Selection Modeling

To analyze the effects of an all-inclusive approach to airlift planning, we created a mathematical model called the Aircraft Selection Model (ASM). The ASM is a rule-based modeling tool developed to consider the broadest possible set of airlift alternatives—given a specific cargo requirement and desired city pair—to foster objective, data-driven aircraft selection decisions. While the ASM can be modified to model different objective functions, it was designed to minimize a scenario's fuel consumption. Using historical data collected from two AMC information systems, it was possible to compare historical aircraft selection decisions to ASM's ideal aircraft mixes. The ASM explicitly considers the C-130J-30 together with the C-17A and the C-5M as available aircraft in the strategic mix. This model assumes that aircraft are available as needed, which, in reality, is a constraint for air mobility planners.

The scope of analysis focused on one month of cargo movement data (July 2012) for four high-traffic, intertheater city pairs (fig. 1):

- Dover AFB, DE (KDOV), to Ramstein AB, Germany (ETAR)
- Dover AFB, DE (KDOV), to Rota Naval Station, Spain (LERT)
- Travis AFB, CA (KSUU), to Hickam Air Field, HI (PHIK)
- Travis AFB, CA (KSUU), to Joint Base Elmendorf, AK (PAED)

July 2012 was chosen because of the relatively large amount of cargo moving from stateside to overseas that month, which allows the ASM to come up with unique alternative solutions. Available data suggests that cargo movement is highly seasonal and tends to peak during the summer months.

Analysis of this month of airlift data showed several instances in which the ASM found ideal airlift choices that differed from the actual historical data and resulted in significant fuel and operational cost savings. The 8 July 2012 Dover-to-Ramstein city-pair scenario illustrates the ASM's potential use. On that day, 20 individual cargo items accounting for 20.2 pallet position equivalents and 125,500 pounds were transported between this city pair by two C-17As. Our model identified four viable aircraft mix alternatives that could conceivably fulfill this cargo lift requirement, as shown in Figure 2.

Figure 1. Strategic city pairs analyzed using the ASM

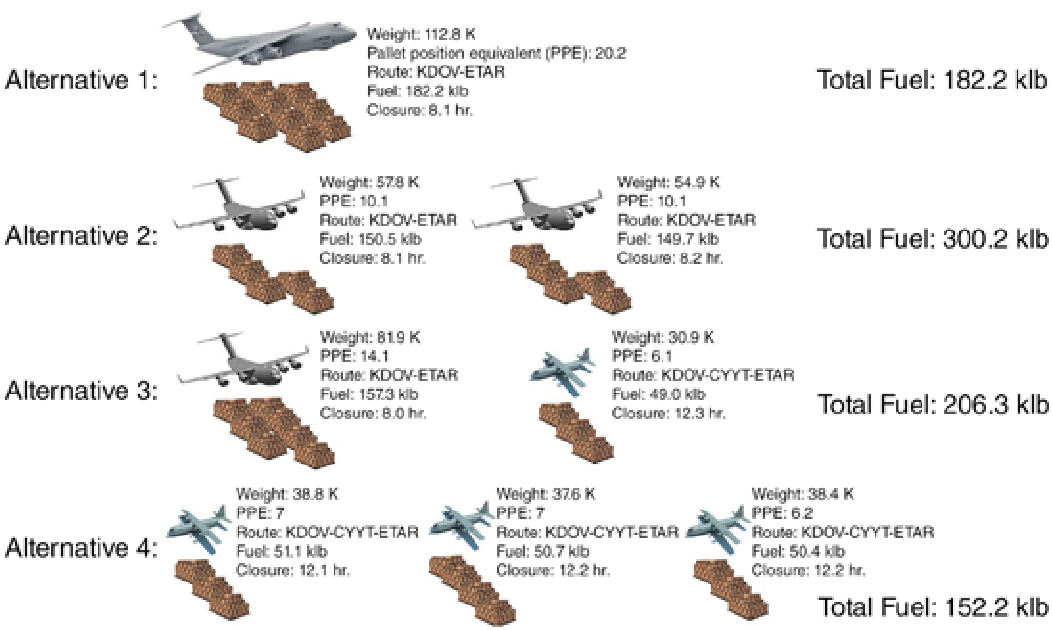

Figure 2. Aircraft mix alternative, KDOV-ETAR, 8 July 2012

The model shows a possible savings of 148,000 lb., 118,000 lb., or 94,000 lb. of fuel by respectively selecting three C-130J-30s, a single C-5M, or a C-17A and C-130J-30 for this particular cargo movement. Using the conversion rate of 6.7 lb./gallon and the fiscal year 2016 price of Defense Logistics Agency aviation fuel of $2.95, the variable cost savings is about $65,000, $52,000, and $41,000, respectively. We also analyzed the effect of this modeling approach for semivariable costs by including two Air Force cost metrics: Air Force total ownership cost (AFTOC) and logistics cost planning factors costs per flying hour (CPFH). These two comprehensive cost metrics incorporate fuel and contracted/organic maintenance, repair, personnel, and supply costs. By taking the total flight time for each aircraft type in the aircraft alternative and multiplying by its respective CPFH figures, we show that selecting figure 2's alternative 1, 3, or 4 would reduce semivariable flying hour costs by about $113,000, $72,000, or $83,000 (using logistics CPFH figures) or $39,000, $40,000, or $37,000 (using AFTOC CPFH figures), respectively.

This method was repeated for each day and each city pair during the July month of analysis with the following results (fig. 3):

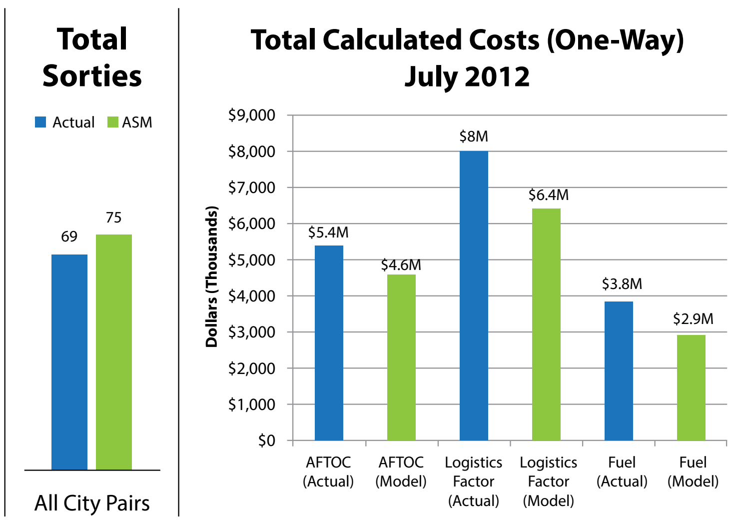

Figure 3. Actual versus ASM cost metric comparison

As figure 3 shows, meaningful fuel and operational cost savings can be achieved by using a holistic, fleet-based quantitative approach to select airlift aircraft. These results parallel a scheduling and delivery problem studied by Chinyao Low, Chien-Min Chang, Rong-Kwei Li, and Chia-Ling Huang demonstrating that total costs (defined as fixed vehicle costs and variable routing costs) gradually decrease as the vehicle types employed are increased. By expanding delivery fleet diversity, planners are more able to tailor airlift capacity to a specific demand. To illustrate this concept, our 8 July 2012 Dover-to-Ramstein city-pair scenario is again shown in figure 4. When considering only the traditional strategic airlift for aircraft selection, planners are limited to only two options for the cargo demand on that day: two C-17As or a single C-5M. In contrast, an all-inclusive approach that comprises all airlift assets identifies two additional viable options that outperform the actual aircraft selected on the day of analysis (two C-17As)—both in terms of fuel consumption and semivariable costs. Including smaller increments of airlift capability allows for aircraft mix alternatives with reduced excess capacities, leading to improvements in operational efficiency.

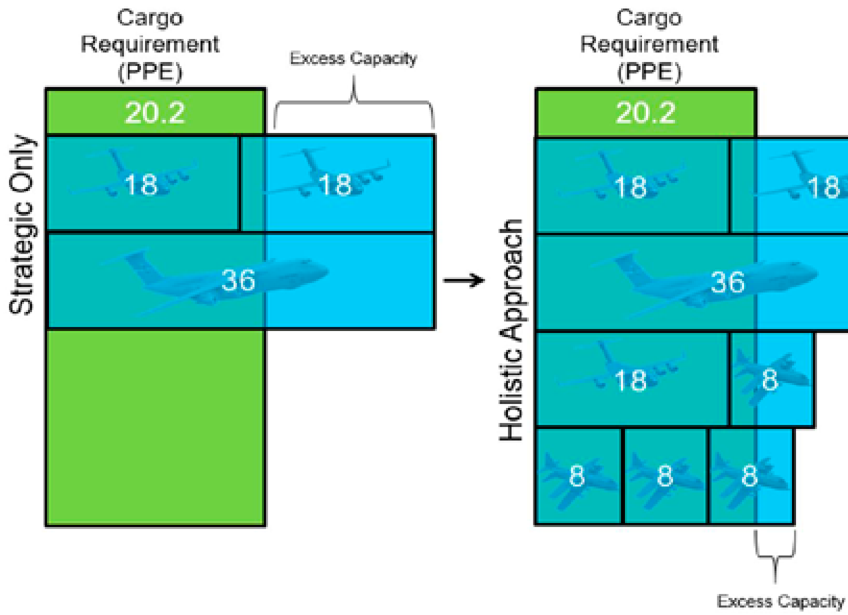

Figure 4. Strategic-only versus all-inclusive planning approach

Conclusion

Delivering combat capability effectively should be the primary goal of any military operation, but limited resources demand that military planners constantly search for new ways to operate to achieve this goal. Energy is one of the largest line items in the DOD's budget and therefore presents itself as a prime target for efficiency analysis. While necessary to curb growing demand, researching and developing new technologies aimed at reducing fuel consumption can be expensive and doesn't necessarily guarantee a return on investment. A smarter short-term approach is to analyze how we are using assets and to look for innovative ways to better use them. One should note that while the ASM's algorithm focuses on fuel efficiency, other variables determine in concert the overall efficiency—and importantly the effectiveness—of the system. The increased probability of maintenance actions, required additional en route support, and supplemental aircrews to support a revised airlift strategy would affect the overall efficiency of the airlift system. More research is needed to determine an aircraft mix that doesn't compromise the level of effectiveness our war fighters require.

For air mobility operations, a simple change in how assets are considered in the planning process may improve operating efficiency. As General Horner observed, constraining ourselves with arbitrary strategic or tactical labels can be "more often used to divide people and frustrate efforts than illuminate and facilitate."[13] In understanding mobility operations, the doctrinal tenet of centralized control and decentralized execution demands an appreciation for the differences between *strategic* and *tactical* in terms of mission planning and execution. However, we should recognize that while the present air mobility hub-and-spoke system requires an understanding of missions as being strategic or tactical in nature, any corresponding categorization of airlift assets is not necessary. It may, in fact, be counterintuitive to the efficient operation of the airlift system. By using a more holistic, deliberate approach to the mobility aircraft selection process, planners can more closely tailor capability to demand, resulting in less excess capacity and waste and a reduction in fuel consumption and operating costs. ✪

Notes

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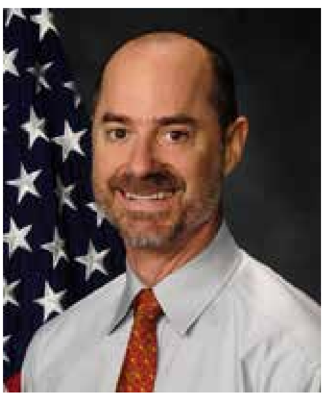
Capt Jacob D. Maywald, USAF

Captain Maywald (BS, Campbell University; MS, Air Force Institute of Technology [AFIT]) is a career logistics readiness officer serving as the strategic plans officer in charge, 635th Supply Chain Operations Wing, Scott AFB, Illinois. He is responsible for the oversight of several of the wing's strategic Air Force–wide supply chain centralization initiatives. Before this assignment, Captain Maywald was a graduate student at AFIT, Wright-Patterson AFB, Ohio, where he studied logistics and supply chain management. His research aided in the construction of a comprehensive airlift planning model, and his thesis examined the possibility of reducing mobility airlift inefficiency through aircraft selection modeling.

Col Adam D. Reiman, USAF

Colonel Reiman (BS, USAFA; MS, Air Force Institute of Technology [AFIT]; PhD, AFIT) is the dean of students at AFIT, Wright-Patterson AFB, Ohio. He is responsible for 800 military, civilian, and international in-residence students. He oversees admissions and registrar functions for the Graduate School of Engineering and Management and is an assistant professor of logistics and supply chain management in the Department of Operational Sciences. A command pilot with 3,000 flight hours and more than 300 combat hours, Colonel Reiman served in leadership and staff at the squadron, group, wing, and numbered Air Force levels. He was a global operations director and the chief of the flight management division at the 618th Air and Space Operations Center. Colonel Reiman was a 1995 distinguished graduate of the US Air Force Academy with a bachelor of science degree in astronautical engineering. He is a graduate of the Advanced School of Air Mobility program and assisted in the development of the School for Advanced Nuclear Deterrence Studies program. His specialization is airlift optimization.



Dr. Alan W. Johnson, Lieutenant Colonel, USAF, Retired

Dr. Johnson (MS, Air Force Institute of Technology [AFIT]; PhD, Virginia Tech University) is a professor of logistics and supply chain management at AFIT. He received his doctorate in industrial and systems engineering and his master's degree in systems management. His research interests include all aspects of military logistics but emphasize reliability and maintainability and their effects on weapon system life cycle management, as well as issues related to strategic airlift and global mobility.

Lt Col Robert E. Overstreet, USAF

Colonel Overstreet (BBA, Campbell University; MS, Air Force Institute of Technology [AFIT]; PhD, Auburn University) is the military deputy department head, Department of Operational Sciences, Graduate School of Engineering and Management, at AFIT. He is a career logistician with 27 years of experience in both medical and line logistics. Colonel Overstreet has published in several journals, including the *Journal of Business Logistics*, *International Journal of Logistics Management*, *International Journal of Production Economics*, *Journal of Applied Social Psychology*, *Journal of Humanitarian Logistics and Supply Chain Management*, and *Transportation Journal*.