
Halvorsen loader pulls away from C-130J Super Hercules at Bagram Air Field, Afghanistan, where Airmen from aerial port and airlift squadrons support operations 24/7 at DOD's busiest single runway airfield (U.S. Air Force/Brian Wagner)

# Theater Airlift Modernization

## Options for Closing the Gap

By Robert C. Owen

America's renewed strategic emphasis on state-on-state conflict highlights significant gaps in the country's theater airlift capabilities, particularly in the Asia-Pacific region. Quantitatively, there likely will not be enough airlift capacity available to cover major conflict requirements. Qualitatively, the current program-of-record (POR) airlift fleet (what the Nation has and what it expects to acquire) presents serious shortfalls in the ability to maneuver land forces on the scale, to the destinations, or in the timeframes desired by Army planners. Air commanders also have reason for concern since the core aircraft of the theater fleet, the C-17 and C-130, pose capacity and operational risks in their abilities to support high-volume combat operations at forward bases when threatened or damaged by attack.

Given these gaps between capabilities and requirements, this article considers two questions. First, it begins by asking whether the POR airlift fleet will be adequate to the demands likely to be placed on it. The discussion then turns to the question of whether affordable opportunities exist to mitigate the gaps identified.

### Requirements

Many organizations articulate versions of airlift requirements based on subjective guesses about future scenarios. Moreover, the details of the more authoritative Department of Defense (DOD) studies are classified. Therefore, this article asserts only that the steady reduction of airlift planning goals over

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Thirty-sixth Airlift Squadron co-pilot flies C-130 Hercules during training mission as part of Readiness Week at Yokota Air Base, Japan, providing rapid tactical airlift support throughout Pacific theater (U.S. Air Force/Raymond Geoffroy)

the past four decades makes shortages practically certain. In 1981, for example, defense planners accepted a fleet capacity of 66 million ton/miles per day (MTMD) as a "fiscally responsible" target, even though their planning scenarios required as much as 124 MTMD.[1] Ten years later, DOD reduced its airlift capacity to 54.5 MTMD, which conveniently matched the force structure actually on hand at the time.[2] This number raised high-level concerns over the methodology of the study and the adequacy of its findings.[3] Most recently, the DOD *Mobility Capabilities and Requirements Study 2016* tacitly lowered the planning baseline to 30.7 MTMD and declared that the C-130 fleet was larger than needed.[4] These findings and the methodologies that produced them drew immediate criticism from the Government Accountability Office.[5] Thus, if baseline airlift studies have a theme, it is that their force structure goals reflect budgetary concerns as much as they do actual requirements.

As in the case of quantitative assessments of airlift shortfalls, qualitative assessments must be parsed from a collection of formal requirements documents, strategies, and Service visions. At the highest level, President Barack Obama's *Sustaining U.S. Global Leadership: Priorities for 21st Century Defense* calls for the "ability to project power in areas in which our access and freedom to operate are challenged."[6] The DOD *Joint Operational Access Concept* expands on this guideline, calling for forces capable of "deploying and operating on multiple . . . lines of operations," "maneuver[ing] directly against key operational objectives from strategic distance," and supporting "forces that may be in multiple locations with multiple objectives."[7] Joint forcible entry operations doctrine calls for forces to "seize and hold lodgments against armed opposition . . . [making] the continuous landing of troops and materiel possible and . . . [gaining] maneuver space for subsequent operations."[8] Thus, the weight of defense policy implies a need for airlift forces able to support air and land combat operations at almost any location and in the face of substantive threats.

The mounted vertical maneuver (MVM) vision further articulates the Army's maximal airlift requirements. MVM has passed through several conceptual stages since the mid-1990s, but at its heart calls for "the maneuver and *vertical* insertion of *medium weight armored forces* into areas in close proximity to their battlefield objectives without the need for fixed airports, airfields, or prepared airheads."[9] To make the MVM vision practical, proponents call for development of a large vertical takeoff and landing (VTOL) aircraft. As the MVM vision has matured, the expected payloads of these joint heavy lift (JHL) aircraft have increased from 26- to 30-ton *Stryker* or Future Combat System vehicles to Bradley fighting vehicles up to 36 or more tons in weight. MVM visionaries expect that these aircraft will enable a revolutionary increase in the combat power and survivability of air maneuvered forces.[10]

The Air Force has not developed a conceptual equivalent to mounted vertical maneuver, but it probably should. In the past, most Air Force airlift support concepts have presumed that transport aircraft would operate under the umbrella of American air dominance to reach the main bases used by the combat units they supported. However, deeper thought about the possibility of major conflicts in the Asia-Pacific suggests that the United States may not always enjoy unbroken air dominance and invulnerable bases in future conflicts and that potential foes may plan to target American airlift forces at the beginning of any future conflicts.[11] There is a need, therefore, to articulate expeditionary strategies that presume that the Service's airlift forces may be called on to operate at bases that are damaged or under current or imminent attack.

Land maneuver and air operations at degraded airfields will demand high throughputs from airlift forces at austere or off-runway locations. Even in support of JHL-based operations, fixed-wing transports will be needed to move large quantities of vehicles and supplies into MVM bases or operating locations established deep in contested territories or otherwise beyond land lines of communication. Given the vulnerabilities of transport aircraft at forward bases, local commanders may want to push their operations out to unpaved areas of main bases or even to remote fields. Such relocations would reduce the likelihood that cargo aircraft could be destroyed during their predictable ground movements or at their parking areas. They also would minimize the chance of collateral losses of personnel and nearby aircraft in the event of detonations of aircraft loaded with tons of munitions or other hazardous cargo.

## The Air Force POR Fleet

In terms of gross capacity, the program-of-record fleet is in good shape. The Air Force fields about 213 C-17s and 428 C-130s, which comprise its core theater airlift capabilities. The Air Mobility Command (AMC) manages all of these aircraft logistically, but they are assigned to AMC, geographic combatant commands, and the Air Reserve Components (the Air Force Reserve and Air National Guard). Production of C-17s has ended, but a program to replace older C-130s with C-130Js is under way. Conflict tested for the past 20 years, this fleet remains the only force capable of moving brigades, divisions, wings, air forces, and their sustainment anywhere on the planet. Additionally, the Army and Marines field hundreds of CH-47 and CH-53 battlefield airlift aircraft, while the Navy and Marines also conduct airlift operations with about 50 C-130s of their own.

Importantly, the capacity of the Air Force's theater transport fleet diminishes quickly when it is called on to operate in austere or degraded airfield environments. Under sea level atmospheric conditions and depending on their loaded weights, the maximum effort takeoff distances of the C-130 range from 1,700 to 3,200 feet.[12] Under similar conditions, C-17s need between 3,000 and 7,000 feet.[13] Presuming that runways of suitable length are available, the limiting operational factor becomes the load-bearing strength of their surfaces. A C-17, for example, will rut, gouge, and render unusable runways rated at a California bearing ratio of 10 (graded soil and gravel) in just 30 passes (30 landings and 30 takeoffs). Lighter C-130s could make 1,500 passes on the same surface.[14] Thus, in situations where airstrips or the undamaged sections of main runways are short, the most capacious aircraft in the fleet will not be able to get in, while the smaller aircraft could get in but would be limited in their throughput. The impact of runway strength becomes clearer when one considers that a C-17 flying an unrefueled 2,800 nautical mile (nm) round trip from the main U.S. airbase on Guam in support of Army operations on the Philippine island of Luzon could carry up to 60 tons of cargo, while a C-130 would deliver only 6 tons. Furthermore, C-130s could not deliver any of the armored combat vehicles or other outsize items required by most maneuver brigades.[15]

The limitations of the C-17/C-130 team trouble proponents of MVM. Illustrating the impact of these limitations, a 2008 Army study determined that a C-5/C-17 fleet would in most cases be obliged to set down MVM units 50 kilometers (km) or more from their objectives or points of need/effect (PON/E).[16] C-130s, once brought into such a distant theater, could ease the access problem, but they would be incapable of delivering much of the equipment required. These limitations, therefore, render the MVM vision moot.

In summary, the POR airlift fleet presents theater warfighters with three capabilities/requirements gaps. Historical experience suggests that there always will be shortfalls in capacity versus requirements. Also, the C-17/C-130 combination is capable but restricted in its ability to deliver high tonnages and mechanized ground units into degraded or austere airfield environments. Last, the fleet on the books has little to no capability to satisfy the Army's MVM vision of conducting air assaults with medium mechanized units near or at their PON/Es. While this last gap does not relate to a concept endorsed for funding by DOD, it still has relevance to airlift planners since the Army, historically the biggest user of airlift, favors it.

## Options for Closing the Gaps

In broad terms, there are three approaches to closing these theater airlift gaps: buy more of the same aircraft, buy off-the-shelf aircraft offering desired capabilities, or develop completely new aircraft. Each of these approaches offers its own mix of cost and operational features as capability gap fillers. Consequently, this brief analysis focuses on three criteria for assessing these gap-filler approaches: the likelihood that a given option actually will close some or all the gaps, lifecycle costs, and general impact or opportunity costs on other mission areas.

Numerous studies have been done on at least some elements of this issue. In 2007, DOD issued an initial capabilities document (ICD) for a JHL aircraft with either super-short takeoff and landing (SSTOL) or VTOL capabilities. By *SSTOL*, the ICD meant an aircraft able to take off from an unprepared surface and climb over a 50-foot obstacle in 1,000 feet or less. The concept aircraft also was to be capable of carrying a 28-ton medium armored vehicle over a 250 nm mission radius to within either 25–50 km of desirable points of need (if SSTOL capable) or less than 25 km (if a VTOL design).[17] Sensitive to its other airlift support obligations, the Air Force in 2010 eased the takeoff- obstacle-clearance distance requirement to 1,500 feet to gain some trade space to increase the notional aircraft's mission radius to 1,000 nm and thereby improve its ability "to satisfy a wide variety of airlift mission requirements."[18] More recently, the U.S. Transportation Command and Air Mobility Command conducted studies focused on satisfying mounted vertical maneuver needs.[19]

The Air Mobility Command's Joint Future Theater Lift (JFTL) Technology Study, released in February 2013, addressed gaps in the command's ability to operate into austere landing areas, support the maneuver of medium-weight armored vehicles, and transport medium-weight forces and their logistics over strategic and operational distances directly to their PON/E.[20] The technology options it studied included the C-17s, C-130s, and CH-47s of the "baseline fleet," a conventional takeoff and landing (CTOL) turboprop-powered aircraft, a CTOL turbofan-powered aircraft, a short takeoff and landing (STOL)-capable turboprop, a STOL turbofan-powered aircraft of planform design, a VTOL tiltrotor, and a VTOL hybrid airship. In the end, AMC concluded that a new heavy-lift tiltrotor would be the "most operationally effective of all the options." New design STOL turboprops, planform turbofans, and hybrid airships also offered useful, but not maximal, operational values in the scenarios examined.[21] Given the characteristics of those scenarios, the JFTL found the turboprop CTOL option as "high risk."[22]

The JFTL also estimated the 30-year lifecycle costs of a force of each aircraft capable of carrying a medium-armored brigade over strategic distances into a theater, carrying a "primarily medium weight" brigade task force in a forcible entry operation, moving a medium-weight battalion within a theater, and supporting the logistics of these operations (see table).

**Table. JFTL Technology Study Lifecycle Cost Estimates**

| Alternative | Number of Aircraft | Lifecycle Cost of Budget Year 2012 (in $ billions) |
|---|---|---|
| Baseline | 63 (C-130)<br>36 (C-17)<br>20 (CH-47) | 62.1 |
| CTOL Turboprop | 49 | 36.4 |
| CTOL Turbofan | 84 | 111.1 |
| STOL Turboprop | 93 | 110.7 |
| STOL Turbofan | 93 | 120.8 |
| VTOL Tiltrotor | 98 | 128.4 |
| VTOL Hybrid Airship | 92 | 84.3 |

*Source*: Air Mobility Command, ***Joint Future Theater Lift: Technology Study Final Report***, February 20, 2013, 125.

*Key*: CTOL = conventional takeoff and landing; STOL = short takeoff and landing; VTOL = vertical takeoff and landing.

## Assessing the Options

We turn now to analysis of options for closing the theater airlift gap. Option 1—buying more of the same aircraft already in the POR fleet—likely will be unattractive to theater and Service planners. Most important, buying additional C-17s and C-130s will not close any of the three airlift gaps. They might make a contribution to the shortfall in gross capacity, but they would have little impact on the Air Force's ability to deliver high cargo volumes and outsize vehicles into damaged and austere airfields, and they would leave MVM unsupported. In terms of opportunity costs, acquisition of such aircraft could make airlift capacity available to otherwise unserved users, but its $62.1 billion price tag also would siphon funds away from other programs. In addition, the Air Force has stated that it has plenty of C-17s and C-130s, so making a politically and financially compelling case for more would be difficult.[23]

Option 2—acquiring an off-the-shelf aircraft—is a more complex proposition than expanding the existing fleet. The only mid-sized airlifter on the market that could address the Air Force's airlift gaps would be the Airbus A400M, an aircraft similar to the turboprop CTOL aircraft discussed in the JFTL. With a maximum payload of 40.5 tons and the ability to carry a Bradley fighting vehicle for 2,400 nm, this aircraft could contribute to gross long-range lift capacity. Moreover, the A400M has airfield length and strength requirements close to those of the C-130, giving it significant ability to sustain high throughput into airfields not suitable for the C-17.[24] The A400M also could deliver medium-weight armored units closer to their PON/E than could a C-5/C-17 fleet. Thus, if the Army and Air Force remain unable to attain DOD authorization and funding to pursue a VTOL option, an off-the-shelf turboprop CTOL could be an affordable second approach to at least improving joint aerial maneuver capabilities.

It is worth noting here that the lifecycle costs of the medium CTOL option likely would be lower than those estimated in the JFTL. Those numbers

Air Force C17 Globemaster takes off from old Israeli airstrip in Sinai Peninsula of Egypt to provide airlift support for Soldiers from Aviation Company, 1st Support Battalion, Task Force Sinai (U.S. Army/Thomas Duval)

were based on an unaugmented fleet of 49 CTOLs needed to meet the gross lift requirements of its chosen scenarios.[25] But in reality, the Air Force likely would buy only enough new CTOL aircraft to augment the existing C-130 fleet's ability to deploy and sustain forces into airfields too short or soft for C-17s. For example, C-130s would be capable of moving the personnel, supplies, and about half of the 300 or so vehicles possessed by a mechanized infantry battalion. Consequently, the Air Force would need to field only enough new medium CTOL aircraft, such as the A400M, to move the other, heavier vehicles in the battalion. More practically, however, the Air Force might want to acquire enough medium CTOLs to make such moves alone, since they would greatly increase movement velocities and the flow of sustainment in forward airfields or at degraded air bases.

This brings the discussion to the final option for addressing theater airlift gaps—developing and acquiring a completely new aircraft. If DOD pursued this costly option, the only reasonable choice would be the VTOL tiltrotor. The other options discussed in the JFTL are unrealistic, and their merits in relation to the theoretical capabilities of a new tiltrotor and the real capabilities of, say, the A400M would be too marginal to justify their costs. Given its inherent performance limitations, the tiltrotor would make little or no contribution to the general airlift shortfall over strategic distances. Over distances of a few hundred miles, VTOL tiltrotors could increase the flow of forces into austere airfields because more of them could land in a given area. But their ability to sustain high throughputs at those locations, in comparison to what fixed-wing transports could do, bears close examination. Historically, rotary-wing aircraft have not been able to generate the flight hours over time or the ton-mile productivity of fixed-wing transports. Of course, the attraction of a heavy-lift VTOL would be its maximal contribution to the aspirations of MVM advocates.

The assertion that tiltrotors would be inherently unable to generate fixed-wing-like throughputs bears some expansion. Suffice it here to offer a simple comparison of the current MV-22 tiltrotor and the C-130J fixed-wing transports. An MV-22, with total engine power of 12,300 horsepower, cruising at 240 knots with its maximum 8-ton payload, produces 0.12 ton-miles of useful lift per hour *per engine horsepower available*.[26] A C-130J, with total power of 19,364 horsepower, cruising at 350 knots with a less-than-maximum payload of 20 tons, will produce 0.36 ton-miles per available horsepower.[27] This comparison is inexact, but in its magnitude, it offers compelling and relevant insights into the operational offsets of VTOL capabilities.

## Recommendations

In its examination of theater airlift gaps and mitigation options, this article has highlighted two broad conclusions. First, gaps do exist in general long-range airlift capacity, the C-17/C-130 team's ability to achieve high throughputs into austere landing areas, and the POR fleet's ability to satisfy the maximal requirements of the MVM vision. Second, there are numerous mitigation options for these shortfalls. But as likely as the gross lift shortfalls will be, they are unlikely to spur additional spending on airlift forces. The shortfall in austere airfield capabilities, in contrast, should trouble combatant commanders and fortunately can be addressed through modest investments in existing aircraft designs. Addressing the MVM requirement, if it ever gains DOD funding approval, will be both an expensive undertaking and one with significant implications for other mission areas.

The first step toward mitigating these theater airlift gaps will be to settle the MVM issue, at least for the moment. Because MVM is the long pole in theater airlift planning and has dominated recent studies, combatant commanders need to determine how badly they want it. The estimated cost of $128 billion or more represents a large commitment, particularly when the JFTL indicates that MVM will shorten the closure time of a maneuvering battalion by only 21 hours in comparison to current capabilities of the POR fleet.[28] Perhaps the time has come for the Army to accept less "precise" maneuver for its medium forces or to develop an MVM concept based on lighter units that can be lifted by a modestly augmented POR fleet and helicopters.

The second step should be to develop an affordable strategy for enhancing the ability of combatant commands to deploy ground forces to austere locations and support combat air operations from degraded airfields. This is an immediate requirement affecting land force mobility and air combat capabilities. If an appropriate fixed-wing aircraft is chosen to mitigate this requirement, acquiring it in appropriate numbers probably will not break the bank. Moreover, since such new planes will be augmenting the existing fleet, their costs can be offset by reducing buys or deferring the service-life extensions of other transports. The imperative, in any case, is to begin taking concrete steps to understand and address theater airlift shortfalls in the very near future, rather than let them worsen until they unhinge future combat operations. **JFQ**

## Notes

[1] Duncan McNabb, "Point Paper, Subject: Congressionally Mandated Mobility Study (CMMS)," Headquarters MAC/XPPB (Scott Air Force Base, IL: Air Mobility Command History Office, February 12, 1986); John Shea, interview by Robert C. Owen, August 8, 1990, tape 3A, index 409.

[2] Office of the Secretary of Defense (OSD), "Executive Summary," *Mobility Requirements Study 2005 (MRS)* (Washington, DC: OSD, December 2000), 4.

[3] "GAO: Military 30% Short of Airlift Requirement for War," *Defense Week*, December 18, 2000, 1; "Ryan: 'We Will Never Have Enough Lift' for Two Regional Wars," *Aerospace Daily*, June 22, 2000, 1.

[4] Carl Lude and Jean Mahan, "Executive Summary," *Mobility Capabilities and Requirements Study 2016* (Washington, DC: OSD, 2010), 1–8; John A. Tirpak, "The Double Life of Air Mobility," *Air Force Magazine* (July 2010), 31.

[5] U.S. Government Accountability Office (GAO), *Defense Transportation: Additional Information is Needed for DOD's Mobility Capabilities and Requirements Study 2016 to Fully Address All of Its Study Objectives*, GAO Report 11-82R (Washington, DC: GAO, December 8, 2010), 3–12 and throughout; GAO, *Mobility Capabilities: DOD's Mobility Study Limitations and Newly Issued Strategic Guidance Raise Questions about Air Mobility Requirements*, GAO Report 12–510T (Washington, DC: GAO, March 7, 2012), 9.

[6] *Sustaining U.S. Global Leadership: Priorities for 21st Century Defense* (Washington, DC: Department of Defense, January 2012), 4.

[7] *Joint Operational Access Concept (JOAC), Version 1.0* (Washington, DC: The Joint Staff, January 17, 2012), ii, 32.

[8] Joint Publication 3-18, *Joint Forcible Entry Operations* (Washington, DC: The Joint Staff, November 27, 2012), I-1.

[9] U.S. Army and U.S. Marine Corps, *Gaining and Maintaining Access: An Army–Marine Corps Concept*, March 2012, 10. Emphasis added.

[10] Brigadier General Robin P. Swan and Lieutenant Colonel Scott R. McMichael, "Mounted Vertical Maneuver: A Giant Leap Forward in Maneuver and Sustainment," *Army* (January–February 2007), 52–62. The Bradley concept is based on discussions by the author and Army proponents of the MVM concept.

[11] OSD, *Military Power of the People's Republic of China 2007*, Annual Report to Congress (Washington, DC: Department of Defense, 2008), 17; and Roger Cliff et al., *Entering the Dragon's Lair: Chinese Antiaccess Strategies and Their Implications for the United States* (Santa Monica, CA: RAND, 2007), 60–62.

[12] Lockheed Martin Corporation, "C-130J Super Hercules: Whatever the Situation, We'll Be There," 27–28, available at <http://cc-130j.ca/wp-content/pdfs/Spec_Book.pdf>.

[13] Boeing Corporation, "Backgrounder: C-17 Globemaster III," February 2014.

[14] The California bearing ratio (CBR) measures the resistance of unpaved surfaces to compression and rutting. A CBR of 100 equates to a surface of crushed California limestone, almost equivalent to pavement in its strength. A CBR of 10 equates to one of wet sand and soil, while anything less delineates wet tilled soil or plain mud. For discussions of C-17 and C-130 effects on soft fields, see Air Force Civil Engineer Support Agency, "Engineering Technical Letter 97-9; Criteria and Guidance for C-17 Contingency and Training Operations on Semi-Prepared Airfields," November 25, 1997, 10; and Lockheed Martin, "C-130J Super Hercules."

[15] Lockheed Martin, "C-130J Super Hercules," 29.

[16] U.S. Army Concepts Integration Command, "Global Deployment Assessment: Examining Deployment Considerations within the Arc of Instability," PowerPoint briefing, July 7, 2008, slides 15–24.

[17] Joint Requirements Oversight Council, "Initial Capabilities Document for Joint Heavy Lift (JHL)," October 12, 2007, 8, 22.

[18] Air Force, Chief of Staff, "Initial Capabilities Document for Joint Future Theater Lift (JFTL)," October 27, 2009, 5, 6, 9.

[19] U.S. Transportation Command (USTRANSCOM), *Future Deployment and Distribution Assessment: Mobility Lift Platforms, Final Report, Volume 1* (Scott Air Force Base, IL: USTRANSCOM, 2011); and Air Mobility Command, *Joint Future Theater Lift: Technology Study Final Report*, February 20, 2013 (hereafter "AMC JFTL").

[20] AMC JFTL, 17–18, 31.

[21] Ibid., 10–14, 125–126.

[22] Ibid., 77–86.

[23] Lude and Mahan, 6; and David Ignatius, "No clipping these wings," *The Washington Post*, July 5, 2013, available at <http://articles.washingtonpost.com/2013-07-05/opinions/40390066_1_planes-c-130s-cuts>.

[24] EADS North America, "Joint Future Theater Lift (JFTL) Technology Study Capability RFI (C-RFI) Response," December 22, 2012, 44.

[25] AMC JFTL, 125.

[26] All MV-22 data in this paragraph are extracted from U.S. Marine Corps, *V-22 Osprey Guidebook 2011–2012* (Washington, DC: Department of the Navy, 2011), 5, 44, 59.

[27] All C-130J data in this paragraph are extracted from Lockheed Martin, "C-130J Super Hercules."

[28] AMC JFTL, 125.