CBO MEMORANDUM

OPTIONS FOR STRATEGIC AIRLIFT

October 1995

CONGRESSIONAL BUDGET OFFICE

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WASHINGTON, D.C. 20515

This Congressional Budget Office (CBO) memorandum was prepared in response to a request from the Ranking Democratic Member of the House Committee on National Security. It reviews how requirements for strategic airlift have changed since the Cold War and looks at the costs and capabilities of three illustrative airlift purchases.

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SUMMARY

The need for strategic airlift, the planes that carry troops and equipment between continents, has lessened markedly in recent years. Current requirements for the first two weeks of a major regional conflict are 36 percent to 58 percent lower than those estimated during the Cold War for a confrontation with the Soviet Union. However, during the 1980s, the actual number of airlift aircraft was insufficient to handle the deliveries that the Department of Defense (DoD) estimated would be needed for a NATO/Warsaw Pact conflict. Current plans to maintain an airlift fleet with a theoretical capacity of 49 million to 52 million ton-miles per day come much closer to meeting delivery requirements that the Pentagon has set for itself. Yet critics might question why meeting DoD's airlift requirements is receiving relatively more emphasis today.

The defense bill for fiscal year 1996 will complete funding for 40 C-17 aircraft. Some military analysts would prefer to buy 80 to 100 additional C-17s to replace the Air Force's aging C-141 Starlifters. But a combination of C-17s and the Lockheed Martin C-5D or the C-33, a military version of Boeing's 747-400 freighter, might provide sufficient capability at lower cost.

The Congress might want to consider three criteria for evaluating airlift options: ability to meet delivery requirements for two major regional conflicts; ability to perform special missions, such as air-dropping a brigade after traveling between continents or repositioning outsize equipment within a theater by air; and cost. How to balance the tradeoffs between performance and cost depends on the likelihood that the United States will become involved in two major conflicts at the same time or in crises that will require U.S. forces to perform special missions.

After the Air Force retires its C-141s, purchasing 80 more C-17s would allow it to meet its airlift requirements, increase the share of planes in its fleet that can carry outsize cargo, and address special military missions. Based on the Congressional Budget Office's (CBO's) estimates, the Air Force would pay more than $36 billion (in 1996 dollars) to purchase and operate 80 additional C-17s through 2020.

DoD is planning to send less outsize cargo to major regional contingencies than it would have sent to a NATO/Warsaw Pact conflict. Thus, a mixture of C-17s and planes that cannot carry most outsize equipment, such as C-33s, might still meet requirements to deliver cargo to major regional contingencies. If there was adequate room at airfields in regions of potential conflict, buying 32 more C-17s plus 30 C-33s would provide the same delivery capability as 80 additional C-17s. That option would also be nearly $8 billion cheaper: it would cost about $28 billion to buy and operate the planes through 2020 (in 1996 dollars). If, however, U.S. forces were limited to a few airfields that had a small amount of ramp space, that option might

not deliver cargo as quickly as would 80 more C-17s. And such a combination would not provide as much flexibility to handle specific military missions such as strategic brigade airdrops.

Compared with the C-33, the C-5D might enhance DoD's ability to perform some military missions but still cost less than buying only C-17s. CBO estimates that buying and operating 65 C-5Ds would cost more than $27 billion through 2020—nearly $9 billion less than 80 additional C-17s (in 1996 dollars). However, the C-5D does not have all of the C-17's capabilities. For example, it could not be used to land on the shortest runways. And if access to airfields was limited, a fleet with 65 C-5Ds might not deliver cargo as quickly as could 80 additional C-17s.

The appropriate mixture of planes depends on how much DoD and the Congress are willing to pay for the flexibility provided by 80 additional C-17s. The options described in this memorandum could cost $8 billion to $9 billion less through 2020. The near-term costs of those alternatives could be higher or lower than for 80 more C-17s, depending on the timing of the purchases. Those cost issues may be of particular concern now, when the Congress is adding acquisition programs to the defense budget and, at the same time, trying to eliminate the federal budget deficit.

INTRODUCTION

Most types of U.S. military forces have been cut over the past several years. But one mission that the Department of Defense (DoD) has made a priority for new investment spending is strategic airlift—aircraft that carry troops and equipment over intercontinental distances. In DoD's Future Years Defense Program for 1996 to 2001, $21.1 billion would go toward acquiring new aircraft to replace the aging C-141 Starlifter. The Administration has not yet recommended which aircraft to buy, but three under consideration are the McDonnell Douglas C-17, Lockheed Martin's C-5D, and the C-33, a new military version of Boeing's 747-400 freighter. Ultimately, whatever plane or mixture of planes the Congress decides to buy will account for one of the largest defense procurement programs through the remainder of the decade.

In December 1993, DoD officials put the C-17 program on probation for two years because of its significant cost growth and difficulty achieving performance goals.[1] The two-year period has given the Air Force and McDonnell Douglas a chance to demonstrate whether the C-17 can operate at its planned wartime utilization rate of 15.2 hours per day. The aircraft exceeded that goal during a monthlong evaluation in July 1995. In addition, McDonnell Douglas has reduced its estimate of production costs and reportedly has proposed a fixed-price offer for further C-17s at prices lower than were previously thought achievable.

Yet even with that turnaround in the program, questions remain about the cost-effectiveness of the C-17. The C-5D and the C-33 are expected to cost less, and both of those planes can carry a much larger average payload than the C-17. Thus, the Air Force might be able to procure fewer aircraft and still meet its lift goals. However, the C-17 is the most flexible of the three planes. It can handle a wide variety of missions that are unique to the military, such as moving outsize cargo within a theater, air-dropping paratroopers or equipment, and landing on short or ill-equipped airfields. The questions now at hand for defense policymakers are these: How important will the C-17's unique capabilities be in future conflicts? What premium would DoD pay for those capabilities? And can a mixture of aircraft satisfy both general strategic lift needs and more specialized military missions?

Airlift in Perspective

The importance of strategic lift results from the assumptions and planning scenarios of U.S. national security strategy. Current plans require U.S. forces to prepare for a set of conflicts that occur nearly simultaneously—the most demanding scenario

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1. For a discussion of the cost and performance issues in the C-17 program, see Congressional Budget Office, "The C-17: Costs and Alternatives," CBO Paper (August 1993); and General Accounting Office, *C-17 Aircraft: Cost and Performance Issues,* GAO/NSIAD-95-26 (January 1995).

being a conflict on the Korean Peninsula followed by another in Southwest Asia (the Middle East). DoD uses the scenarios in its Mobility Requirements Study Bottom-Up Review Update (MRS BURU), released to the Congress in early 1995, to set its goals for strategic lift. The MRS BURU poses a set of assumptions and then uses simulations of warfighting and deployment schedules to estimate the number of airlift planes and ships needed to deliver U.S. forces to those regional contingencies.

In order to halt initial assaults threatening key assets such as ports and airfields, the United States now plans to deploy larger numbers of heavy forces much more quickly than in previous plans. Under mobilization plans for the end of this decade, the Army would deploy an entire heavy division in about two weeks. That is a more demanding requirement than earlier analyses had assumed or than was achieved in the Persian Gulf War. For example, in the 1992 Mobility Requirements Study (the last mobility analysis conducted before the Bottom-Up Review), only one brigade of heavy forces was to be delivered within the first two weeks of deployment. During Operation Desert Shield, the first heavy unit to arrive—the 24th Mechanized Infantry Division—was not fully in place until 47 days after the United States began deploying forces to the region.

DoD recently expanded the amount of equipment and supplies it has prepositioned near Southwest Asia and Korea. One set of equipment for a heavy brigade is now prepositioned on land in Kuwait, and Administration officials have entered negotiations to place one or two others elsewhere in Southwest Asia. Similarly, the Army is planning to supplement the 2nd Infantry Division in South Korea by prepositioning equipment for a heavy brigade. The Army has also placed equipment that can be tailored for an armored or mechanized brigade or an armored cavalry regiment on board roll-on/roll-off ships in the Indian Ocean. Those ships also contain 30 days' worth of supplies for contingency forces.

Because of those investments, DoD may be able to deliver heavy forces more quickly than it did during Operation Desert Shield. During the October 1994 deployment to Southwest Asia known as Vigilant Warrior, for example, the Army demonstrated the usefulness of its afloat prepositioning concept. Aircraft from the Air Force and planes volunteered by the Civil Reserve Air Fleet (CRAF) flew elements of the 24th Infantry Division to meet up with equipment stored both on land and on board prepositioned ships that steamed to the region. Because of that prepositioned equipment, the deployment of mechanized forces and support units in October 1994 took place at a considerably faster pace than during Desert Shield.

Setting Requirements for Strategic Airlift

The earliest forces sent to a conflict rely on a combination of airlift and prepositioned equipment to deploy in a theater, since even the fastest type of sealift ship takes roughly three weeks to reach the Persian Gulf. DoD bases its requirements for the size of the airlift fleet and prepositioned stocks on estimates of the amount of equipment and number of troops required to halt an enemy assault. Those estimates are derived from DoD's warfighting simulations and assumptions about the size of enemy forces and how such an assault might proceed. Although the precise timing of operations remains classified, defense officials expect that the halting phase of a conflict will last roughly two to three weeks.

Since prepositioning places equipment closer to a potential region of conflict, a deployment strategy that relies heavily on prepositioned forces should theoretically lead to lower requirements for airlift. However, military officials do not plan to preposition some types of equipment, such as helicopters and Patriot missiles, because they are too few in number or difficult to maintain aboard prepositioning ships. Thus, although prepositioning equipment decreases the need for DoD to lift some pieces of heavy cargo, airlift planes are still needed to deliver the remaining equipment, the troops who operate it, support for tactical air forces, and lighter military units.

Today's airlift needs are substantially lower than those during the Cold War (see Figure 1). In 1981, a DoD analysis known as the Congressionally Mandated Mobility Study (CMMS) estimated airlift needs for a war between NATO and the Warsaw Pact, along with other, less demanding scenarios in the Persian Gulf and Iran. Compared with its findings, early lift requirements for the Bottom-Up Review's Korean and Southwest Asian scenarios are between 36 percent and 58 percent lower than requirements for a major confrontation with the Soviet Union, as measured in millions of ton-miles. (Ton-miles measure the weight of equipment deploying to a region multiplied by the distance carried.)

Actual Delivery Capability Versus Theoretical Fleet Capacity

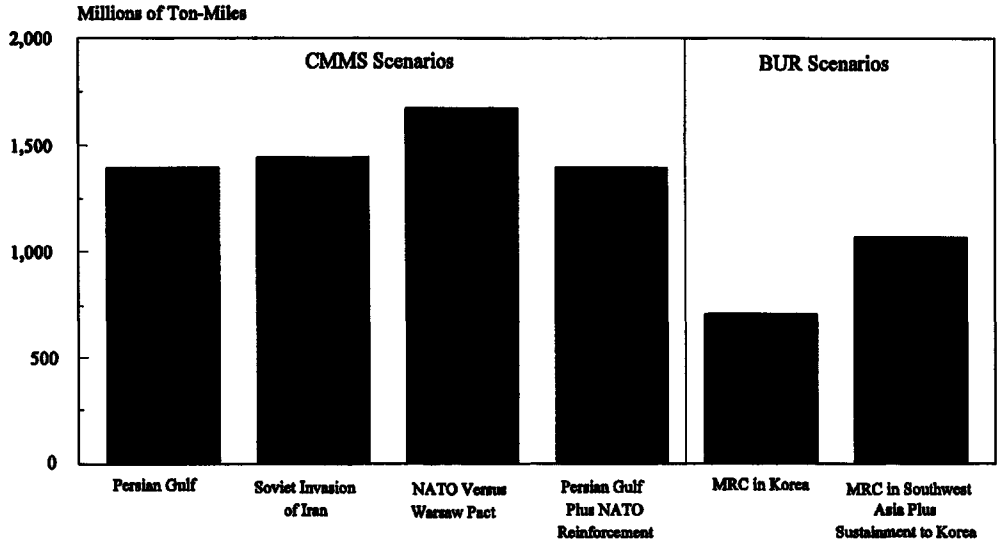
For budgeting and planning purposes, the Air Force describes the capability of its airlift fleet in terms of theoretical capacity, based on average measures of performance (such as payload and flight speed) for each plane in a fully mobilized fleet. However, a fleet's actual ability to deliver cargo to a theater tends to be far less than its theoretical capacity.

For example, at the time of Desert Shield, the theoretical capacity of U.S. airlifters and all Civil Reserve Air Fleet planes was 48 million ton-miles per day

(MTM/D). However, some aircraft were withheld for other missions or suffered from maintenance problems; commercial planes in Stage 3 of CRAF were never called into service; and reserve aircrews were only partially mobilized. As a result, actual deliveries averaged 17 MTM/D during the first six weeks of operations and peaked at 21 MTM/D during January 1991—or 35 percent and 44 percent of theoretical capacity, respectively.

One result of the 1981 CMMS was a recommendation that DoD try to obtain a fleet of military airlifters and CRAF planes with a theoretical capacity of 66 MTM/D. That goal was used to support the development of the C-17 (originally with a planned purchase of 210 planes) and led to the procurement of C-5B and KC-10 aircraft as a near-term solution to the shortfall. Yet even with significant investments

FIGURE 1. AIRLIFT REQUIREMENTS FOR THE FIRST TWO WEEKS OF DEPLOYMENT



SOURCES: Unclassified airlift requirements for the Cold War era taken from Department of Defense, Under Secretary of Defense for Research and Engineering, *Congressionally-Mandated Mobility Study (Secret)* (1981); requirements for a major regional contingency in Korea followed by one in Southwest Asia provided by the Department of Defense.

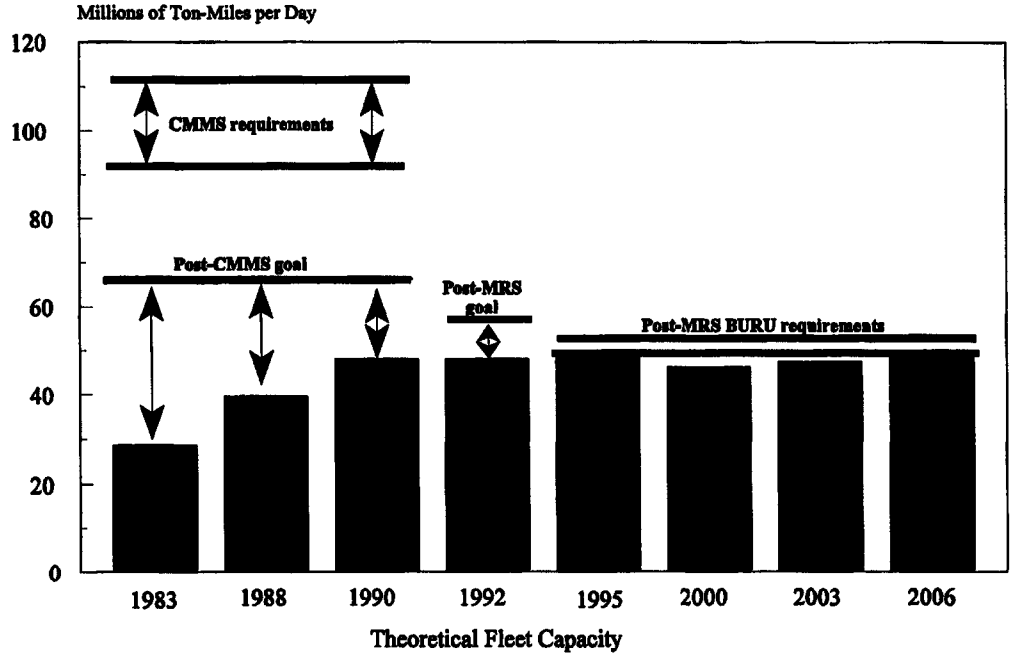
NOTES: Since the Bottom-Up Review scenarios occur nearly simultaneously but more than two weeks apart, the requirements for a conflict in Southwest Asia also include supplies that must be flown to the first conflict in Korea. Requirements for conflicts in Korea and Southwest Asia include force deterrent options (FDOs) that begin prior to the official start of deployment. Excluding weight associated with FDOs would mean that early airlift requirements for Korea and Southwest Asia were each about 65 percent lower than those for a NATO/Warsaw Pact conflict.

CMMS = Congressionally Mandated Mobility Study; BUR = Bottom-Up Review; MRC = major regional contingency.

in airlift capacity during the 1980s, DoD never reached that goal. At its peak, total airlift capacity was just below 50 MTM/D. And even if DoD had reached it, the 66 MTM/D goal was limited by fiscal realities: it was actually insufficient to handle the airlift requirements estimated in the CMMS (see Figure 2).

Because of factors such as those that applied during Desert Shield and other limits on the number of planes that can be serviced en route and in-theater, a fleet with a theoretical capacity of 66 MTM/D would have much smaller actual

FIGURE 2. AIRLIFT FLEET CAPABILITIES, GOALS, AND REQUIREMENTS



SOURCES: U.S. Air Force, *Airlift Master Plan* (1983); Secretary of Defense, *Annual Report to the President and the Congress* (various years).

NOTES: Projections of future fleet capabilities are based on continued purchases of C-17s or purchases of other aircraft with the equivalent amount of ton-miles per day. The projections use standard planning assumptions of the Air Mobility Command.

CMMS = Congressionally Mandated Mobility Study; MRS = Mobility Requirements Study; MRS BURU = Mobility Requirements Study Bottom-Up Review Update.

effectiveness.[2] In fact, DoD's estimates suggest that a 66 MTM/D fleet composed of 210 C-17s plus C-5s, C-141s, KC-10s, and a robust CRAF program would probably achieve an operational effectiveness over the first two weeks of deployment of about 40 MTM/D in a NATO/Warsaw Pact conflict, or 35 to 50 MTM/D in a Persian Gulf contingency.[3] Thus, even if DoD had been able to achieve the 66 MTM/D goal for theoretical capacity, such a fleet would have addressed only 35 percent to 50 percent of the requirements estimated in the CMMS. Put another way, the fleet might have taken twice as long or longer to airlift forces to Europe as commanders said was necessary to halt a Soviet offensive.

Mobility analyses that are based on current planning scenarios have set lower airlift requirements than those of the Cold War era. Based on the 1992 Mobility Requirements Study, which posited two "concurrent sequential" major regional conflicts, DoD established a target of 57 MTM/D for its airlift fleet capability. The 1995 Mobility Requirements Study Bottom-Up Review Update further lowered airlift requirements to 49 to 52 MTM/D, depending on the degree to which the United States was able to preposition stocks of gear and supplies abroad. That range essentially calls for keeping the airlift fleet's theoretical capacity at its current level. However, the Air Force plans to retire the C-141 by 2006 (studies by the Institute for Defense Analyses and DoD's Scientific Advisory Board suggested that a service-life-extension program for the C-141 might not be cost-effective or worthwhile technically).[4] In order to hold the capability of the current fleet level, the Air Force will need to procure replacement aircraft.

HOW MANY C-17s ARE NEEDED?

The Department of Defense is considering whether to propose buying only C-17s or a mixture of aircraft. Alternatives will be judged on three measures: how well each option's fleet can deliver the heavy cargo needed for the first two weeks of nearly simultaneous conflicts in Korea and Southwest Asia; how well it performs specialized military missions such as airdrop; and how much it is expected to cost.

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2. In military parlance, factors such as an airfield's ramp space, the availability of fuel and manpower to service aircraft, and the speed at which planes can be loaded or unloaded are called maximum on-the-ground, or MOG, constraints.

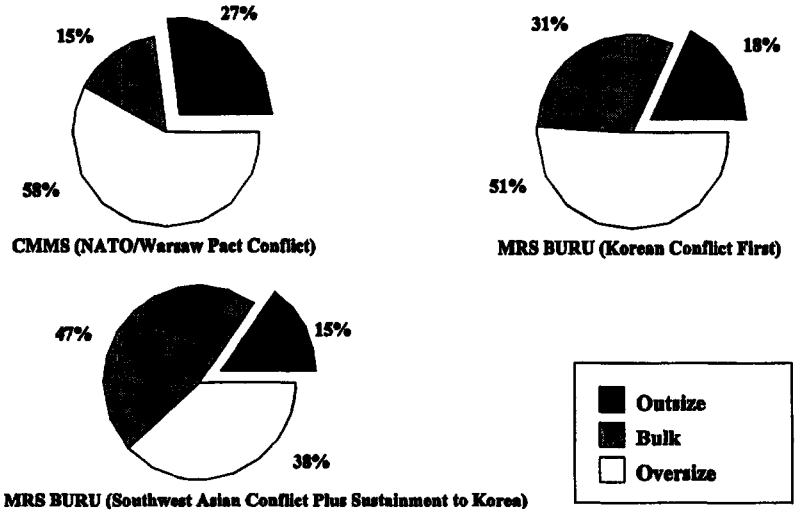
3. Department of Defense, *DoD Airlift Requirements: Report to Congress Required by the National Defense Authorization Act for Fiscal Year 1994* (January 1995).

4. W. L. Greer, *Cost and Operational Effectiveness Analysis of the C-17 Program,* Report R-390 (Alexandria, Va.: Institute for Defense Analyses, December 1993), p. ES-9; Jeff Cole, "Report Warns Against Plans to Refit C-141," *Wall Street Journal,* August 23, 1993, pp. A3, A12.

Heavy Cargo Deliveries

The mix of equipment DoD plans to airlift to a major regional contingency today differs from what it planned to send for a conflict with the Soviet Union. Military planners categorize airlift loads into three sizes: bulk loads that fit on a standard pallet, oversize loads that are larger than bulk loads but will fit into a C-141, and outsize loads that can fit only on a C-5 or C-17. According to the CMMS, 27 percent (by weight) of the equipment that DoD planned to send to a NATO/Warsaw Pact conflict within the first two weeks was outsize (see Figure 3). By comparison, DoD's simulations of deployments to Korea and Southwest Asia suggest that 15 percent to 18 percent of airlift deliveries over a similar period will be outsize. Official data for the first two weeks of Desert Shield are unavailable, but approximately 10 percent

FIGURE 3. SHARES OF EARLY AIRLIFT REQUIREMENTS BY CARGO TYPE



SOURCE: Congressional Budget Office based on data from the Department of Defense.

NOTES: The percentages above show the shares of cumulative airlift deliveries within the first two weeks of deployment. Since the Bottom-Up Review scenarios occur nearly simultaneously but more than two weeks apart, the requirements for a conflict in Southwest Asia also include supplies that must be flown to the first conflict in Korea.

CMMS = Congressionally Mandated Mobility Study; MRS BURU = Mobility Requirements Study Bottom-Up Review Update.

(by weight) of the cargo loads were outsize and half were bulk during the first month of deployment to the Persian Gulf.[5]

The decline in the requirement for carrying outsize cargo is an important issue in the debate over how many more C-17s are needed. One advantage of the C-17 and C-5 relative to the C-33 is their ability to carry such cargo. However, if a large proportion of the equipment that DoD plans to send can fit on the C-33, then a mixture of planes might be equally effective.

Advocates of the C-17 and C-5 point out that those planes were designed specifically with military loads in mind. Both aircraft have wings that are high on their fuselages and ramps that lower to the ground so that military equipment can move on and off quickly. The planes also have large doors and unobstructed cargo compartments capable of handling outsize equipment, as well as reinforced floors to handle heavy loads. The ramps and floors of the C-17 and C-5 were designed so that those planes can air-drop equipment while in flight. The C-17 also has a system of thrust-reversers, flaps, and slats that allows it to land on short airfields, much like the smaller C-130 can.

By comparison, the 747-400 freighter (on which the C-33 is based) was designed to maximize range while carrying a large payload of standard containerized cargo. Its cargo compartment is much higher off the ground than a military airlifter's. As a result, the Air Force would need to transport loaders and other material-handling equipment (as it does for its KC-10s) in order to move supplies on and off the C-33, and loading the aircraft might take more time. But the C-33 would most likely be constructed with wider doors and stronger floors than the civil version of the 747 to handle heavier and bulkier military equipment. And the C-33 would be capable of carrying an average payload more than 60 percent larger than that of the C-17 over a much longer range—potentially reducing the need to refuel airlift planes in flight.

Based on data from the Department of Defense, the Congressional Budget Office (CBO) estimates that at least 70 percent (by weight) of equipment that military officials plan to airlift to major contingencies in Korea and Southwest Asia could fit on the C-33—that is, all bulk cargo, most oversize equipment, and a few outsize pieces. The plane would not be able to accommodate equipment such as attack, scout, and utility helicopters, or some heavy trucks and vehicles that are built on tank chassis, but it would hold more types of cargo than most CRAF aircraft or the standard configuration of the 747-400 freighter.

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5. Jean Gebman, Lois Batchelder, and Katherine Poehlmann, *Finding the Right Mix of Military and Civil Aircraft, Issues and Implications*, vol. 2, *Analysis*, MR-406/2-AF (Santa Monica, Calif.: RAND, 1994).