

CRS Report for Congress

Military Airlift: C-17 Aircraft Program

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Committees of Congress

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Summary

The C-17 Globemaster III is a long-range cargo/transport aircraft operated by the U.S. Air Force since 1993. Congress approved development of the aircraft in the late 1970s, when it was recognized that the Air Force did not have enough airlift capability. In 1981, the McDonnell Douglas C-17 emerged as winner of a competition with Boeing and Lockheed to develop a next-generation aircraft to replace C-130s and C-141s.

Full-scale development of the C-17 got underway in 1986, but technical problems and funding shortfalls delayed the program, leading to slipped schedules and increased costs. Despite those difficulties, the C-17 has retained broad congressional support and enjoys strong Air Force and Army backing. Defense officials view the C-17 as essential because of its ability to fly long distances with large payloads yet still use smaller bases in remote areas.

The C-17 first flew in 1991, about a year later than originally scheduled. Deliveries began in 1993, and initial operational capability (IOC) was declared in June of that year. C-17s have been successfully employed in military operations in Bosnia, Kosovo, Afghanistan, Iraq, and also in support of several humanitarian/disaster relief operations.

Production problems in the late 1980s raised questions about the possibility of more cost-effective alternatives. In April 1990, Defense Secretary Cheney reduced the projected buy from 210 to 120 planes. In late 1993, the Department of Defense (DOD) gave the contractor two years to solve production problems or face termination of the contract, with airlift shortfalls to be filled by modified commercial transport planes or existing military airlifters.

By the mid-1990s, the program's difficulties had been largely resolved, although some questioned the number of C-17s to be procured. In 1996 DOD approved plans to order 80 more C-17s for a total of 120 aircraft — increased in late 1998 to 134. In June 2001, DOD announced its decision to acquire 137 C-17s, which would bring the Air Force's million-ton-miles-per-day capability to 45.3. Through FY2006, \$54.5 billion has been provided for the C-17 program, and it is expected to cost an additional \$5 billion to complete the program, as estimated in December 2005.

DOD planned to end C-17 production at 180 aircraft in FY2007, but both authorizers and appropriators voiced concern over that plan. Appropriators provided \$2 billion in un-requested funding to purchase 10 additional C-17 aircraft and directed DOD to fund the program in FY2008.

The C-17 program is at the center of a number of airlift debates that confront policymakers. These issues include, but may not be limited to airlift needs and requirements, cost and budget, and industrial base issues.

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Military Airlift: C-17 Aircraft Program

Introduction

Background

The Air Force's C-17 Globemaster III is a long-range cargo/transport aircraft manufactured by Boeing (since its acquisition of McDonnell Douglas in 1997). Powered by four turbofan engines made by Pratt & Whitney, the C-17 is expected to meet U.S. strategic (long-range) airlift requirements, complementing the tactical (shorter-range) airlift capabilities of the C-130 Hercules cargo/transport planes built by Lockheed-Martin. The C-17 can carry some 169,000 lbs of outsize or oversized cargo (e.g., Abrams tanks and Apache helicopters) and can operate from smaller runways than the larger C-5 Galaxy strategic airlifter.

The program had a difficult time winning the support of Congress in the late 1970s. The main hurdle at the program's outset was that the Air Force had not clearly demonstrated a need for additional strategic airlift capacity. Funding was finally approved to begin development in FY1981. Just when the program was getting under way, however, DOD decided in early 1982 that the airlift shortfall was too urgent to await development of a new plane and that it would also be better to buy some planes already in production. Congress approved funds in the FY1983 budget to purchase 50 additional C-5 cargo planes (made by Lockheed Martin) and 44 new KC-10 Extender aerial refueling aircraft (then made by McDonnell Douglas) to make up part of the airlift shortfall in the shortest time possible.¹ Since the Air Force wanted to develop the C-17 as well as to buy additional C-5s, Congress directed the service to develop a comprehensive description of its future acquisition plans. The result was the Airlift Master Plan of September 1983, which compared several alternatives for modernizing the airlift fleet and concluded that the C-17 was the most cost-effective.

Performance Considerations

The Air Force states that the performance characteristics of the C-17 are significantly better than those of other cargo/transport aircraft. The C-17 can land on shorter runways and is more maneuverable on the ground than the larger C-5 or commercial transport planes, such as the Boeing 747, which require much longer and wider runways. That requirement limits the number of available bases, and the

¹ The KC-10 is a large aircraft. In addition to 356,000 lbs of fuel, it can carry up to 75 troops and 170,000 lbs of cargo. The KC-10 fleet represents approximately 12% of all of DOD's organic airlift capability. For more information, see CRS Report RS20941, *Air Force Aerial Refueling*, by Christopher Bolkcom.

number of aircraft that can use a base at any one time (called “maximum on the ground” or MOG by logisticians). In explaining the November 1995 decision to buy another 80 C-17s, DOD officials cited as a critical feature their calculations that eight C-17s could land and offload 3,852 tons per day in a space where only three modified 747s could operate delivering 1,754 tons per day.

The C-17 is also expected to be more cost-effective than its competitors based on projected life-cycle costs. The C-17’s performance in the “reliability, maintainability, and availability evaluation” exercises of July-August 1995 confirmed its supporters’ expectations about operational capabilities with favorable cost implications, in part because fewer people are needed to operate and maintain the aircraft.

As part of the 1993 omnibus agreement between the Air Force and McDonnell Douglas, DOD agreed to change certain contract specifications that were causing design and cost problems. The most noteworthy of these changes included cruise speed reduced from Mach 0.77 to Mach 0.74; maximum payload from 172,200 lb to 169,000 lb; and ferry range from 4,600 nm to 4,300 nm. Air Force General Ronald Fogleman, then head of the U.S. Mobility Command, said these changes did not affect critical operational requirements, explaining that a 3,200-mile mission with a 110,000-lb payload had been established as a goal and that the C-17 would meet or exceed this requirement.

Production and Schedule

The C-17 program has experienced a noteworthy amount of turbulence, and planned purchases and inventories have been increased and decreased over time.

The FY1985 budget included \$129 million to begin full-scale development of the C-17 — then to be produced in a 210-aircraft program. The Airlift Master Plan had projected a requirement for 210 C-17s, with 180 in the active fleet and 30 additional aircraft for backup and spares and for testing and evaluation. The Air Force would also retain 114 C-5s but would turn many of these over to the Air Force Reserve and Air National Guard. By the mid-1980s the C-17 program appeared to be on track, if somewhat behind schedule. Production difficulties later delayed the program further, with slipped schedules and rising development costs. In April 1990, Defense Secretary Dick Cheney reduced the program from 210 to 120 production C-17s, reflecting revised estimates of airlift requirements in view of the collapse of the Soviet Union, as well as domestic budgetary restraints.

The Air Force agreed in December 1993 to buy another 12 C-17s during FY1994- FY1995, but Defense Secretary Les Aspin stated that the contract would end with the 40 aircraft then on order if McDonnell Douglas failed to resolve production and cost problems during that two-year period. In that event, DOD would buy a mix of C-17s and modified commercial transport planes, or C-5 military transports to replace the aging C-141 Starlifter. By accepting the 1993 agreement, McDonnell Douglas incurred a loss of nearly \$1.5 billion on the development phase of the program. In addition, the company agreed to spend \$456 million in process improvements and testing. DOD agreed to provide an additional \$438 million for the

program — \$237 million to settle claims with McDonnell Douglas and \$201 million for flight testing.

In November 1995, the Defense Department decided to continue procurement of the C-17 for a total program of 120 aircraft instead of meeting airlift requirements with a mix of C-17s, modified Lockheed C-5s, and Boeing C-33s. The military services argued that additional airlift capacity was critical and that if C-17s were not procured, other less capable cargo/transport aircraft would be needed to make up the shortfall. Most Members of Congress recognized the need for additional airlift, although some questioned the need to buy as many as 80 more C-17s.

In January 1996, the Defense Acquisition Board (DAB) approved plans to buy 80 C-17s (for a total of 120 aircraft) over a seven-year period (FY1997-FY2003) in a multiyear contract that would be less expensive than either single-year buys or multiyear procurement over a longer period (with savings estimated at 5% of a projected program cost of \$18 billion). The Air Force argued that buying the C-17 in six or seven years would provide the planes sooner and more cost-effectively and would avoid funding competition with other Air Force programs after 2003. Critics argued that such a long-term contract could entail financial penalties for reducing annual buys, if budgetary constraints in future years were to force the Air Force to choose between buying C-17s or other aircraft, such as F-22A Raptor.

On May 31, 1996, the Air Force and McDonnell Douglas (now owned by Boeing) signed a \$16.2-billion multi year procurement contract for 80 aircraft to be produced over seven years. The first of these 80 aircraft was delivered on August 10, 1998, bringing total deliveries to 41 aircraft. In late 1998, 14 more aircraft were added to planned buy, bringing the planned total to 134 C-17s. By late 2002, the Air Force had taken delivery of 100 C-17s.

In early 2002, Air Force officials said that even more C-17s are needed. Chief of the U.S. Transportation Command, Gen. John Handy, said that he wanted 222 C-17s to meet the nation's airlift needs.² Gen. Handy's advocacy represented an increase of at least 42 aircraft from the desires of his predecessor. Former head of the U.S. Transportation Command, Gen. Charles "Tony" Robertson testified in April 2001 that he needed 170 to 180 of the aircraft to meet requirements outlined in DOD's Mobility Requirements Study 2005 (MRS-05).³ In August 2002, Boeing was awarded a \$9.7 billion contract to produce an additional 60 C-17s, which would bring DOD's total inventory to 180. This contract was expected to keep the Long Beach, CA production line open until 2008.⁴ Final assembly at the Long Beach plant would have begun on the last aircraft, in June 2007 and be completed in April 2008,⁵ but

² Harry Levins, "Transportation Command's Chief Emphasizes the Need for More C-17 Cargo Planes," *St. Louis Post-Dispatch*, Feb. 2, 2002, p. 9.

³ Marc Selinger, "DoD Needs More C-17s to Eliminate Airlift Shortfall, AMC Commander Says," *Aerospace Daily*, Apr. 27, 2001.

⁴ Peter Pae, "Boeing Lands \$9.7 Billion C-17 Contract," *Los Angeles Times*, Aug. 16, 2002.

⁵ Final assembly of the Globemaster takes approximately 10 months. Meeting between CRS (continued...)

appropriations conferees provided an unrequested \$2 billion in FY2007 to purchase an additional 10 C-17 aircraft.

Basing

Active duty C-17s are based at Charleston AFB, SC (437th Airlift Wing), McChord AFB, WA (62nd Airlift Wing), and McGuire AFB, NJ (this is an active duty base with a Reserve Associate Unit). A training unit of eight aircraft is based at Altus, OK (97th Air Mobility Wing). The first C-17 arrived at March Air Reserve Base, CA, on August 9, 2005, and seven more Globemasters are scheduled to be based there. The Air Force plans to base C-17s at six additional bases: McGuire AFB, NJ, Dover AFB, DE, Travis AFB, CA, Elmendorf AFB, AK, Hickam AFB, HI, and an Air National Guard wing at Jackson International Airport, MS.⁶ This basing plan has proven controversial for some Members of Congress.⁷

C-17 in Recent Operations

The C-17 has been used in a number of military operations, including Joint Endeavor (Bosnia) Allied Force (Kosovo), Northern/Southern Watch (Iraq), Atlas Response (Mozambique and South Africa), Enduring Freedom (Afghanistan) Iraqi Freedom (Iraq). Also, the C-17 has been used to support peacekeeping operations, such as delivering cargo to peacekeepers in Darwin, Australia who were preparing to quell the ethnic fighting in East Timor, Indonesia. (1999). C-17s have also been used to support humanitarian and relief efforts. In 1999, for example, C-17s from the 437th Airlift Wing delivered cargo to victims of Hurricane Mitch in Honduras and Nicaragua and, in 2001, they carried federal relief workers and 30,000 lbs of supplies to flood-soaked Houston, Texas.⁸

The C-17 was first systematically employed in a major contingency beginning in December 1995, when U.S. and allied nations deployed peacekeeping forces to Bosnia in support of Operation Joint Endeavor. In the first three months of operations, Air Force mobility forces flew 3,827 missions, carried over 18,539 troops and delivered more than 45,000 short tons of cargo. The C-17 — used to satisfy the Army's need for high-capacity, short distance air transport to move peacekeepers, equipment and outsize cargo from Central Europe to the Bosnia area of operations — flew slightly more than 26 percent of the missions but delivered over 44 percent

⁵ (...continued)

and USAF Directorate of Global Reach (SAF/AQQ). April 19, 2006. Rosslyn, VA.

⁶ Jonathan Block and Laura Colarusso, "Briefing Reveals Air Force's Future C-17 Basing Plans to Congress," *Inside The Air Force*, Apr. 19, 2002, p.1.

⁷ Laura Colarusso, "Ohio Congressman Criticizes C-17 Beddown Plans, Seeks Other Options," *Inside the Air Force*, May 3, 2002.

⁸ Harold Kennedy, "Charleston's C-17s Flying Wherever There's a Runway," *National Defense*, Dec. 2000; "C-17 Hauls Supplied to Houston," *Charleston (SC) Post and Courier*, June 13, 2001.

of the cargo.⁹ Globemaster crews reportedly offloaded cargos of some 165,000 lb in less than 15 minutes.¹⁰ GAO assessment of the C-17's performance during Joint Endeavor (GAO/NSIAD-97-50) found good news to report. The C-17's mission capable rate was reported to be 86.2 percent, 5 percent higher than the required 81.2 percent. On the other hand, the GAO wrote that the C-17 was not required to perform many tasks which it had previous trouble doing, or could not do during operational testing. These tasks included landing at small austere airfields on short, wet runways, performing strategic airdrops of both troops and equipment, and providing aeromedical evacuation capability.

The C-17's ability to operate from austere airfields in Albania and Macedonia was further demonstrated during the Operation Allied Force in March-June 1999, when C-17s achieved a 96-percent mission-capable rate. In their joint testimony before the Senate Armed Services Committee, Secretary of Defense William Cohen and Chairman of the Joint Chiefs of Staff General Henry Shelton extolled the C-17's contributions to the Kosovo conflict. They said that "...the C-17 was the workhouse of the airlift force, providing for the rapid deployment of critical warfighting and humanitarian materiel." Furthermore, they testified that

Throughout Operation Allied Force, U.S. forces had to overcome many limitations in transportation infrastructure. Poor airport surface conditions in Tirana, Albania, for example, slowed aircraft turnaround times, limited throughput, and slowed the onward movement of forces and humanitarian supplies. Our transportation and other logistic assets proved to be flexible, effective, and efficient in responding to these limitations. In particular, the C-17 made the concept of direct delivery — the strategic air movement of cargo from an aerial port of embarkation to an airfield as close as practicable to the final destination, a reality.¹¹

Air Force officials said that the C-17s high payload capacity, ability to land on short, austere airfields, and its ground maneuverability were the keys to success during this operation.

Almost all of the Air Force's inventory of 50 C-17s were involved in the Balkan operation and the Globemaster flew half of the strategic airlift missions required by the operation."¹² The U.S. Air Force reports that C-17s from Charleston AFB, S.C.

⁹ U.S. Army Office of Public Affairs, *Task Force Eagle SFOR X Stabilization Force*, [http://www.globalsecurity.org/military/ops/joint_endeavor.htm]; [<http://www.tfeagle.army.mil/default2.asp>]

¹⁰ U.S. General Accounting Office, *C-17 Globemaster — Support of Operation Joint Endeavor*, GAO/NSIAD-97-50, Feb. 1997.

¹¹ Joint Statement of Secretary of Defense William S. Cohen and Chairman of the Joint Chiefs of Staff General Henry H. Shelton, in U.S. Congress, Senate Committee on Armed Services, *Kosovo After-Action Review*, hearing, 106th Cong., 1st sess., Oct. 14, 1999, pp. 11-12, (Washington: GPO, 1999).

¹² U.S. Department of Defense, Report to Congress, *Kosovo/Operation Allied Force After-* (continued...)

had flown 1,092 missions into the theater as of June 29, 1999, with a departure reliability rate of 96 percent. C-17 was also used extensively for intra-theater operations. Twelve C-17s flew 430 intra-theater airlift missions.¹³

The Air Force has consistently praised the C-17's performance in support of Operation Enduring Freedom, the war against terrorism in Afghanistan. Nearly 170 C-5 and C-17 cargo planes have been dispatched to create an "air bridge" to this distant, landlocked theater of operations.¹⁴ C-5 aircraft bring cargo and troops from the United States to staging bases in Europe and the C-17s fly directly to forward operating bases in Afghanistan. C-17s fly from Ramstein Air Base in Germany to Afghanistan, approximately 26 hours each way and 10,000 miles round trip.¹⁵ C-17s have also flown missions from U.S. bases directly to forward operating locations in Afghanistan.¹⁶

While distance is clearly a challenge, overflight, and infrastructure challenges appear to be even more burdensome. Most of the Afghan airfields from which C-17s operate are short (~3,500 feet), and strewn with debris and potholes. Some airfields are nothing more than packed dirt. C-5s cannot operate from these primitive airfields.¹⁷ For security reasons, C-17s offload cargo as quickly as possible (usually with engines running), make unscheduled landings, and fly seemingly erratic routes.¹⁸

In addition to moving personnel and war materiel, C-17s conducted numerous food drops early in the campaign. Beginning on October 7, 2001, the first day of the war, the Air Force began flying two to four food-drop flights per day. From an altitude of 25,000 feet, each C-17 unloaded about 17,000 humanitarian daily rations over Afghanistan.¹⁹

Air mobility operations, as expected, played a significant role in the Iraq war. Reports suggest that airlift operations were largely satisfactory, and that the C-17 airlift aircraft performed well. Air mobility missions accounted for 16,740, or 40%,

¹² (...continued)

Action Report, Jan. 31, 2000, p. 40.

¹³ Anthony Cordesman, "The Lessons and Non-Lessons of the Air and Missile Campaign in Kosovo," Center for Strategic and International Studies, Mar. 5, 2000.

¹⁴ Eric Schmitt, "Busy Skies Over Asia Controlled from U.S.," *New York Times*, Oct. 14, 2001.

¹⁵ David Castellon, "C-17s Get Roar of Approval For Role In Afghanistan," *Air Force Times*, May 27, 2002, p. 34.

¹⁶ Tony Capaccio, "Boeing \$9.6 Bln Deal for More C-17s To U.S. Said Due Next Month," *Bloomberg.com.*, Apr. 26, 2002.

¹⁷ Seena Simon, "Air Force Makes Play for More C-17s," *Air Force Times*, Mar. 18, 2002, p. 26.

¹⁸ Lt. Col. Douglas Lefforge, "C-17 Is Vital to War on Terror," *Air Force News Archive*, Feb. 5, 2002.

¹⁹ Richard Newman, "Tankers and Lifters for a Distant War," *Air Force Magazine*, Jan. 2002.

of the 41,404 sorties (excluding sorties by special operations forces and Army helicopters, and “coalition sovereignty flights”) in the war.²⁰ The U.S. Transportation Command reported that by April 10, 2003, it had flown 16,213 air mobility missions for the war, exceeding the total number of such missions flown in the 1991 Persian Gulf war.²¹

The requirement for U.S. strike aircraft to fly around rather than through Turkish airspace increased aerial refueling requirements because those aircraft now had to fly longer missions. Turkey’s decision not to allow the U.S. Army’s 4th Infantry Division to attack northern Iraq from bases in Turkey increased airlift requirements because establishing a U.S. ground presence in northern Iraq then had to be done primarily by air. Fifteen C-17 aircraft executed one of the largest air assaults in recent memory, airdropping 1,100 paratroopers from the Army’s 173rd Airborne Brigade. To buttress this force, U.S. airlift aircraft transported an additional million pounds of equipment, several M-1 Abrams tanks, and another 1,000 soldiers.

Issues

The C-17 program is at the center of a number of airlift issues that confront policymakers. These issues include, but may not be limited to airlift needs and requirements, cost and budget, and industrial base issues. Also, alternatives to the C-17 program must also be weighed.

Needs and Requirements

The number of C-17s that should be procured is related to the overall airlift requirement, which is typically measured in millions of ton-miles per day (MTM/D). In March 2001, the Air Force announced the findings of its Mobility Requirements Study 05 (MRS-05). MRS-05’s principal finding was that the goal set by the previous mobility study for an airlift fleet capable of moving 49.7 MTM/D of personnel and cargo was inadequate to meet the national military strategy. MRS-05 recommended an airlift fleet capable of 54.5 MTM/D. At that time, DOD’s strategic airlift capability was approximately 44.7 MTM/D, nearly 10 MTM/D short of the MRS-05 goal.²² In June 2001, DOD announced its decision to acquire three additional C-17s, which would bring the Air Force’s million-ton-miles-per-day capability to 45.3.²³ This increase to 137 Globemasters reduced the gap between and desired and actual airlift capabilities to 9.2 MTM/D.

²⁰ Lt. Gen. T. Michael Moseley, USAF Commander, *Operation IRAQI FREEDOM — By the Numbers*, USCENTAF, Assessment and Analysis Division, Unclassified, Apr. 30, 2003, pp. 7-8.

²¹ Chuck Roberts, “C-130 Crews Keep The Supplies Coming,” *Air Force News*, Apr. 16, 2003.

²² For more information on MRS-05, see CRS Report RS20915, *Strategic Airlift Modernization: Background, Issues and Options*, by Christopher Bolkcom.

²³ Jonathan M. Block, “Officials: Air Force to Procure Three Additional Boeing C-17s,” *Inside the Air Force*, June 29, 2001.

The terror attacks of September 11, 2001, and the subsequent operation in Afghanistan led many to believe that the findings of the MRS-05 were outdated. Significant changes in the National Military Strategy were required, and a different strategy would likely require different airlift capabilities. In June 2004 DOD began its first “post 9/11” review of transportation requirements. This Mobility Capabilities Study (MCS), once scheduled for completion in March 2005, was completed and briefed to Congress in February 2006.

The findings of the MCS have not been made publically available. Extensive press reporting of the study emphasize the following points: 1) unlike past mobility studies, the MCS did not recommend an airlift requirement, expressed in million ton miles per day (MTM/D), 2) instead, the MCS assessed the capabilities of the current and currently projected force, and 3) found that force to be sufficient to meet the National Military Strategy with acceptable risk.

The MCS caught observers by surprise, who expected the study to project a growth in airlift needs, perhaps a requirement closer to 60 MTM/D than the 2000 estimate of 54.5 MTM/D.²⁴ Others speculated, however, that the MCS would not increase the 54.5 MTM/D requirement, because planners know that DOD cannot afford to purchase enough aircraft to provide this amount of airlift.²⁵ Those who hold this perspective imply that the MCS is not an unbiased study of requirements, but a compromise between what is needed, and what can be achieved.

Many have criticized the MCS. In a September 14, 2005, letter to Defense Secretary Rumsfeld, for example, the GAO documented a number of shortcomings in the MCS’ methodology.²⁶ Others criticized the study for not assessing intra-theater lift needs, and for focusing on “near term” capabilities rather than taking a longer view.²⁷ Some have called on DOD or an independent agency to conduct another mobility study to rectify the MCS’ perceived shortcomings.

How significant is a potential shortfall in airlift? Does it jeopardize current and future force projection capabilities? The commander of the U.S. Transportation Command testified that he could not provide the airlift capabilities on the schedule desired by Operation Iraqi Freedom’s planners.²⁸ However, others point out that despite these perceived shortfalls, the war was executed successfully. Further, the significance of the current and projected shortfall may be mitigated by a historical

²⁴ Marc Selinger, “DoD Launching New Review of Transportation Needs,” *Aerospace Daily*, Mar. 11, 2004.

²⁵ John Tirpak. “Air Mobility in the Doldrums.” *Air Force Magazine*. August 2005.

²⁶ *Defense Transportation: Opportunities Exist to Enhance the Credibility of the Current and Future Mobility Capabilities Studies*. Government Accountability Office. September 14, 2005. William M. Solis, Director Defense Capabilities and Management.

²⁷ John T. Bennett. “Influential DoD Mobility Study’s Focus on Intratheater Needs Questioned.” *Inside the Air Force*. April 7, 2006.

²⁸ Sharon Weinberger, “Handy: Airlift Shortage Forcing Military Tradeoffs,” *Defense Daily*, Mar. 23, 2004, p.3.

review which indicates that DOD has always “required” more airlift than it was able to provide.²⁹

Budget and Cost Factors

A major issue in the C-17 program has been the fact that while it appears to offer relevant and important capabilities, the aircraft is more expensive than other potential alternatives. The acquisition of several proposed “non-developmental airlift aircraft” (NDAA) alternatives, as projected by their manufacturers and the Congressional Budget Office, were less expensive than an airlifter, such as the C-17, designed and manufactured to military specifications. (See “alternatives” section below.) As of December 31, 2005, DOD estimated a 180-aircraft C-17 program to cost \$59.5 billion, for a program acquisition cost (PUAC) of \$330 million per aircraft. Average procurement cost (excluding “sunk costs,” such as R&D) is estimated at \$280 million per aircraft. C-17 advocates point out that unit costs have been reduced by multiyear procurement. Under the multiyear production contract of May 31, 1996, 80 aircraft were produced during the 1996-2003 period for some \$16.2 billion, an average of \$202.5 million per aircraft.³⁰ The current \$9.7 billion multiyear procurement contract equates to an average cost of \$161.6 million per aircraft.

A second and related concern has been potential budgetary competition between additional C-17 aircraft and other airlift requirements. Senior DOD officials have implicitly recognized this competition. For example, Ryan Henry, principal deputy under secretary of defense for policy was reported to have said that keeping the C-17 production line open “would be a smart thing to do” from a pure risk perspective, but, “the cost would be prohibitive” given the other airlift procurement programs that the Air Force plans.”³¹ Recapitalizing the KC-135 tanker fleet and initiating the Joint Cargo Aircraft (JCA) program are two potential programs that may be competing with the C-17 programs for limited budget authority.

A third issue that has dogged the C-17 program has been a controversy over recent budget profiles. Congressional appropriators in FY2003 and FY2004 (see congressional action section below) have expressed concern that the Air Force has not requested funding consistent with “full funding” principles which guide prudent procurement practice and could be creating future liability for DOD and Congress. If the C-17 were being “incrementally funded” some fear that it would violate the

²⁹ For more information about airlift requirements see CRS Report RS20915, *Strategic Airlift Modernization: Background, Issues and Options*, by Christopher Bolkcom.

³⁰ Brian Bender, “Pentagon Signs \$16 Billion Deal for C-17 Transport Planes,” *Defense Daily*, June 3, 1996, p. 366-367.

³¹ Michael Sirak. Senior DoD Officials Defend Decision To Halt C-17 Production At 180.” *Defense Daily*. February 10, 2006.

Antideficiency Act, which defends against procuring items for which funds have not been allocated.³²

In March 2004, it was reported that a study by the House Appropriations Surveys and Investigation staff raised concerns that the Air Force had in fact overstepped its authority in the current C-17 MYP by committing DOD to producing the aircraft in advance of congressional appropriations.³³ The contract's liability clause (which pays a negotiated penalty to the manufacturer if the government decides to breach the terms of the contract) was also deemed suspect as inconsistent with general practice. Air Force officials disagree with these depictions of the C-17 MYP contract, and emphasize the cost savings realized by such contracts. In their FY2005 spending bill, Congressional appropriators strongly expressed their dissatisfaction with the current C-17 funding profile (see Congressional Action section, below).

Industry and Exports

Without a commitment in FY2008 to purchase additional Globemasters, the C-17 production line in Long Beach, CA could begin shutting down as early as June 2007. Some in Congress have encouraged DOD to procure more C-17s than are currently planned, arguing that airlift needs are increasing.³⁴ Procuring additional C-17s domestically or exporting them are seen as two potentially complementary methods of both keeping the production line open and reducing the per-aircraft production costs.

Appropriations conferees have directed the Air Force to study options for commercializing the heavy, outsized aircraft for incorporation into CRAF. (H.Rept. 108-553, p. 77.) Some industry studies suggest that a commercial market for up to 10 C-17s may exist for use in heavy industry, mining, or similar endeavors. The Air Force and Boeing have considered a number of different potential strategies to exploit or expand this potential market.³⁵

The first potential strategy has been called the Commercial Application of Military Airlift Aircraft (CAMAA). Under CAMAA, DOD would loan money directly to companies or guarantee the financing of companies which would purchase C-17s from Boeing. Civilian owners of the BC-17X (as the commercial variant would be called) would make the aircraft available to DOD in time of need,

³² For more information on defense procurement and full funding policy, see CRS Report RL31404, *Defense Procurement: Full Funding Policy Background, Issues, and Options for Congress*, by Ronald O'Rourke and Stephen Daggett.

³³ Amy Butler, "Lawmakers Question C-17 Multiyear Deal With Boeing After House Investigation," *Defense Daily*, Mar. 23, 2004, p. 1.

³⁴ Gail Kaufman, "USAF C-17s May Come Earlier Than Requested," *Defense News*, Mar. 29, 2004.

³⁵ Aircraft like the C-17, built to military specifications, tend to be too expensive for civil users. Trucks, ships, or large commercial aircraft are often used to move large industrial parts and products.

much like CRAF. The Air Force proposed several options to sweeten the deal, such as helping companies find customers who need outsized cargo delivery and providing them monthly military business paid for at commercial rates. In addition to having access to these aircraft, the Air Force and civilian users would benefit because building BC-17Xs for civilian use would effectively exploit excess production capacity and help lower the per-unit cost of those aircraft bought by DOD.³⁶ In October 2002 it was reported that DOD's Business Initiatives Council had approved the CAMAA program as an "efficiency measure," but DOD has reportedly cooled to this particular approach.³⁷

A second potential strategy would be for the Air Force or the General Services Administration (GSA) to sell used C-17s to commercial companies. Commercial clients would, presumably, be interested in used aircraft because they would cost less than new aircraft. As part of the arrangement, the commercial owner would make the aircraft available to DOD in times of crisis, thus increasing the potential inventory of outsize/oversize airlifters available to DOD. The Air Force could use the profits of the sale to help finance the purchase of new C-17s.

A third potential strategy would be for the Air Force to trade in older C-17s to Boeing and receive credit to purchase new ones. Reportedly, the Air Force prefers this approach to selling the aircraft directly to commercial companies because it would relieve it of any potential responsibility for ensuring the aircraft are certified for civil application.³⁸ Some question why the Air Force would want to sell any of its C-17s if there is a growing requirement for them.

The feasibility of any of these strategies is unclear. In a "post-9/11" environment typified by a declining aviation market, few companies may wish to risk investing in such expensive cargo aircraft. On the other hand, one private company — *Cargo Force* — has publicly stated that it desires to purchase 25 to 80 C-17s, but allege that DOD is blocking such a sale because it fears that this might reduce the likelihood that Congress will fund additional C-17s for the Air Force.³⁹

Some also question whether Congress' appetite for unconventional financing and procurement strategies in the aftermath of the KC-767 tanker lease proposal.⁴⁰

³⁶ Amy Butler, "Commercial C-17 Buys Would Stabilize Cost, Enhance Reserve Air Fleet," *Inside the Air Force*, Dec. 22, 2000; Christian Lowe, "Air Force Issues Draft Solicitation for Civilian C-17s," *Defense Week*, July 9, 2001.

³⁷ "DoD Business Initiatives Council Supports C-17 'Commercialization,'" *Defense Daily*, Oct. 16, 2002, p. 8.

³⁸ Cynthia Di Pasquale. "Pentagon Proposes Trading in Older C-17s to Boeing to Grow CRAF." *Inside the Air Force*. April 22, 2005.

³⁹ Dave Ahearn. "Air Force maneuvers to Ensure it Gets 220 C-17s — Analyst." *Defense Today*. March 7, 2005.

⁴⁰ For more information, see CRS Report RL32056, *The Air Force KC-767 Tanker Lease Proposal: Key Issues For Congress*, coordinated by Christopher Bolkom.

Any creative attempts to establish an outsize/oversize commercial market based on the C-17 would likely have to be done without creating financial liability for DOD.⁴¹

While Boeing representatives express confidence that a niche market exists for a commercial variant of the C-17, Air Force leaders appear uninterested in exploiting this potential market. In an April 2006 letter to Congress, Secretary Michael Wynne wrote that the Pentagon's recent reviews of mobility requirements determined there is no need for an outsized, commercial aircraft in the Civil Reserve Air Fleet (CRAF).⁴²

Close U.S. allies also have strategic airlift requirements that could potentially be satisfied by the C-17, and recent news on exports has been promising for Boeing. In August 2006, the Royal Australian Air Force awarded Boeing a \$780 million contract for four C-17 aircraft.⁴³ Canada has also proposed importing four C-17s.⁴⁴

Whether the C-17 is successful in the export market will be determined in part by its competition. The most prominent competition is the European A400 M aircraft. Having long recognized a deficit in their long range airlift capabilities, several NATO countries (Germany, France, Spain, Britain, Turkey, Belgium, and Portugal) plan on purchasing the jointly developed A400M turboprop airlifter. This program has experienced numerous perturbations in schedule and budget. In December 2002, for example, Germany announced that it would reduce its planned acquisition of the A400M from 73 to 60 aircraft. Portugal, it is rumored, is considering cancelling its order entirely.⁴⁵ In September 2006 NATO announced that 13 of its members had signed a letter of intent to jointly purchase four C-17 aircraft.⁴⁶ If this sale comes to fruition it would represent a significant boost for the Globemaster's export prospects, and a blow to the A400M program.

British defense officials view the C-17 as an asset that can be used in rapid-reaction operations. The United Kingdom's Strategic Defense Review of July 1998 indicated that the Ministry of Defense might lease or buy several C-17s to meet air mobility requirements of Britain's Rapid Reaction forces. In August 2006 it was reported that the U.K.'s Royal Air Force had committed to purchasing outright the four C-17s that it had leased from Boeing and would purchase a fifth aircraft in 2008.⁴⁷ Britain had "conditionally committed" to purchase 25 Airbus A400M

⁴¹ Di Pasquale, *OpCit.*

⁴² Jason Sherman, "Wynne: No Room for Commercialized C-17 in Civil Reserve Air Fleet," *Inside Defense.com*, April 6, 2006.

⁴³ "Boeing to Provide Four C-17s to Australia Air Force." *Defense Daily*. August 1, 2006.

⁴⁴ "Canada to Spend \$1.3 billion for Four Boeing C-17 Globemasters." *Defense Daily*. September 15, 2006.

⁴⁵ "Germany Trims A400M, Meteor, IRIS-T Acquisitions," *Defense Daily*, Dec. 6, 2002.

⁴⁶ Nicholas Fiorenza. "NATO pools resources to buy C-17s." *Dane's Defence Weekly*. September 13, 2006.

⁴⁷ "More C-17s." *Aerospace Daily & Defense Report*. August 8, 2006.

transports following the C-17 lease. It is unclear whether the U.K. might purchase additional C-17 instead of the A400M aircraft.

Some Alternatives

Opponents of the C-17 have proposed alternatives ranging from extending the service life of cargo planes now in service to relying more on sea lift or developing large airships (blimps). Timeliness is the strongest argument for delivering military cargo by air, and some analysts believe that where time is not so critical it would be possible to use sea lift instead of buying additional airlift assets. The Department of Defense has steadfastly defended the C-17, arguing that it will be needed even more, as more U.S. troops return from overseas stations. The Air Force continues to assert that the C-17 holds high priority in relation to other Air Force programs, pointing out that the current U.S. airlift capability is only about 48 million ton miles per day compared to the 54.5 MTM/D stipulated in the 2001 mobility requirements study.

Buy Fewer C-17s and More Commercial Aircraft. One proposed alternative is to buy fewer C-17s and to make up the shortfall with additional commercial transport/cargo aircraft — referred to as “non-developmental airlift aircraft” (NDAAs). The leading candidate in the NDAA option is a military version of the Boeing 747 jumbo jet, designated the C-33. These Boeing C-33s would not be replacements for the C-17 but would fill the need for routine cargo flights between large airports. The C-17 can be operated on unimproved surfaces and can unload under austere conditions. Proponents of the NDAA argued that its acquisition cost would be less than that of the C-17, whose special performance features would not be needed in many airlift operations.

Air Force officials conceded that in some situations a mix of C-17s and NDAAs might be the most cost-effective way to carry military cargo. However, DOD’s decision in November 1995 reflected a choice of an all-C-17 force of 120 aircraft (including the 40 then under contract) in lieu of a C-17/NDAA mix. A 1997 report by the Congressional Budget Office (CBO) stated:

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.... 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.... 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.

This report considered the costs and capabilities of five alternatives to Administration plans for modernizing strategic airlift and sea lift, including buying fewer C-17s with estimated savings of \$8.4 to \$18.9 billion in 1998-2020.⁴⁸

⁴⁸ U.S. Congressional Budget Office, *Moving U.S. Forces: Options For Strategic Mobility*, Rachel Schmidt, Feb.1997; U.S. General Accounting Office, *Military Airlift — Options* (continued...)

Modernize the C-5 Galaxy Fleet. The Air Force owns 109 C-5s: 60 C-5As, 49C-5Bs, and two C-5Cs modified for the space program. On average, the A models are eight years older than the B models. The C-5, made by Lockheed Martin, is typified by its payload and range. One of the largest aircraft in the world, the C-5 can carry 160,000 lbs of cargo up to 3,730 nautical miles, and has a maximum payload of 291,000 lbs. The C-5 can carry large and irregularly shaped cargo, such as the Army's 74-ton mobile scissors bridge, that no other U.S. aircraft can hold. Both the nose and aft ends of the C-5 open, facilitating rapid loading and off-loading. The C-5 has been plagued by reliability problems; its mission capable rate for 2000, for example, was 58 percent.

The debate regarding the C-5 fleet is how many aircraft should be modernized and kept operational, and how many should be retired. Rising maintenance costs have led some to argue that more C-5s should be retired sooner, and the savings be applied to increased purchases of the new and modern C-17. Proponents of the C-17 also argue that reducing the C-5 fleet in favor of C-17s make sense given the growing need to engage terrorists and insurgents in theaters with limited aviation infrastructure. The Cold War paradigm of using strategic cargo aircraft to move large amounts of materiel to forward U.S. bases, then moving it a second time to the theater of operations on smaller airlift aircraft is not efficient, they argue. The C-17, they say, can do the job of both the C-5 (strategic airlift) and the C-130 Hercules (intra-theater airlift) and move war materiel directly from the United States into combat, if need be. As a more modern aircraft, the C-17 also offers more potential for upgrades and modifications than the C-5, it is argued. The C-17, for example, might be an option to consider when replacing the Air Force's aging fleet of AC-130 gunships. Investing more in the C-17 today, proponents argue, could benefit the Air Force in a number of ways that are currently not even obvious. Modernizing C-5Bs might make sense, some say, to improve that aircraft's mission capable rate, but sinking billions of dollars into the C-5A fleet is not a prudent investment.

Opponents of proposals to retire C-5s in favor of increased C-17 purchases say that the C-5 offers unique capabilities that the C-17 can't match. In a period of increasing mobility requirements, they argue, it makes little sense to prematurely retire aircraft in today's inventory. Proponents of the C-5 point out that a full 70 percent of the Galaxy's structural life remains, which suggests that today's investments could be recouped for decades. The per-aircraft cost of AMP and RERP is expected to be approximately one-third that of a new C-17, and the C-5 will carry twice the payload. The upgraded aircraft (called the C-5M), is also expected to have greatly improved mission capable rates.⁴⁹ C-5 proponents also note that over the past three years, DOD has leased Russian AN-124 aircraft to carry outsize and oversize cargo because C-5 aircraft were unavailable. In 2003, it was estimated that the 79

⁴⁸ (...continued)

Exist for Meeting Requirements While Acquiring Fewer C-17s, GAO/NSIAD-97-38, Feb. 1997.

⁴⁹ David Hughes, "C5 Avionic and Engine Upgrades Rolling," *Aviation Week & Space Technology*, Oct. 25, 2004. *C-5 Galaxy Modernization*, FY2006 Point Paper, Lockheed Martin Corp, July 1, 2005.

AN-124 missions conducted in that year cost DOD \$28.9 million.⁵⁰ While the C-5 may not be as modern as the C-17, or able to operate from as many runways, the fact that DOD has to outsource missions to Russia indicates that the C-5 still offers important capabilities that the C-17 can't.

Currently, it appears that the Air Force plan is to upgrade and maintain both the C-5A and C-5B models.⁵¹ On July 14, 2004, the Air Force's Fleet Viability Board (AFVB) released its assessment of the C-5A fleet. The AFVB found that the C-5A fleet — with appropriate investments — has at least 25 years of life remaining.⁵² In Sec. 133 of their report on H.R. 1588 (H.Rept. (108-106) p. 97, House authorizers expressed concern over potentially premature retirement of the C-5A fleet, and

recommend a provision that would limit the Secretary of the Air Force from proceeding with a decision to retire C-5A aircraft from the active inventory if the active inventory of such aircraft would fall below 112, until a RERP (re-engine and reliability program)- configured C-5A aircraft completes a dedicated initial operational test and evaluation, and the Department of Defense's Director of the Operational Test and Evaluation has provided his assessment of the RERP-configured C-5A's performance to both the Secretary of Defense and the congressional defense committees.

Invest in Lighter-than-Air Concepts. The Army, the Navy and the Joint Staff have, or are studying, the pros and cons of augmenting fixed-wing airlift aircraft with "lighter-than-air" aircraft. Also known as airships, blimps, dirigibles, or zeppelins, these potentially large, helium-filled balloons offer many potential advantages over fixed wing aircraft. One potential advantage is cargo capacity. Some airships being considered can carry up to 1,000 tons (2.2 million lbs) of cargo. Thus, the cargo capacity of just one airship is roughly equivalent to the payload of 13 C-17s. Because it can hover, and land vertically on both land and water, airships can potentially deliver their cargos from the United States directly to the theater of operations, eliminating inter-theater transport, and reducing U.S. dependence on forward basing.

Opponents to lighter-than-air concepts argue that airships fly slower than fixed-wing aircraft, and are probably more vulnerable to enemy missiles. Proponents counter that while the airship top speed of 100 knots is slower than an airlifters speed (typically 450 knots) the very large payload makes up for the slower speed, and that some cargo can be delivered at slower rates and still meet operational needs. Also, airships may be more survivable than they appear, proponents argue, because despite

⁵⁰ Master Sgt. Scott Elliot, "Jumper: Strategic Airlift Capability "Front Burner Issue,"" *Air Force Print News*, Feb. 11, 2003; Gene Rector, "Russian Aircraft Getting U.S. C-5 Work," *Macon Telegraph*, Dec. 21, 2003.

⁵¹ Stephen Trimble, "USAF Proceeding With C-5 Upgrade Plan Despite Pending Review of Fleet," *Aerospace Daily*, May 30, 2003.

⁵² Tech. Sgt. David A. Jablonski. "Air Force Fleet Viability Board releases C-5A Assessment," *Air Force Print News*, July 15, 2004. Amy Butler, "With a Little Help — And Cash — C-5As Can Fly For 25 More Years, Panel Says," *Defense Daily*, July 19, 2004.

their large sizes, airships have smaller radar and infrared signatures than airlift aircraft.⁵³

A September 2005 Congressional Budget Office (CBO) study appears to endorse investments in heavy-lift airships. Along with investments in high-speed sealift ships, and pre-positioned equipment, investments in heavy-lift airships, the CBO found, could improve DOD's ability to effectively execute large military deployments more than investments in additional airlift aircraft.⁵⁴

Congressional Action

The Bush Administration's budget for **FY2007** requested \$3 billion in overall C-17 funding and is broken down in the table below. Congressional action is also described, with changes to the request highlighted in **bold** text.

C-17 FY2007 Funding (\$ Millions)			
	Procurement		R&D
	\$	#	\$
Request	MYP 2,636.2 APCY 0.0 Mods 251.4	12	173.7
Authorization Conference (H.R. 5122, 109-702)	2,288.1 0.0 251.4	12	173.7
Appropriations Conference (H.R. 5631, 109-676)	2,624.7 0.0 251.4 2,094.0	12 10	173.7

Both authorizers and appropriators expressed concern over DOD's plan to end C-17 procurement with FY2007 funds. Both committees directed DOD to apply funds provided in FY2006 for closing the production line, to purchasing additional aircraft. H.R. 5122 Sec. 132 requires the Air Force to maintain a minimum of 299 strategic airlift aircraft beginning in FY2009. Appropriations conferees gave the C-17 program a significant boost by providing \$2 billion in un-requested funding.

⁵³ For more information, see CRS Report RS21886, *Potential Military Use of Airships and Aerostats*, by Christopher Bolkcom.

⁵⁴ *Options for Strategic Military Transportation Systems*. Congressional Budget Office. September 2005. p.x

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The Bush Administration requested \$28 million to replenish initial spares used to repair C-17s damaged during operations in Afghanistan. In their reports H.Rept. 109-388 and S.Rept. 109-230, appropriators matched this funding request and expressed concern over the imminent closure of the C-17 production line. House appropriators recommended \$100,000,000, and Senate appropriators recommended \$227,500,000 for additional aircraft procurement in FY2008.

The Bush Administration's budget for **FY2006** requested \$4.1 billion in overall C-17 funding and is broken down in the table below. Congressional action is also described, with changes to the request highlighted in **bold** text.

C-17 FY2006 Funding (\$ Millions)			
	Procurement		R&D
	\$	#	\$
Request	MYP 2790.9 APCY 445.4 Mods 260.8	15	165.7
Authorization, Conference (H.R. 1815, 109-360)	Matched all funding requests		
Appropriations, Conference (H.R. 2863, 109-359)	2790.9 445.4 176.8	15	167.1

Both house (H.R. 1815 Sec.131) and Senate (S.1042 Sec. 133) authorizers expressed support for DOD to enter into a new multiyear procurement contract for 42 additional C-17s.

The Bush Administration's budget for **FY2005** requested \$4.1 billion in overall C-17 funding, and is broken down in the table below. Congressional action is also described, with changes to the request highlighted in **bold** text.

C-17 FY2005 Funding (\$ Millions)			
	Procurement		R&D
	\$	#	\$
Request	MYP 2,512.5 APCY 381.8 ICS 945.6 Mods 89.1	14	199.7
Authorization Conference	2,546.5 381.8 945.6 89.1	14	199.7
Appropriations Conference	2,671.0 381.8 786.9 89.1	15	201.7

Appropriations conferees supported the house position to procure 15 C-17s in FY2005, provide advance procurement for 15 aircraft in FY2006, and fully fund these aircraft. House appropriators (108-553, p. 192) were "extremely displeased by the Air Force's continued use of a flawed and irresponsible financial strategy for the C-17 multiyear procurement contract." Committee members wrote that the Air Forces' approach to funding the C-17 was "an incremental financing scheme that abused the political support for the program and flaunted acquisition regulations and standard practices." (108-553, p. 192) The appropriators reduction of \$159.6 million from the C-17 ICS line funded the increase in MYP.

Appendix: System Description⁵⁵

Power Plant:	Four Pratt & Whitney F117-PW-100 turbofan engines
Wingspan:	169 feet 10 inches (to winglet tips) (51.76 meters)
Length:	174 feet (53 meters)
Height:	55 feet 1 inch (16.79 meters)
Cargo Compartment:	length, 88 feet (26.82 meters); width, 18 feet (5.48 meters); height, 12 feet 4 inches (3.76 meters)
Speed:	450 knots at 28,000 feet (8,534 meters) (Mach .74)
Service Ceiling:	45,000 feet at cruising speed (13,716 meters)
Range:	Global with in-flight refueling ⁵⁶
Crew:	Three (two pilots and one load master)
Maximum T/O Weight:	585,000 pounds (265,352 kilograms)
Load:	102 troops/paratroops; 48 litter and 54 ambulatory patients and attendants; 170,900 pounds (77,519 kilograms) of cargo (18 pallet positions)

C-17 Globemaster III Taking off From Unfinished Runway



USAF photo by 1st Lt. Laurel Scherer

⁵⁵ Information derived from C-17 Globemaster III Fact Sheet, [<http://www.af.mil/factsheets/factsheet.asp?fsID=86>] and Air Force Magazine, 2000 USAF Almanac, May 2000.

⁵⁶ The first 70 C-17s have an unrefueled range of 4,370 miles with a 90,000 lb load. An extra fuel tank will be installed in the 71st and subsequent aircraft which will extend the unrefueled range to 5,060 miles with a 90,000 lb load, Seena Simon, "Extra Fuel Tank Allows C-17s to Fly Farther," *Air Force Times*, Apr. 2, 2001.