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C-17 AIRCRAFT

Cost and Performance Issues





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Chairman
The Honorable Sam Nunn
Ranking Minority Member
Committee on Armed Services
United States Senate

The Honorable Floyd Spence
Chairman
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Ranking Minority Member
Committee on National Security
House of Representatives

The fiscal year 1994 conference report on the Department of Defense's authorization act contains a provision calling for us to assess the C-17's original justification and the effect of technical problems and cost increases on the aircraft's ability to achieve original program requirements. This report responds to that provision and also discusses some of the assumptions underlying the conclusions in the recent C-17 cost and operational effectiveness analysis.

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Executive Summary

Purpose

In recent years, there has been congressional concern about whether the C-17 is the most cost-effective aircraft to meet the Air Force's airlift requirement. The Fiscal Year 1994 National Defense Authorization Act conference report contains a provision calling for GAO to assess the C-17's original justification and the effect of technical problems and cost increases on the aircraft's ability to achieve original program requirements. This report responds to that provision. It also discusses the nature of the performance problems, the extent of the cost growth, and the results of the Department of Defense's (DOD) recent C-17 cost and operational effectiveness analysis.

Background

In 1981, DOD identified a need for additional long-range airlift and established a fiscally constrained airlift goal of 66 million ton-miles per day. At that time, long-range airlift capacity was about 29 million ton-miles per day. To reach the goal, the Air Force procured 50 C-5Bs and 44 KC-10 aircraft and began developing a new airlifter, the C-17.

The Air Force originally planned to acquire 210 C-17 aircraft. However, in April 1990, as part of DOD's Major Aircraft Review, the Secretary of Defense reduced the program to 120 aircraft—a sufficient number to maintain an airlift capacity of 52 million ton-miles per day, which was judged to be sufficient in the post-Cold War era. Through fiscal year 1995, Congress has appropriated almost \$18 billion for the C-17 program. Due to cost, schedule, and performance concerns, the Deputy Secretary of Defense recently reduced the program to 40 aircraft, pending a Defense Acquisition Board review currently scheduled to occur in November 1995. The Air Force, however, is still planning for a 120-aircraft program. This report is intended to be used in congressional oversight of the pending decision. The provisional 40-aircraft program is estimated to cost \$22.5 billion, an additional \$4.5 billion over the amount appropriated through fiscal year 1995.

Results in Brief

The C-17 was intended to perform several unique military missions, such as delivering cargo and troops directly to forward airfields, potentially near the battle zone; operating routinely into small, austere airfields in an intratheater role; airlifting outsize cargo—the largest items in the Army's inventory, for example, tanks—and performing airdrop missions. However, these capabilities, on which the aircraft was originally justified, are not likely to be used as originally intended. Meanwhile, the program's cost continues to increase. DOD's recent C-17 cost and operational

effectiveness analysis, while concluding that the C-17 is the preferred airlifter, showed that a fleet comprised of 40 C-17s and 64 commercial freighters could meet DOD's airlift requirements as expressed in the Mobility Requirements Study. This alternative fleet can be procured at cost savings of \$10.7 billion or more (in constant fiscal year 1993 dollars) when compared to a fleet of 120 C-17s.

Changes in the C-17's intended role, the results of DOD's C-17 cost and operational effectiveness analysis, and continued program cost growth lead us to conclude that a 120-aircraft C-17 program is not the most cost-effective way to meet airlift requirements.

Principal Findings

C-17's Original Role Has Changed

The C-17 will not be used as initially envisioned because:

- The Air Force no longer plans to routinely operate the C-17 in an intratheater shuttle role, largely as a result of DOD's decision to reduce the quantity of aircraft from 210 to 120.
- The Army has not incorporated direct delivery¹ into its deployment doctrine or mobility planning exercises and would have to fundamentally change its deployment doctrine to use direct delivery routinely. Even if the Army implemented a direct delivery concept, the C-17 would only rarely be used to deliver cargo to forward airfields near the battle front, in contrast to the original C-17 concept of operations.
- The Air Force has reported that the C-17's capability to land on short airfields would enable it to land on 6,400 more airfields in the free world (less the United States) than the C-5. However, when wartime landing requirements, including minimum runway strength, are considered, the C-17's wartime airfield advantage decreases from 6,400 to about 1,400 airfields.
- Outsize cargo requirements have declined in the post-Cold War world, and DOD's analysis shows that fewer than 120 C-17s are needed to meet current outsize airlift requirements.
- The Army no longer plans to use the C-17's unique low-altitude parachute extraction capability to deliver platforms weighing up to 60,000 pounds, and, due to airflow problems on the aircraft, the C-17 airdrop requirement will be reduced.

¹Direct delivery involves bypassing a main operating base to land directly at another base in the theater of operations. This base may or may not be a small, austere airfield.

**Program Cost Increases
Continue**

DOD's original plan was to buy 210 aircraft for a total cost of \$41.8 billion. In December 1992, total program costs for 120 aircraft were estimated to be \$39.5 billion at a maximum production rate of 16 aircraft per year. In January 1994, estimated program costs increased to \$43 billion, in part because the projected maximum procurement rate was reduced to 12 aircraft per year.

In May 1994, DOD estimated that program costs would further increase to \$45.4 billion at a maximum production rate of 12 aircraft per year, due to higher production and support costs. DOD also indicated that, if the maximum production rate were restricted to eight aircraft per year, program costs could increase to about \$48 billion. In recent years, because of its concern with ongoing development and production problems, Congress has reduced funding to slow the C-17's procurement rate and to reduce the level of concurrency in the program.

**Cost-Effective Alternatives
to the C-17**

A recent C-17 cost and operational effectiveness analysis, conducted for DOD by the Institute for Defense Analyses, compared the delivery capability of the C-17 to alternative fleets, including a mixed fleet of 40 C-17s and 64 modified commercial freighters. That analysis concluded that the C-17 is the preferred airlifter. However, this conclusion was based on questionable assumptions about airfield availability, aircraft utilization rates, and the C-17's intratheater capability. If alternative—and, we believe, more realistic—assumptions are made, the C-17/commercial fleet could meet airlift requirements at cost savings of about \$10.7 billion.

**Matter for
Congressional
Consideration**

In light of changes in the C-17's intended role, the results of DOD's cost and operational effectiveness analysis, and continued program cost growth, Congress should not support the C-17 program beyond the minimum number needed to fulfill unique military requirements. That number has not yet been determined, but is the subject of several ongoing studies.

**Agency Comments
and GAO's Evaluation**

In commenting on a draft of this report, DOD agreed that it would be premature to commit to buying 120 C-17s at this time. However, DOD stated that (1) the role of the C-17 has not changed, (2) the C-17 can and will perform routine direct delivery and intratheater missions, (3) the airfield accessibility advantage of the C-17 over the C-5 is significant, and (4) crediting a 120-C-17 fleet with cost savings to reflect a reduced C-130

role was appropriate and did not result in understating the potential savings associated with mixed fleet alternatives.

GAO's comparison of the C-17's originally envisioned role (as discussed in the 1986 C-17 System Operational Concept and the 1983 Airlift Master Plan) with how the Air Force currently plans to operate it clearly shows that a change in the C-17's role has occurred. The C-17 was originally intended to routinely deliver cargo directly to areas near the battle front, but now the Air Force concept of operation says it will only rarely be used in a direct delivery role into forward areas.

The Air Mobility Command has informed GAO that, given the reduction in the number of C-17s from 210 to 120, it no longer intends to use the C-17 extensively for intratheater shuttle missions.

Of the 1,400 airfields that comprise the C-17's advantage over the C-5, DOD's 1992 Mobility Requirements Study identified only 3 that would likely be used in a major regional contingency.

The number of C-130s in the inventory has not been reduced as a result of the introduction of the C-17 nor are there plans to do so. Therefore, the C-17 should not be credited with any degree of additional cost savings to reflect an intratheater shuttle role and a reduction in the use of the C-130. The inclusion of cost savings in the cost and operational effectiveness analysis increased the cost of the alternative fleets relative to the C-17.

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Abbreviations

AMC	Air Mobility Command
COEA	cost and operational effectiveness analysis
DOD	Department of Defense
IDA	Institute for Defense Analysis
LAPES	low-altitude parachute extraction system
MRS	Mobility Requirements Study
MTM/D	million ton-miles per day

Introduction

In the event of a conflict or crisis overseas, the United States must be able to deliver the troops, equipment, and supplies necessary to meet the threat. The Department of Defense (DOD) relies on airlift, sealift, and prepositioned assets to accomplish this mission. Airlift, the vital component that provides rapid mobility to combat forces, delivers Army light forces, equipment, initial resupply and bulk ammunition, and nearly all precision munitions and time-critical items. Airlift can also rapidly transport troops and supplies to link up with prepositioned equipment, thus speeding the deployment of heavier units early in a conflict.

C-17 Expected to Modernize Airlift Fleet

Airlift is classified as either intertheater (from one theater of operation to another) or intratheater (operations within a theater). Intertheater airlift services are provided by the Air Force's Air Mobility Command (AMC), which has a fleet of C-5, C-141, and KC-10 aircraft to carry out that mission. AMC also relies on the Civil Reserve Air Fleet to supplement its military airlift capacity during contingencies. The Air Combat Command is responsible for operating C-130 aircraft, which provide intratheater airlift.

In July 1982, the Air Force contracted with McDonnell Douglas Corporation to develop and produce the C-17, which is an air refuelable, four-engine jet transport, designed to operate in both the intertheater and intratheater roles (see fig. 1.1). The C-17 is currently contracted to carry a maximum payload of 160,000 pounds 2,400 nautical miles unrefueled and perform the full range of airlift missions, including unique military missions such as direct delivery to forward airfields, potentially near the battle zone; routine operations into small, austere airfields in an intratheater role; airlift of outsize cargo such as tanks; and airdrop.

Figure 1.1: C-17 Aircraft



Source: McDonnell Douglas Corporation.

The Air Force originally planned to acquire 210 C-17 aircraft. However, in April 1990, as a result of DOD's Major Aircraft Review, the Secretary of Defense reduced the program to 120 aircraft. The C-17 is still undergoing test and evaluation, with the flight test program scheduled to be completed in June 1995. DOD plans to have a fleet of 120 C-17s delivered by 2004.

Provisional 40-Aircraft Program Implemented

In recent years, Congress has expressed concern with the C-17's growing cost and continuing technical problems. The Fiscal Year 1993 Defense Authorization Act required DOD to conduct a special Defense Acquisition Board review of the program. In December 1993, as a result of the review, the Secretary of Defense announced that the program would be stopped at 40 aircraft unless McDonnell Douglas could demonstrate that program cost, schedule, and performance warranted completing the 120 aircraft program. As we recently testified,¹ DOD has proposed lowering the C-17's payload/range specifications. DOD has also proposed relaxing the aircraft's contracted short field landing specifications to levels that the C-17 can probably achieve. DOD plans to assess the contractor's improvements in November 1995, at the scheduled full-rate production decision milestone.

Through fiscal year 1995, Congress has appropriated almost \$18 billion for the C-17 program, including (1) \$5.8 billion for research, development, test, and evaluation; (2) \$12 billion for procurement; and (3) \$163 million for military construction. Congress has also authorized the procurement of 32 C-17 aircraft and advance procurement funds for another 8 aircraft. As of December 1994, 17 production C-17s had been delivered to the Air Force.

Objective, Scope, and Methodology

The Fiscal Year 1994 Defense Authorization Act conference report contains a provision calling for us to assess whether (1) the original C-17 justification remains valid and (2) the C-17 can still achieve its original program requirements, given cost increases and technical problems. This report responds to that provision. It also discusses the nature of the performance problems, the extent of the cost growth, and the results of DOD's recent C-17 cost and operational effectiveness analysis (COEA), which was conducted by the Institute for Defense Analyses (IDA).

To determine if the C-17's original justification has changed, we reviewed program documents, including past and current system specifications, operational requirements documents, concepts of operation, and Army field manuals and doctrine. We also used our past work on the Major Aircraft Review, Operation Desert Shield/Storm, the Mobility Requirements Study (MRS), and the C-17 program. We interviewed officials from the Office of the Secretary of Defense, the Joint Chiefs of Staff, Air Force Headquarters, AMC, Army Headquarters, and the Army's Training and Doctrine Command.

¹Military Airlift: The C-17 Proposed Settlement and Program Update (GAO/T-NSIAD-94-172, Apr. 28, 1994).

We used information from our continuing work to monitor cost, schedule, and performance issues related to the program at the McDonnell Douglas plant, Long Beach, California, and C-17 developmental and operational testing by the Air Force at Edwards Air Force Base, California. We also reviewed a recent Defense Science Board report on the C-17 and spoke with members of the Board's working groups regarding the C-17's payload/range performance and other aspects of the program.

To determine whether cost-effective alternatives to the full C-17 program exist, we reviewed the COEA. We also interviewed officials from IDA, the Office of the Secretary of Defense, AMC, McDonnell Douglas Corporation, Boeing Corporation, and Lockheed Corporation.

We conducted our review between April 1993 and December 1994 in accordance with generally accepted government auditing standards. We obtained DOD comments on a draft of this report, which are discussed at the end of each of the following chapters and are presented in their entirety in appendix I along with our detailed evaluation of them.

C-17's Planned Role Has Changed

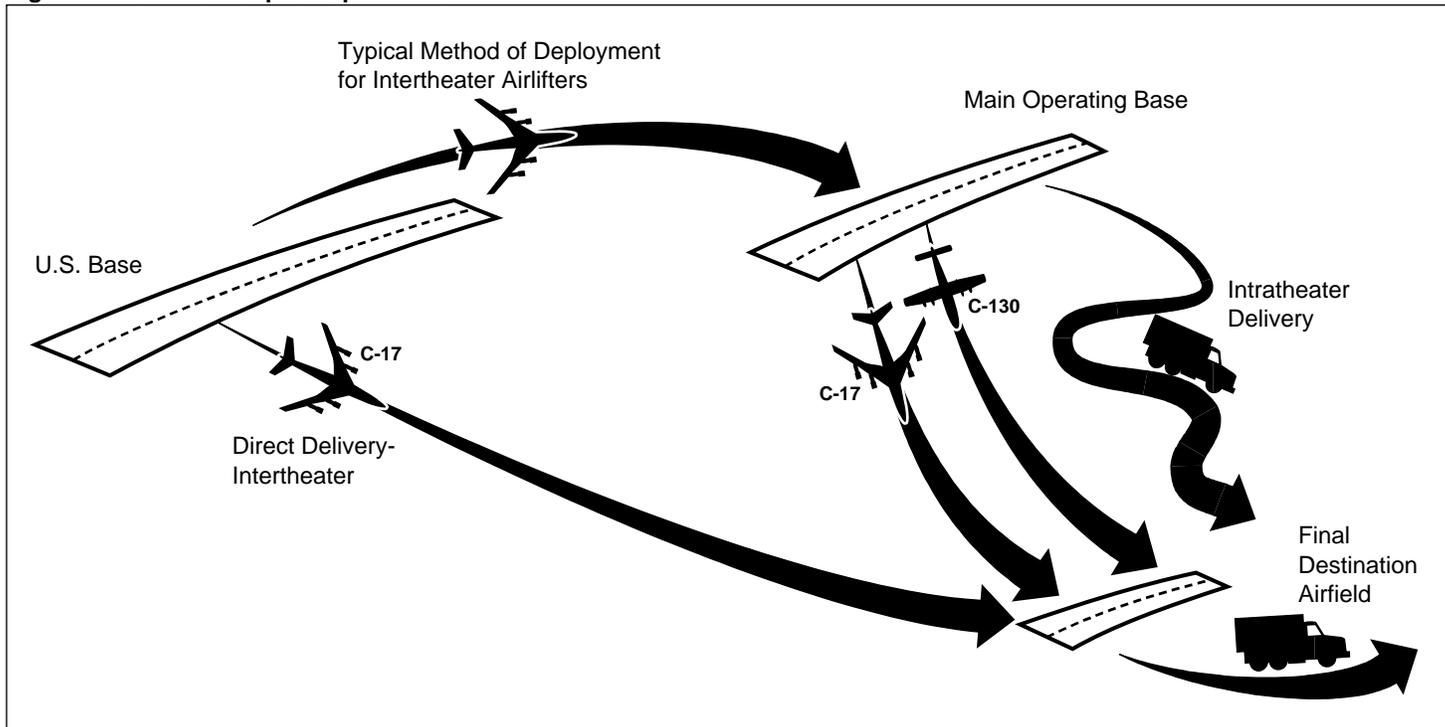
The Air Force justified the C-17 in the early 1980s on the aircraft's planned capabilities to operate routinely in an intratheater shuttle role; perform direct delivery missions to forward airfields, potentially in hostile areas; and airlift substantial amounts of outsize cargo such as tanks and helicopters. The C-17 was also intended to provide the capability to conduct low-level parachute extractions of the Army's heavy equipment and to airdrop troops and equipment. However, the C-17's envisioned role has changed, and these capabilities will not be used as originally intended.

Justification for the C-17

DOD's 1981 Congressionally Mandated Mobility Study addressed the U.S. policy objective of concurrently supporting a major North Atlantic Treaty Organization-Warsaw Pact conflict and a lesser contingency involving a Soviet-backed threat in the Persian Gulf region. DOD recommended increasing U.S. airlift capacity by about 20 million ton-miles per day (MTM/D) to 66 MTM/D—the capacity to lift the required amount of cargo and troops to Europe and Southwest Asia to counter an imminent threat. The 1981 mobility study highlighted the need for a new airlifter that could land on small, austere airfields; perform both intertheater and intratheater airlift missions; and carry outsize cargo—the largest items in the Army's inventory. Outsize cargo includes, for example, M1 tanks, Patriot battery radar, and Apache helicopters.

The Air Force's 1983 Airlift Master Plan concluded that, in addition to new C-5B and KC-10 aircraft, procuring 210 C-17s was the most cost-effective way to reach the goal of 66 MTM/D while providing necessary military utility. Military utility included the ability to operate from austere airfields in an intratheater airlift role, perform direct delivery missions to forward operating locations, carry all types of combat equipment, and airdrop combat equipment and troops. Figure 2.1 depicts the C-17's concept of operations.

Figure 2.1: C-17 Concept of Operations



Source: Air Force.

C-17's Intended Role Has Changed

The C-17's role has been modified from that envisioned in the 1983 Airlift Master Plan. The C-17 will not routinely conduct intratheater shuttle missions, will not routinely perform direct delivery missions, and will rarely land near the battle front. Furthermore, the dissolution of the Soviet threat has resulted in a reduced requirement for outsize cargo. In addition, the number of airfields open to the C-17 but not the C-5 is much less than the Air Force has previously stated.¹ Finally, the C-17's unique 60,000 pound low-altitude parachute extraction system (LAPES) capability is not needed, and the aircraft cannot meet original airdrop requirements.

C-17 Will Not Perform Intratheater Shuttle Missions Routinely

The C-17's planned intratheater capability was key to its anticipated cost-effectiveness. Intratheater missions are needed when sealifted cargo arrives in the theater or when deployed forces need to be repositioned quickly. These missions are typically carried out by C-130s or ground

¹Military Airlift: Comparison of C-5 and C-17 Airfield Availability (GAO/NSIAD-94-225, July 11, 1994).

transportation. Because the C-17 would perform the workload of the C-130s, the Air Force's 1983 Airlift Master Plan stated that 198 C-130s would be retired and not replaced, a key factor in establishing the C-17's cost-effectiveness. Current Air Force policy, however, reflects a substantially diminished intratheater role for the C-17. For example, AMC's 1993 Air Mobility Master Plan does not discuss using the C-17 in an intratheater role or retiring a significant number of C-130s.

The Air Force initially anticipated that the C-17 would routinely perform intratheater missions during contingencies. However, as a result of the 1990 Major Aircraft Review, the Secretary of Defense reduced the number of C-17s from 210 to 120, citing the changing strategic environment and diminished Soviet threat. Under the current 120-aircraft program, the intertheater airlift flow would be adversely affected if C-17s were diverted to perform intratheater missions on a routine basis. AMC officials acknowledge that while C-17s will provide theater commanders additional flexibility when needed, the aircraft will not routinely perform intratheater missions as originally planned.

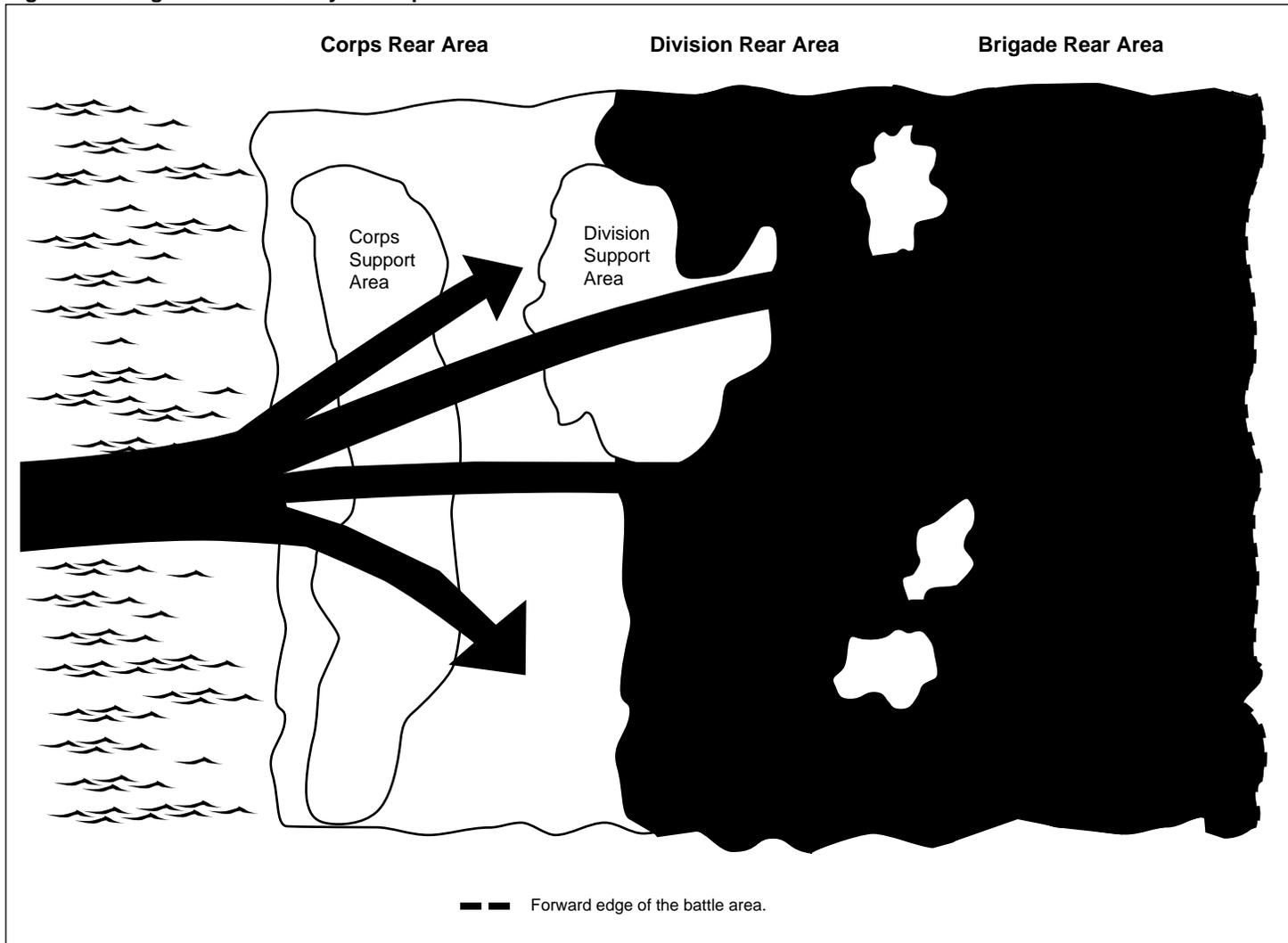
Direct Delivery Role May Not Be Used Routinely

The C-17 was also intended to offer an extended direct delivery capability by landing at forward airfields near the battle front. However, the Air Force's current C-17 operational concept states that the aircraft will rarely land near the battle front. Moreover, current Army doctrine calls into question the extent to which the C-17's direct delivery capability will be used. The Army—the primary user of airlift—prefers to deploy to main operating bases rather than directly to final destination airfields.

C-17 Will Rarely Deliver Cargo to Forward Areas

The C-17's operational concept has changed from one that emphasizes direct delivery to forward airfields at the brigade rear area to one that stresses more standard airlift operations at the corps support area. The 1986 C-17 System Operational Concept stated that "the C-17's capability to deliver directly to small, austere airfields close to the battle area will reduce delivery times, reduce congestion at main operating bases, and enhance operational flexibility by increasing the number of airfields that can be used." This document also stated that the C-17's routine destination airfields would likely be located at the brigade rear area. Figure 2.2 provides an illustrative example of this concept.

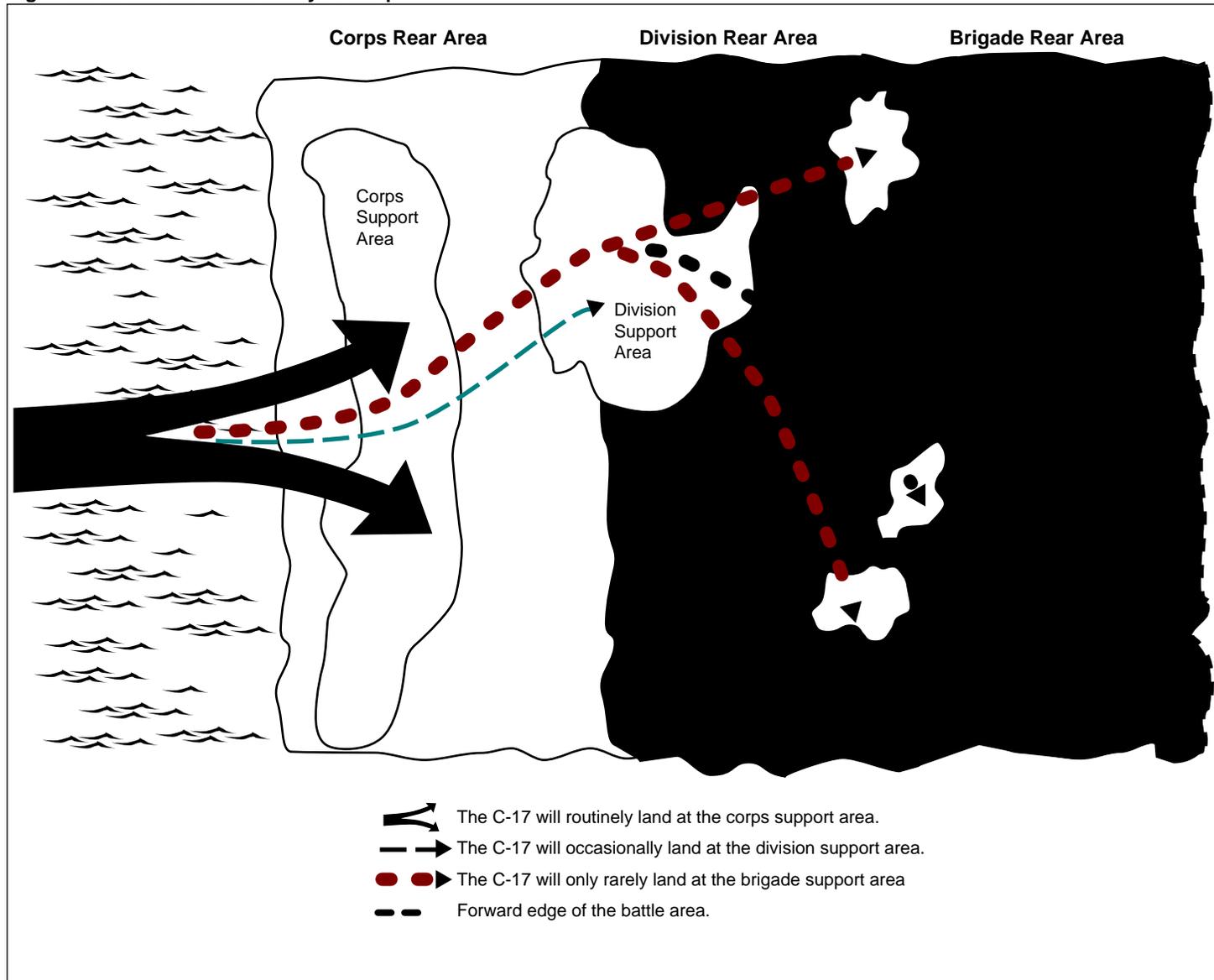
Figure 2.2: Original C-17 Delivery Concept



Source: GAO representation of Army and Air Force information.

Recently, the Air Force has downplayed the extent to which the C-17 will fly into forward areas near the front. The 1993 C-17 Employment Concept of Operations states that the C-17 will rarely deliver cargo to the brigade support area. The brigade support area is typically near the boundary between the brigade rear area and the division rear area. Figure 2.3 illustrates the current concept.

Figure 2.3: Current C-17 Delivery Concept



Source: GAO representation of Army and Air Force information.

According to Air Force and Army officials, the C-17 would be very unlikely to use an airfield not protected by a corps. However, AMC officials stated that the C-17 will provide theater commanders the flexibility to operate in forward areas if necessary.

Army Doctrinal Change
Required to Use Direct Delivery
Routinely

The Army's current method of deployment does not use direct delivery, even to well-developed airfields. The Army trains and fights based on a "mass and maneuver" strategy, with forward movements planned from major bases in the theater of operations. Desert Shield/Storm experience and the 1992 MRS indicate that the Army remains reluctant to use direct delivery.

During Desert Shield/Storm, numerous well-developed airfields eventually became accessible to military airlifters in Saudi Arabia. However, the Army preferred to use the two main operating bases and was opposed to sending units directly to other airfields. AMC had to convince some Army units to use direct delivery to bypass these bases and send troops and cargo directly to the final destination airfields on C-5s and C-141s. For example, 3 months after the Desert Shield deployment began, the Army was still requesting that over 75 percent of its missions go to a main operating base.

When preparing its deployment database for the MRS, which assumed a fleet of 80 C-17s would be available, the Army again did not make use of direct delivery. For example, in the Southwest Asia scenario, the Army planned to send all troops and cargo to the two main operating bases that had been used in Desert Shield/Storm. AMC persuaded the Joint Chiefs of Staff to add more locations to increase delivery capability.

Army, Air Force, and other DOD officials agree that doctrinal changes will be needed if the Army is to deploy using the direct delivery concept on a routine basis.

C-17 Can Land at Fewer
Small, Austere Airfields
Than Air Force Has
Reported

The Air Force has reported that the C-17's capability to land on short airfields would enable it to land at about 6,400 more airfields in the free world (less the United States) than the C-5. However, the 6,400 figure is overstated because it did not take into account runway strength and included all types of airfields, ranging from concrete and asphalt to gravel, dirt, and grass, many of which are not suitable for either aircraft. When

wartime landing requirements,² including minimum runway strength, are considered, the C-17's wartime airfield advantage decreases from 6,400 to about 1,400 airfields. More importantly, DOD's 1992 MRS identified only three such airfields that would likely be used by the C-17 in the major regional contingency scenarios. Two are located in Korea and one in Saudi Arabia.

Outsize Cargo Requirements Have Decreased

The 1983 Air Force decision to buy the C-17 was based largely on the aircraft's ability to carry outsize cargo. In the North Atlantic Treaty Organization-Warsaw Pact scenario examined in DOD's 1981 Congressionally Mandated Mobility Study, 27 percent of the airlifted equipment was outsize. The post-Cold War scenarios examined in DOD's recent MRS, however, require a smaller percentage of outsize cargo than the Soviet-based scenarios. In the most lift-intensive scenario in the 1992 MRS—simultaneous deployments to Southwest Asia and Korea—about 15 percent of the cargo was outsize. Recent deployment experience also reflects a smaller outsize cargo requirement. During Desert Shield/Storm, only 12 percent of the airlifted cargo was outsize.

An Air Force and DOD analysis shows that fewer than 120 C-17s would be needed, in conjunction with the existing aircraft fleet, to meet the outsize airlift delivery requirement in the 1992 MRS. The MRS moderate risk airlift requirement, judged acceptable by DOD, was accomplished with a fleet that included 80 C-17s. DOD did not determine the minimum number of C-17s that would be needed to meet the moderate risk requirement. DOD is currently preparing a new MRS, scheduled to be completed by the end of January 1995, that will reflect the recommendations in the Department's 1993 Bottom-up Review. Preliminary AMC data indicate that the percentage of outsize cargo will not change significantly from the 15 percent assumed in the 1992 MRS.

Unique C-17 LAPES Capability No Longer Required

LAPES is a means of extracting equipment while an airlifter flies at low levels. At present, the C-130 is the only aircraft capable of LAPES operations, and it is limited to extracting 42,000 pounds of equipment. In 1981, the Army identified an "urgent need" to develop a LAPES capability up to 60,000 pounds. According to Army officials, this capability was needed to extract armored artillery pieces, ammunition, and towing vehicles from

²The number of airfields on which the C-5 could land was based on a wartime runway length and width criteria of 5,000 feet by 131 feet since Air Force officials told us this is the narrowest runway that a C-5 has actually landed on during wartime.

the same LAPES platform, which would minimize dispersion over the drop zone. The C-17 was intended to provide this unique capability.

In March 1994, the Army acknowledged that "LAPES has been an expensive, unused, untrained capability and is potentially of limited battlefield use." The Army stated that the current C-130 42,000-pound LAPES capability "appears to more than adequately address foreseeable Army requirements." The Army intends neither to maintain the material systems and rigging required for the 60,000-pound LAPES platform nor to conduct C-17 LAPES training. Thus, the C-17 will not be used for this mission. However, AMC officials noted that testing of a 42,000-pound C-17 LAPES capability is currently underway.

C-17 Cannot Meet Original Airdrop Requirements

The ability to airdrop troops and equipment is one of DOD's most critical requirements. Currently, only the C-141 and C-130 aircraft are capable of routinely performing airdrop missions.³ The Joint Chiefs of Staff recently revalidated the requirement for a strategic airdrop of a brigade's worth of troops and equipment. Because the C-130 cannot fly the long distances required for this mission and the C-141 fleet is being retired, the C-17 is expected to fulfill this requirement. However, the C-17 has not been able to meet initial requirements because of airflow problems caused by its design. As a result, the Army is lowering its airdrop requirements.

The contracted specifications call for the C-17 to airdrop 102 combat-equipped paratroopers using static line deployed parachutes, preceded by at least 8, 500-pound equipment bundles, within 55 seconds. The bundles are to be dropped out of the cargo ramp door while the paratroopers jump from the two troop doors on the aircraft's sides. The Army considers combination drops critical to early entry lethality and survivability on the battlefield. However, testing has shown that the C-17 has severe airflow problems when the side troop doors and the rear cargo door and ramp are open.

In March 1994, the Army notified AMC that, due to the C-17's airflow problems, it had revised its airdrop requirement in terms of "desired" and "required" capabilities. The Army's new desired objective for the combination airdrop is to drop 102 paratroopers and 8 bundles in 70 seconds. The required capability is to drop 102 paratroopers and 2 bundles in 55 seconds. However, AMC officials told us that this is an

³While the C-5 is capable of airdropping equipment, the Air Force does not routinely use the aircraft in this role.

unrealistic requirement because 102 paratroopers cannot exit the C-17 within this time frame. Accordingly, AMC plans to reduce the C-17 airdrop requirement.

Another specification requires airdropping 40 containerized delivery system bundles, weighing 2,350 pounds each. However, the C-17 has been restricted to dropping only 30 bundles because of safety concerns. The C-17 program office is making design changes to eliminate this safety hazard and enable the C-17 to drop 40 bundles.

Conclusion

The C-17's anticipated role has changed and the aircraft will not be used as originally envisioned. The C-17 was justified on the basis of its unique capability to routinely deliver the full range of Army combat equipment to locations inaccessible to other strategic airlifters. The C-17 is not likely to conduct routine intratheater and direct delivery missions as planned, and it is no longer expected to operate into forward airfields near the battle front. Furthermore, the number of airfields in the free world open to the C-17, but not the C-5, is significantly less than the Air Force claimed in justifying the C-17. While the C-17 is capable of carrying outsize cargo, a DOD analysis indicates that a fleet of 120 C-17s may not be necessary to fulfill outsize delivery requirements. Finally, one of the aircraft's unique capabilities—using LAPES to deliver a 60,000-pound platform—will not be used, and its airdrop capability does not meet the Army's original requirements. The aircraft is likely to operate primarily in a routine intertheater airlift role.

Agency Comments and Our Evaluation

DOD's position in commenting on a draft of this report is that (1) the role of the C-17 has not changed, (2) the C-17 can and will perform routine direct delivery and intratheater shuttle missions, and (3) the airfield accessibility advantage of the C-17 over the C-5 is significant.

A comparison of the C-17's envisioned role as discussed in the 1986 C-17 System Operational Concept, the 1983 Airlift Master Plan, the 1993 C-17 Employment Concept of Operations, and the 1993 Air Mobility Master Plan shows that the role of the C-17 has clearly changed. For example, the Air Force no longer plans to use the C-17 to routinely conduct intratheater shuttle missions. Further, while direct delivery is still a part of the concept for the C-17, the C-17's operational concept has changed from one that emphasized direct delivery to forward airfields near the battle front to one that emphasizes more standard airlift operations at or near a main

operating base. The Army is changing its doctrine to incorporate the use of direct delivery, but these doctrinal changes do not call for routine direct delivery to forward airfields near the battle front.

Although the C-17 can land on more airfields than the C-5, the C-17's airfield advantage is significantly less than the 6,400 airfields originally claimed, and the 1992 MRS identified only three small austere airfields that would likely be used by the C-17 in major regional contingencies.

Alternatives to the C-17 Can Help Meet Airlift Requirements at Significantly Lower Cost

DOD's COEA showed that the C-17 is the preferred military airlifter because, when considering delivery of outsize cargo, the C-17 retains its throughput ability better than the C-5 if (1) airfield constraints are encountered and (2) the C-17's planned utilization rate (higher than the C-5's experienced rate) is achieved. However, the COEA also showed that alternative airlift fleets, such as a combination of 40 C-17s and 64 modified commercial freighters, can meet airlift requirements at a significantly lower cost if alternative—in our opinion, more reasonable—assumptions are made. In addition, C-17 program costs have continued to increase, and potential savings from adopting an alternative to the 120-aircraft fleet could approach \$4 billion more than the \$10.7 billion (in constant fiscal year 1993 dollars) we identified in our earlier report.¹

C-17 COEA

DOD's COEA examined alternatives to the full C-17 program, including (1) restarting the C-5 line, (2) extending the service life of the C-141, and (3) procuring new commercial freighter aircraft. The capability of Boeing 747 freighters was assessed to determine how commercial aircraft would contribute to airlift missions.² The COEA's conclusion was that an airlift fleet with 120 C-17s was the preferred choice to meet the requirements set forth in the 1992 MRS, despite the fact that it was more expensive than a fleet comprised of C-17s and modified commercial freighters. This conclusion was based on three major assumptions:

- Airfield availability for airlift use would be extremely constrained.
- The C-17 would achieve a 15.2-hour per day utilization rate while commercial freighters would achieve only a 12.5-hour per day rate.
- The C-17 would be used routinely in place of the C-130 to accomplish intratheater delivery, so C-130 operating and support costs should be added to non-C-17 alternatives.

Our review indicated that alternative assumptions pertaining to airfield availability, utilization rates, and intratheater capability are more realistic. Adjusting for these assumptions would result in the C-17 fleet being less capable and a mixed C-17/commercial fleet being more capable and more cost-effective than the COEA's conclusions indicate.

¹Airlift Requirements: Commercial Freighters Can Help Meet Requirements at Greatly Reduced Cost (GAO/NSIAD-94-209, July 11, 1994).

²To accommodate the Army's new 2.5- and 5-ton trucks, commercial freighters' floors would need to be strengthened and the side doors would need to be widened or the trucks would have to be fitted with collapsible cab tops. The COEA reflects the estimated cost and performance of these modifications.

Airfield Constraints Affect Fleet Capability

The COEA was based on the threat scenario portrayed in the 1992 MRS, which postulated that an aggressive enemy was moving directly into Saudi Arabia. Based on this threat, several airfield assumptions were examined. The COEA showed that the C-17 had a better delivery capability for outsize cargo than the mixed C-17/commercial aircraft fleet when airfield availability was extremely limited. Under the assumption that airlift deliveries would be equivalent to the first 45 days of Desert Shield, when only one major airlift airfield would be available, the C-17 fleet could meet the MRS delivery requirement, but the mixed fleet could not. However, under the airfield assumptions used in the MRS Southwest Asia scenario, in which more airlift airfields were assumed to be available, the COEA showed that the mixed fleet of 40 C-17s and 64 747s could deliver the required amount of cargo. This mixed fleet would cost about \$6 billion less than the fleet of 120 C-17s.

During the first 45 days of Desert Shield, airfield availability was limited to only one major airlift base, due primarily to the Saudi Arabian government's reluctance to allow U.S. access to multiple airfields and the U.S. Army's preference for deploying to only major operating bases. In Desert Shield/Storm, Iraqi troops became entrenched shortly after the invasion of Kuwait and did not invade Saudi Arabia. We believe that, given the threat scenario on which the COEA was based, the MRS assumption that the Saudi government would open additional airlift airfields is more realistic than the airfield assumption based on early Desert Shield experience. Under the MRS airfield assumption, the mixed C-17/commercial fleet meets the airlift requirement.

C-17's Cost-Effectiveness Depends on High Utilization Rate

The COEA indicated that the C-17 would perform better than mixed fleets if a 15.2-hour per day utilization rate were assumed for the C-17. An aircraft's utilization rate is the planned average daily flying hours per aircraft for the entire fleet and is based on numerous elements, such as mission capable rate, number of aircrews per aircraft, and availability of spares. The COEA showed that, based on a 15.2-hour utilization rate for the C-17 and a 12.5 rate for the 747, both alternatives would meet the stated airlift requirement. The fleet of 120 C-17s could deliver more outsize cargo than the mixed fleet but would cost \$6 billion more. If the 747's utilization rate is increased to 15.2, a rate AMC officials acknowledge is feasible, the results show a significant increase in the mixed fleet's ability to deliver outsize and oversize cargo.³

³Oversize cargo includes trucks, Bradley vehicles, High Mobility Multi-purpose Wheeled Vehicles, and self-propelled howitzers.

The C-17's 15.2-hour utilization rate is undemonstrated. To sustain this rate, the C-17 must demonstrate a mission capable rate of 90 percent, and the Air Force must sufficiently fund C-17 spares and aircrews. The level of war reserve spares for airlift aircraft has historically been less than required to sustain projected wartime utilization rates.⁴ Air Force officials told us they believe that the spares level for the C-17 will be fully funded, in part, because spares funding has recently been made a higher priority. The Air Force also plans to maintain a higher aircrew to aircraft ratio for the C-17 than for other strategic airlifters. The relatively higher C-17 aircrew ratio contributes to its ability to maintain a higher utilization rate.

COEA Underestimates Potential Savings Associated With Mixed Fleet Alternative

Because the C-17 was designed to deliver cargo to small, forward airfields typically used by the C-130, the COEA assumed that the alternative with only 40 C-17s would need 80 additional C-130s to provide about the same intratheater movement capability as the fleet of 120 C-17s. Thus, the life-cycle cost of the mixed fleet alternative was increased by \$4.7 billion over 25 years (in constant fiscal year 1993 dollars). However, as discussed in chapter 2, the C-17's planned intratheater role has been largely limited and the Air Force does not plan to replace C-130s with C-17s for intratheater missions. Therefore, it was inappropriate to assume the mixed fleet alternative should include this added \$4.7 billion. If this cost is subtracted from the mixed fleet, the cost of a fleet of 120 C-17s increases from about \$6 billion to about \$10.7 billion more than the mixed fleet alternative.

C-17's Program Cost Continues to Increase

In its May 1994 paper, "Department of Defense Airlift Acquisition Strategy," DOD included average cost figures that indicate that C-17 program cost estimates continue to increase. In December 1992, total program costs were estimated to be \$39.5 billion (in then-year dollars)⁵ at a maximum rate of 16 aircraft per year. In January 1994, the C-17 program director estimated that total program costs would increase to \$43 billion because of a reduced procurement rate of 12 aircraft per year and increased estimates for production and support costs.

DOD's paper indicated that, at a maximum production rate of 12 aircraft per year, total program costs would be \$45.4 billion. This increase is attributable to increased production and support costs and the cost of a

⁴Military Airlift: Peacetime Use of War Reserve Spares Reduces Wartime Capabilities (GAO/NSIAD-90-186, June 25, 1990).

⁵Then-year dollars include estimates of future year inflation.

recently approved business settlement between DOD and McDonnell Douglas.⁶ If the maximum procurement rate were reduced to eight aircraft per year, DOD's paper estimated that total program costs would increase another \$2.6 billion, to about \$48 billion.⁷ In recent years, due to ongoing development and production problems, Congress has reduced funding to slow the C-17's production rate to reduce the level of concurrency in the program. While the Air Force's desired procurement rate may eventually be achieved, the program has been significantly more stretched out than originally planned.

The C-17 procurement cost estimates reported in DOD's paper are significantly higher than those in the C-17 COEA. DOD's paper indicates that estimated procurement costs have increased by \$2.8 billion to \$4 billion (in constant fiscal year 1993 dollars) since the C-17 COEA. Consequently, the potential savings from adopting an alternative to the 120-aircraft fleet would be significantly greater than the \$10.7 billion we previously reported. While estimating the exact amount of savings would be very difficult because of the many variables involved, we believe the increase in savings could approach \$4 billion. However, this estimate does not take into account changes that may have occurred in the estimated costs of modified commercial aircraft.

Minimum Number of C-17s Needed to Fulfill Unique Military Requirements Not Yet Determined

Determining whether a mixed fleet is a viable alternative to a 120-aircraft C-17 program depends on the fleet's capability to fulfill certain unique military requirements such as direct delivery to forward airfields, routine operations into small, austere airfields in an intratheater role, airlift of outsize cargo, and airdrop. The COEA was not intended to address this issue in detail. DOD has several studies underway, scheduled to be completed before the November 1995 Defense Acquisition Board decision on C-17 full-rate production, that will assess the capability of various fleet mixes and identify the minimum number of C-17s needed to fulfill unique military airlift requirements. As currently planned, nondevelopmental airlift aircraft source selection and quantity will depend on the C-17 full-rate production decision. The Defense Acquisition Board will consider several factors in deciding whether to continue the C-17 program, including C-17 flight test and reliability results, contractor performance, and the findings of the Air Force's airlift fleet mix study.

⁶Military Airlift: C-17 Settlement Is Not a Good Deal (GAO/NSIAD-94-141, Apr. 15, 1994).

⁷These higher program cost estimates do not include a number of contractor cost reduction proposals that are now undergoing technical evaluation.

Conclusion

Serious concerns about the C-17's cost-effectiveness have prompted Congress to direct DOD to explore alternatives to the full C-17 program. The COEA identified less costly alternatives that could meet airlift requirements and save billions of dollars. In addition, the C-17's program cost continues to increase. Therefore, the savings associated with a mixed fleet of C-17s and commercial freighters could be significantly greater than the COEA reported.

Matter for Congressional Consideration

In light of changes in the C-17's intended role, its less than anticipated performance, the results of DOD's COEA, and continued program cost growth, we continue to believe that Congress should not support the C-17 program beyond the minimum number needed to fulfill unique military requirements. That number has not yet been determined but is the subject of several ongoing studies.

Agency Comments and Our Evaluation

In commenting on a draft of our report, DOD stated that (1) a direct invasion of Saudi Arabia would still likely result in extremely constrained theater airfield availability in contrast to that reflected in the 1992 MRS, (2) two C-17s flew missions to Kuwait and demonstrated higher utilization rates than required, and (3) its COEA estimate of potential savings associated with the mixed fleet alternatives was not understated.

While the precise extent of airfield availability in any future contingency is unknown, the MRS threat suggests that more airfields will be available than was the case during Desert Shield, when allied forces had the advantage of a 5-month deployment period. We believe that using the Desert Shield-type airfield situation juxtaposed against an MRS threat gives the C-17 an inappropriate advantage over alternative airlifters. In our opinion, a more valid basis on which to compare the C-17 to alternative airlift fleets is the COEA's examination of the MRS airfield availability assumption.

The recent missions to Kuwait are not an adequate basis for establishing the appropriate sustainable utilization rate because these missions were of extremely limited duration. DOD has not yet determined how to extrapolate an inherent utilization rate from the results of the planned July 1995 reliability, maintainability, and availability evaluation. Our position remains that the projected C-17 utilization rate of 15.2 is, as yet, undemonstrated and that comparing this rate to a 12.5-hour utilization rate for commercial airlifters that have demonstrated higher utilization rates inappropriately favored the C-17 in the COEA.

Chapter 3
Alternatives to the C-17 Can Help Meet
Airlift Requirements at Significantly Lower
Cost

DOD's position that the C-17's intratheater role is unchanged from that depicted in the 1983 Airlift Master Plan, despite an almost 50-percent reduction in the number of aircraft, is untenable. DOD's position also contradicts the comments of Office of the Secretary of Defense and AMC officials on our July 1994 report on the COEA, as well as the comments of AMC officials on this report. These officials acknowledged that the C-17's intratheater shuttle role has been substantially diminished in the wake of the reduction from 210 to 120 aircraft. Moreover, they concurred with our finding that the COEA should not have assumed a cost saving to the C-17 to account for this intratheater role.

Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



ACQUISITION AND TECHNOLOGY

OFFICE OF THE UNDER SECRETARY OF DEFENSE

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18 NOV 1994

Mr. Henry L. Hinton
Assistant Comptroller General
National Security and International
Affairs Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Hinton:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "MILITARY AIRLIFT: Changed Role Makes 120 C-17 Program Less Cost-Effective," dated September 26, 1994 (GAO Code 707086) OSD Case 9791. The DoD partially concurs with the report.

The DoD agrees that it is premature to commit to the procurement of 120 C-17s at this time. Accordingly, the Department is conducting update analyses to consider potential C-17 alternatives and support a planned procurement decision on the number of C-17s and/or Non-Developmental Airlift Aircraft at a Milestone III Defense Acquisition Board review in November 1995.

The DoD does not agree with the GAO conclusion that 120 C-17s should not be procured--such a conclusion is premature, since the underlying analyses have not yet been done. Similarly, the DoD disagrees with the GAO that (1) the C-17's planned role has changed, (2) the C-17's direct delivery role may not be used routinely, (3) the 1,400 (at least) airfield accessibility of the C-17 over the C-5 is insignificant, (4) alternatives to the C-17 can meet all airlift requirements at significantly lower costs, and (5) the DoD Cost and Operational Effectiveness Analysis underestimated potential savings associated with mixed-fleet alternatives.

The detailed DoD comments on the draft report findings and matter for congressional consideration are provided in the enclosure. The DoD appreciates the opportunity to comment on the GAO draft report.

Sincerely,

George R. Schneiter
Director
Strategic and Tactical Systems

Enclosure



See comment 1.

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Comments From the Department of Defense

GENERAL ACCOUNTING OFFICE DRAFT REPORT - DATED SEPTEMBER 26, 1994
(GAO CODE 707086) OSD CASE 9791

"MILITARY AIRLIFT: CHANGED ROLE MAKES 120 C-17
PROGRAM LESS COST-EFFECTIVE"

DEPARTMENT OF DEFENSE COMMENTS

* * * * *

FINDINGS

- o **FINDING A: Status of the C-17 Program.** The GAO observed that, in 1981, the DoD identified a need for additional long-range airlift and established a fiscally constrained airlift goal of 66 million ton-miles per day. The GAO also observed that, in July 1982, the Air Force contracted with McDonnell Douglas Corporation to develop and produce the C-17, which is an air refuelable, four-engine jet transport, designed to operate in both the intertheater and intratheater roles. The GAO pointed out that the C-17 is currently contracted to carry a maximum payload of 160,000 pounds, 2,400 nautical miles unrefueled, and perform the full range of airlift missions, including airdrop and parachute extraction of all sizes of equipment. The GAO also explained that the Air Force originally planned to acquire 210 C-17 aircraft; however, in April 1990, as part of the DoD Major Aircraft Review, the Secretary of Defense reduced the program to 120 aircraft. The GAO also observed that the Congress has appropriated over \$15 billion for the C-17 program through FY 1994. The GAO further observed that, due to cost, schedule, and performance concerns, the Deputy Secretary of Defense recently reduced the program to 40 aircraft, pending a Defense Acquisition Board review currently scheduled to occur in November 1995. The GAO also noted that the provisional 40-aircraft program is estimated to cost \$21.3 billion. (pp. 1-2, pp. 8-9/GAO Draft Report)

DOD RESPONSE: Concur.

- o **FINDING B: The C-17 Planned Role Has Changed.** The GAO reported that the Air Force justified the C-17 in the early 1980s on the planned aircraft capabilities to (1) operate routinely in an intratheater shuttle role, (2) perform direct delivery missions to forward airfields, potentially in hostile areas, and (3) airlift substantial amounts of outsize cargo, such as tanks and helicopters. The GAO indicated that the C-17 was also intended to provide the unique capability to conduct low-level parachute extractions of the Army's heavy equipment and to perform strategic

Enclosure

Now on pp. 2-3 and 9-10.

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airdrops of troops and equipment. However, the GAO found that the C-17 envisioned role has changed, and those capabilities will not be used as originally intended--i.e., the C-17 will not routinely conduct intratheater shuttle missions or perform direct delivery missions, and will rarely land in hostile areas. The GAO also found that the dissolution of the Soviet threat has resulted in a reduced requirement for outsize cargo.

In addition, the GAO indicated that the airfield advantage--i.e., the number of airfields open to the C-17, but not the C-5--is much less than the Air Force had previously stated. Finally, the GAO observed that the C-17's unique 60,000 pound low-level parachute extraction system (LAPES) capability is not needed, and that the aircraft cannot meet original airdrop requirements. The GAO asserted that the C-17 planned intratheater capability was key to its anticipated cost-effectiveness, because the Air Force anticipated retiring 198 C-130s that typically carried out the intratheater missions. However, the GAO observed that current Air Force policy and plans reflect a substantially diminished intratheater role for the C-17 and do not discuss retiring a significant number of C-130s. The GAO explained that the Air Force initially anticipated the C-17 would routinely perform intratheater missions during contingencies, but under the current 120-aircraft program, the intertheater airlift flow would be adversely affected if the C-17s were diverted to perform intratheater missions on a routine basis. (pp. 3-4, pp. 12-15/GAO Draft Report)

Now on pp. 2-3 and 12-17.

- o **DOD RESPONSE:** Nonconcur. Special capabilities to meet a wide-range of military requirements were designed into the C-17 weapon system. Those capabilities are still vital. The C-17 is meeting the capability to fulfill all of the roles envisioned for the aircraft and provide the necessary versatility to the warfighting commanders-in-chief (CINCs). Contrary to the GAO position, the Department maintains that more, not fewer C-17s, will provide commanders the most needed capabilities, whether it is intertheater airlift, intratheater airlift, operations into small and austere airfields, direct delivery of supplies close to where the fighting forces need them, or air refueling missions where enroute landing to refuel is denied or fuel is not available at destination airfields.

See comment 2.

The Department has not deleted intratheater shuttle missions from the requirements for the C-17. In fact, the current C-17 Employment Concept of Operations, dated February 4, 1993, allows for C-17 augmentation of the C-130 fleet "when the situation justifies larger capacity, such as outsize cargo, bulk ammunition, fuel supply, or for longer range theater missions." Army Field Manual 100-5, Operations,

See comment 3.

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states "Intratheater Air Lines of Communication (ALOCs) are required to maintain flexibility and effect emergency high priority resupply and replacement actions." Army Field Manual 10-27, General Supply in the Theater of Operation states "Air dropped/air landed forces will receive initial resupply by ALOC." The Military Airlift Command-Army Training and Doctrine Command-Marine Corps Combat Development Command Multi-Service C-17 Employment Concept, dated December 1990, clearly states that "The C-17 ... can operate in both a strategic [intertheater] and theater [intratheater] role" and that "... the C-17 will augment the C-130 fleet when the situation justifies larger capacity, such as for outsize cargo, bulk ammunition, fuel resupply, or for longer range missions." While some of those concepts may be continually evolving, the basic intent of how the Army envisions the employment of the C-17 has not changed. It is recognized that performing such missions reduces the C-17 utilization rate by about three percent. The degree to which intratheater shuttles will be performed may also be influenced by the number procured.

See comment 4.

The versatility offered by the C-17 has become even more important as the world political environment has evolved to requiring fighting two near-simultaneous major regional contingencies, as well as conducting military operations similar to peacekeeping in Bosnia and Haiti, humanitarian relief to Rwanda, and providing credible deterrence in places like Southwest Asia. The C-17 is now proving to be the most capable and versatile airlift aircraft ever built, and will play a critical role in meeting such obligations.

See comment 5.

The Department disagrees with the GAO description of cargo requirements driving the C-17 acquisition. Outsize airlift requirements involve more than percentages of overall cargo weight as the GAO implies. Rather, cargo requirements are based on the number of outsize pieces, their weight and volume, the required accompanying equipment and personnel, and the timing of when and where they need to be in place for the theater commander's use. In addition to outsize cargo, the C-17 is also required to haul oversize (larger than bulk, but smaller than outsize) equipment. Depending on the specific configuration and any modifications, wide-body commercial aircraft cannot carry many oversize equipment pieces. The C-17, on the other hand, can efficiently haul all of those types of loads in a battlefield-ready configuration. The Department is still in the final process of determining the airlift requirement as a result of the 1992 Mobility Requirements Study (MRS) Bottom-Up Review Update (BURU). Thus, conclusions regarding current cargo requirements would be preliminary. However, using the GAO method of determining cargo requirements, it is expected that during the critical force build-up period,

See comment 6.

See comment 7.

though outsize requirements (in terms of percentage of tons of cargo) may decrease relative to the MRS, the combined amount of oversize and outsize cargo requirements will increase. Further, the requirement for outsize-capable aircraft is not just to move the outsize cargo, since each aircraft will carry a mix of outsize and oversize cargo (and possibly bulk cargo as well). It is the time-phased deployment requirements of the cargo on the aircraft that determines the number of C-17s required as part of the outsize cargo-capable airlift fleet. It is misleading to indicate that the outsize cargo requirement is the only justification for the C-17. Furthermore, the DoD Cost and Operational Effectiveness Analysis (COEA) overestimated the capabilities of the commercial aircraft. The COEA gave the commercial aircraft 100 percent credit for oversize cargo. However, no commercial aircraft exists that will carry all of that type of cargo, even if the aircraft are modified by strengthening the floor and widening the cargo door.

The planned use of the C-17 reflects the best use of DoD resources to adapt to the many new roles required by airlift in the 1990s, and into the 21st century. The C-17 continues to offer warfighting CINCs the flexibility to respond to both strategic and theater airlift requirements.

- o **FINDING C: Direct Delivery Role May Not Be Used Routinely.** The GAO observed that the C-17 was also intended to offer an extended direct delivery capability by landing at forward airfields near the battle front; however, the GAO found that the current C-17 operational concept states that the aircraft will rarely land near the battle front. The GAO also found that Army doctrine calls into question the extent to which the delivery capability will be used. The GAO noted that the Army, the primary user of airlift, prefers to deploy to main operating bases (MOBs), rather than directly to final destination airfields. In addition, the GAO found that the C-17 will rarely deliver cargo to forward areas. The GAO also observed that the C-17 operational concept has changed from one that emphasizes direct delivery to forward airfields near the battle front to one that emphasizes more standard airlift operations at or near a MOB. The GAO also reported that Air Force and Army officials stated the C-17 would be very unlikely to use an airfield not protected by a corps, but the C-17 will provide theater commanders the flexibility to operate in forward areas if necessary. The GAO also found that the current Army method of deployment does not use direct delivery, even to well-developed airfields, and that both the Desert Shield/Storm experience and the recent MRS indicated the Army remains reluctant to use direct delivery. (p. 3, pp. 15-19/GAO Draft Report)

Now on pp. 3 and 14-17.

See comment 8.

DOD RESPONSE: Nonconcur. Direct delivery is still a part of the concept for the C-17 and remains an important military role to help the theater commanders conduct their operations effectively. The theater commander may be forced to bypass MOBs in actual combat situations to reduce delivery times, reduce congestion, or because of partial or complete unavailability due to enemy action. Most existing planning documents still reflect current airlift technology and capability. However, it is expected that because of the C-17 proven special capabilities--intertheater range with outsize cargo; small austere airfield operations; ability to air refuel, combat offload, and operate at austere locations; and survivability enhancements--a rethinking of the established planning will occur. Examples of that rethinking follow:

- Director of Army Doctrine memorandum to the Commander, Air Mobility Command, dated September 9, 1994, states "Current doctrine manuals have not addressed direct delivery capabilities because we are currently developing optimum means of employment. However, FM 100-17 (Mobilization, Deployment, Redeployment, and Demobilization), currently under revision, will address the concept of employment of direct delivery methods for providing sustainment supplies into the theater of operation."

- The draft Army Field Manual FM 100-17, dated November 1994, states "The mission and strategic lift capability will determine the final transport mode in the theater. Some units may arrive far forward in the theater via direct delivery"

- The draft Army Field Manual FM 100-7, Decisive Force, The Army in Theater Operations, dated September 1994, states "There are two alternative approaches to establishing positional advantage." "... In the second approach, rapid crisis resolution is sought through the positioning of initially deploying forces into the critical location, i.e. direct delivery."

- The final draft Army Field Manual FM 55-65, Strategic Deployment, dated August 1994, states "The C-17 ... can deliver the same outsize equipment as the C-5 into small airfields previously restricted to the C-130. This ability to land on short runways ... enables delivery of equipment directly to short airfields without intermediate transshipment."

Army 18th Airborne Corps tactics, techniques, and procedures also indicate the necessity of being able to perform direct delivery. Recent examples have demonstrated that capability. The 24th Infantry Division (Mechanized) force

projection standard operating procedure (SOP) calls for the direct deployment of the Division Ready Brigade to as near the Forward Line of Troops as possible. That was accomplished in Kuwait in Operation Vigilant Warrior in October 1994. The 82nd Airborne Division SOP calls for airdrop and immediate follow-on airland operations to reinforce and sustain a forced entry to the most forward airfields. That was the actual concept of operations that would have been executed in Haiti, in September 1994, if forced-entry had been required. As indicated above, as the concept of direct delivery matures, field manuals will be updated and the direct delivery concept will be codified. Though the concept is not a major factor in the strategic deployment planning of the two major regional contingencies scenario, direct delivery can be expected to be of significant benefit in sustainment of the operation, as well as in lesser regional contingencies or humanitarian relief missions.

The GAO has not adequately considered the Air Mobility Command (AMC) intention to use the C-17 "near the battle area." According to the current AMC C-17 Concept of Operations, dated February 4, 1993, "The C-17 will routinely direct deliver supplies to the corps support areas, occasionally to the division support areas, and rarely to the brigade support areas." Army Field Manual 100-10, Combat Service Support, states "Both Air Force and Army aircraft carry critical supplies ... to units operating at ... the Forward Line of Troops." The Department intends to use C-17s in areas protected by a division or brigade when the CINC requires it. Doing so may have a significant impact on air mobility operations.

Though direct delivery may not be used in all situations, the C-17 still offers capabilities and flexibility in actual mobility operations not previously achievable. The C-17, through direct delivery, will effectively provide deterrence and warfighting capability for the CINCs. With only a small number of C-17s in the fleet, that vital option would be severely limited.

- o **FINDING D: The C-17 Can Land at Fewer Small, Austere Airfields Than Air Force Has Reported.** The GAO observed that the Air Force reported the C-17 capability to land on short airfields would enable it to land at about 6,400 more airfields in the free world than the C-5. However, the GAO concluded that the figure is overstated, because it did not take runway strength into account and included all types of airfields--ranging from concrete and asphalt to gravel, dirt, and grass--many of which are not suitable for either aircraft. The GAO also found that when wartime landing

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requirements, including minimum runway strength, are considered, only three airfields would likely be used by the C-17 in the major regional contingencies scenarios, i.e., two in Korea and one in Saudi Arabia.

The GAO also found that outsize cargo requirements have declined in the post-Cold War world--i.e., from about 27 percent in 1981 to about 12 percent in Desert Shield/Storm. In addition, the GAO observed that the DoD analysis in the recent MRS used only 80 C-17s.

The GAO also found that the Army no longer plans to use the C-17 unique LAPES capability to deliver platforms weighing up to 60,000 pounds. The GAO indicated that in March 1994, the Army formally acknowledged that "LAPES has been an expensive, unused, untrained capability and is potentially of limited battlefield use." The GAO also observed that the Army does not intend to maintain the material systems and rigging required for the 60,000 pound LAPES platform, nor to conduct C-17 LAPES training--thus, the C-17 will not be used for that mission. The GAO noted that testing of a 42,000 pound C-17 LAPES capability is currently underway. (pp. 3-4, pp. 20-22/GAO Draft Report)

Now on pp. 3 and 17-18.

DOD RESPONSE: Partially concur. The Department has previously acknowledged that some of its earlier airfield availability comparisons between the C-5 and C-17 did not include weight-bearing capacity and, therefore, overstated the C-17's advantage. As the GAO acknowledged, however, the C-17 still can access 1,400 more airfields than the C-5 (3,700 vice 2,300). The GAO implies that number is insignificant, since it is less than the Air Force originally claimed. That advantage is, however, significant, even by the GAO assessment. Further, that numerical advantage does not include--even though the GAO asserts it is "worldwide"--the majority of airfields in such countries as China, Russia, and those of other countries of the former Soviet Union and the former Warsaw Pact. Nor does it include unpaved runways, both of which would contribute even more in the C-17's favor if included. Current DoD analyses show an approximate 2 to 1 advantage of the C-17 over the C-5 when all significant factors are considered. The C-17 would have even a larger advantage over other airlift aircraft like the C-141 and commercial wide-body aircraft. The airfield access advantage provides a great benefit in terms of capability and flexibility to the theater commander. If an offload or enroute base becomes clogged by other air assets, the C-17 can continue to operate and move heavy cargo by going into smaller airports. Besides having an airfield advantage over the C-5 (and C-141 and commercial wide-body aircraft), the C-17 has a tremendous advantage in throughput--the amount of cargo

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moved per time period--than the C-5. That is due to the C-17's smaller size, increased ground maneuverability, and shorter offload times. The C-17 (but not the other airlifters mentioned) has the ability to routinely back-up and can also turn around in as little as 80 feet. As a result, sufficiently greater numbers of C-17s can operate through small airfields to more than offset its reduced cargo capacity relative to larger airlifters. Finally, the C-17 offers additional flexibility over other airlift aircraft because of the aircraft's superior avionics, which allow it, even in poor weather conditions, to access austere airfields possessing no navigational aids.

The need for access to small, austere airfields depends on the scenario. The regions of interest for the two major regional contingencies scenario--Southwest Asia and Korea--have relatively mature airfield infrastructures. Thus, smaller-type airfields are not very important in the strategic employment analysis. However, in a region with less infrastructure (such as in many areas of Africa), the use of small airfields by the C-17 could be of critical importance. Everyday real-world operations to places like Rwanda, Bosnia, Haiti, Panama, and Somalia provide current examples. Even in the major regional contingencies, the superior runway access offered by the C-17s would be beneficial when the actual results of the battle situation become different from planned, including MOBs being overrun or damaged by the enemy or being used to their maximum capability, and unanticipated force needs or locations, etc. With the C-17, the theater commander would have the flexibility to airlift supplies nearer to where and when they are actually needed.

The DoD airlift requirement should not be assessed on Operation Desert Shield alone. Unlike that scenario, the current strategy involves two near-simultaneous conflicts. Until the MRS-BURU study is published, it would be premature to try to determine the number of C-17s needed just to carry the outsize (and concurrent oversize and bulk) cargo. Additionally, the number of C-5s has been reduced from 109 primary authorized aircraft to 104 since Desert Storm and the MRS, to reflect more realistic depot maintenance requirements. That change will add more burden to the C-17 to carry the large loads. Finally, it must be remembered that the need for the C-17 involves more than its ability to carry outsize cargo, as implied by the GAO. Besides also carrying oversize equipment, the C-17's versatility allows tremendous flexibility to perform a wide array of other military missions, including forced penetration of enemy territory by strategic brigade airdrop. Those types of military-unique missions will be factors in determining the number of C-17s required. The Department is currently

See comment 11.

collecting the necessary information to determine how many C-17s to procure at the Milestone III Defense Acquisition Board review in November 1995.

Finally, it should be recognized that C-17 LAPES testing has been successfully completed up to 42,000 pounds. Test results show the C-17 to be an outstanding LAPES platform. That capability is currently available to the user. Further, the decreased Army emphasis on LAPES also applies to the C-130, and thus is not unique to the C-17.

- o **FINDING E: The C-17 Cannot Meet Original Airdrop Requirements.** The GAO observed that the ability to airdrop troops and equipment is one of the most critical DoD requirements, and that only the C-141 and C-130 aircraft are capable of routinely performing airdrop missions. The GAO noted that, because the C-130 cannot fly the long distances required for that mission and the C-141 fleet is being retired, the C-17 is expected to fulfill that requirement. However, the GAO found that the C-17 has not been able to meet initial requirements, because of internal airflow problems caused by its design, and that consequently, the Army is lowering its airdrop requirements.

The GAO explained that the specifications call for the C-17 to airdrop 102 combat-equipped paratroopers using static line deployed parachutes within 55 seconds, preceded by at least eight 500-pound equipment bundles. The GAO pointed out that the bundles are to be dropped out of the cargo ramp door while the paratroopers jump from the two troop doors on the aircraft sides. The GAO found that the C-17 has severe airflow problems when the side troop doors and the rear cargo door and ramp are open. The GAO also indicated that AMC officials stated the requirement is unrealistic, because 102 paratroopers cannot exit an aircraft within that time-frame. The GAO also found that another specification--which requires the C-17 to airdrop 40 containerized delivery system (CDS) bundles, weighing 2,350 pounds each--is under review because of safety concerns, and that the C-17 has been restricted to dropping only 30 bundles pending completion of that review. (p. 4, pp. 22-25/GAO Draft Report)

DOD RESPONSE: Partially concur. Flight testing is not yet complete in the areas of personnel airdrop and CDS airdrop. Therefore, no conclusion as to the C-17 capability can be drawn. It is premature to conclude that 102 paratroopers cannot exit the C-17 in 55 seconds. The DoD agrees that the airflow inside the cargo compartment has so far precluded paratroopers jumping out the side doors with the rear cargo door and ramp open. That situation is not unlike that on the C-130 and C-141, which have similar restrictions. The

See comment 12.

Now on pp. 3 and 19-20.

See comment 13.

Air Force and Army are investigating ways for the C-17 to satisfy the Army's requirement for airdropping equipment bundles and personnel. The Army is satisfied with the personnel airdrop capability of the C-141, and it is expected that the C-17 will be able to perform to at least that standard. Testing and evaluation are underway to optimize the combination personnel/bundle airdrop capability of the C-17. Low-velocity airdrop, LAPES, and personnel airdrop have been unaffected by the internal airflow situation.

Similarly, although CDS testing is still in progress, it is anticipated that the C-17 will be able to meet the specification to airdrop 40 bundles. The C-17 is currently capable of dropping this number with two loadmasters. Just as importantly, the C-17 is currently certified to drop 30 bundles with one loadmaster, which meets the AMC threshold requirement as stated in the Operational Requirements Document. A vertical restraint method for the 10 ramp bundles is being developed and will be flight tested to verify a satisfactory solution for the single loadmaster operation.

See comment 14.

- **FINDING F: Alternatives to the C-17 Can Help Meet Airlift Requirements at Significantly Lower Cost.** The GAO observed that the DoD Cost and Operational Effectiveness Analysis (COEA) showed that the C-17 is the preferred military airlifter because, when considering delivery of outside cargo, the C-17 retains its throughput ability better than the C-5 if (1) airfield constraints are encountered and (2) the C-17's planned utilization rate (higher than the C-5 experienced rate) is achieved. However, the GAO found the COEA also showed that alternative airlift fleets, such as a combination of 40 C-17s and 64 modified commercial freighters, can meet airlift requirements at a significantly lower cost if alternative--and in the opinion of the GAO more reasonable--assumptions are made. The GAO concluded that alternative assumptions pertaining to airfield availability, utilization rates, and intratheater capability are more realistic, and that adjusting for those assumptions would result in the C-17 fleet being less capable, and a mixed C-17/commercial fleet being more capable and more cost-effective than the COEA's conclusions.

The GAO explained that the COEA was based on the threat scenario portrayed in the 1992 MRS, which postulated that an aggressive enemy was moving directly into Saudi Arabia. The GAO noted that, based on that threat, several airfield assumptions were examined. The GAO observed that the COEA showed the C-17 had a better delivery capability for outside cargo than the mixed C-17/commercial aircraft fleet when

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airfield availability was extremely limited; but when only one major airlift airfield was available, the C-17 fleet could meet the MRS delivery requirement, but the mixed fleet could not. However, the GAO also observed that, under the airfield assumptions used in the MRS's Southwest Asia scenario, in which many more airlift airfields were assumed to be available, the COEA showed that the mixed fleet of 40 C-17s and 64 747s could deliver the required amount of cargo. The GAO concluded the MRS assumption that the Saudi Government would open additional airlift airfields is more realistic than the early Desert Shield experience (when only one major airlift airfield was available). The GAO also concluded that the mixed fleet would cost about \$6 billion less than the fleet of 120 C-17s. (p. 5, pp. 26-29/GAO Draft Report)

Now on pp. 4 and 22-23.

DOD RESPONSE: Nonconcur. Airfield availability can be expected to be constrained in any major contingency operation. That was borne out in Operation Desert Shield and Operation Vigilant Warrior. Contrary to the GAO conclusion, it would be likely that a direct invasion of Saudi Arabia would still constrain the theater airfields, because of the adversary's attempt to deny access to primary airfields. In addition, there is no guarantee that relief of political constraints in theater would remove constraints in the enroute system. Frequently, operations to Southwest Asia were governed by throughput constraints in Europe, due to quiet hours, weather, political restrictions, air traffic control restrictions, etc. In the December 1992 GAO report entitled "DOD'S MOBILITY REQUIREMENTS: Results of Mobility Study Based on Optimistic Airlift Assumptions,"

See comment 15.

(OSD Case 9258-X) the GAO said the Department was incorrect for assuming an unconstrained airfield environment during the 1992 MRS. The current GAO's position on airfield availability is inconsistent and, in this report, unrealistic.

See comment 16.

The C-17 was shown to be a superior performer to the commercial alternatives in the COEA when the availability of airfields was properly considered. The GAO is incorrect when it states that the C-17 is superior to the commercial alternatives only when airfields are "extremely constrained." The COEA clearly states that the C-17 is the preferred option when airfields have even "moderate" constraint. In any event, the MRS-BURU study, on which the Department will base its 1995 integrated airlift decision, will have an even more complete assessment of airfield constraints.

The Strategic Airlift Force Mix Analysis (SAFMA) tailored COEA, to be used to help make the integrated C-17/Non-Developmental Airlift Aircraft (NDAA) decision in November

1995, will include excursions in airfield constraints (as well as C-17 and NDAA candidate utilization rates) so the Defense Acquisition Executive (DAE) will have a range of information available. The DAE will, in turn, be able to make decisions based on the latest estimates for those important values. In support of its goal, the Department is conducting further studies to better quantify and predict airfield constraints and utilization rates.

- o **FINDING G: The C-17 Cost-Effectiveness Depends on High Utilization Rate.** The GAO also found that the COEA indicated the C-17 would perform better than mixed fleets if a 15.2 hour per day utilization rate (i.e., planned average daily flying hours per aircraft, commonly called UTE rate) were assumed for the C-17. The GAO also found the COEA showed that, based on a 15.2 UTE rate for the C-17 and a 12.5 rate for the 747, both alternatives would meet the stated airlift requirement. The GAO concluded that the C-17's 15.2 hour UTE rate is undemonstrated and may not be achievable. The GAO also concluded that to sustain that rate, the C-17 must demonstrate a mission capable rate of 90 percent, and the Air Force must sufficiently fund C-17 spares and aircrews. The GAO found that the C-17 has fallen short of predicted reliability goals during the flight test program, and that the level of war reserve spares for airlift aircraft has been less than required to sustain projected wartime UTE rates. (pp. 29-30/GAO Draft Report)

DOD RESPONSE: Partially concur. The C-17 is now beginning to demonstrate its ability to maintain UTE rates reflected in the COEA. The latest data from the first operational C-17 squadron, indicate the airplane is meeting or exceeding most of the Reliability, Maintainability, and Availability (RM&A) values that will support high wartime surge UTE rates when fully mature. The aircraft has also demonstrated reliable performance during its first operational mobility mission. In the October 1994 mission of two C-17s to Saudi Arabia, demonstrated UTE rates were greater than required (even allowing for enroute ground refueling in lieu of the air refueling actually used). Even at a 12.5 hour UTE rate, the COEA concluded there was no more cost-effective force than one with 120 C-17s when airfields were moderately constrained. The Department intends to fully fund crews, maintenance, spares, and material handling equipment necessary for the C-17 weapon system to achieve its objective UTE rate in a wartime scenario.

Contributing to the C-17's expected high UTE rates is its short ground times (2 hours and 15 minutes), due to ease of onloading and offloading of cargo and ground maneuverability capabilities which have already been demonstrated. Commercial alternatives, if configured to

Now on pp. 22-23.

See comment 17.

See comment 18.

carry some of the large Army equipment, as assumed in the COEA, are expected to stay on the ground longer to complete onloading and offloading, due to the commercial aircraft's higher floor and increased difficulty in moving cargo through the commercial aircraft's doors. Longer ground times contribute to lower inherent UTE rates.

As recognized by the GAO, UTE rate is an important determinant of any airplane's capability. Operational squadron data indicate the C-17 will meet or exceed its RM&A specifications, which will be more fully illustrated at the July 1995 RM&A evaluation. The Department is conducting further studies to better predict inherent UTE rate from RM&A parameters.

The Department is strongly convinced that the C-17 full rate production decision in November 1995 will take into account high-fidelity information, including the UTE rate of each competitor, in making the mobility aircraft fleet decision.

- o **FINDING H: The COEA Underestimates Potential Savings Associated With Mixed Fleet Alternative.** The GAO observed that, because the C-17 was designed to deliver cargo to small, forward airfields typically used by the C-130, the COEA assumed that the alternative with only 40 C-17s would need 80 additional C-130s to provide about the same intratheater movement capability as the fleet of 120 C-17s. The GAO noted that, as a result, the life-cycle cost of the mixed fleet alternative was increased by \$4.7 billion over 25 years (in constant FY 1993 dollars). The GAO asserted that the C-17 planned intratheater role has been largely limited and that the Air Force does not plan to replace C-130s with C-17s for intratheater missions. The GAO concluded that it was inappropriate to assume the mixed fleet alternative should include the added \$4.7 billion, and that if that cost is subtracted from the mixed fleet, the cost of 120 C-17s increases from about \$6 billion to about \$10.7 billion more than the mixed fleet alternative. (pp. 30-31/GAO Draft Report)

Now on p. 24.

See comment 19.

DOD RESPONSE: Nonconcur. Although perhaps difficult to quantify, clearly a special and important advantage of the C-17 is to augment C-130s, in moving troops and cargo (including outsize), close to the battle area. As discussed in the DoD response to Finding B, the DoD has not discontinued the use of C-17s in an intratheater shuttle mode. The Department is studying a method to describe that added flexibility and include it for consideration in the November 1995 airlift decision.

See comment 20.

The DoD also does not agree with the GAO statement that the operating and support (O&S) cost differential for 120 and 40 aircraft C-17 fleets is \$4.7 billion. The GAO has not included the full C-130 O&S costs that must be borne during the period that C-130s must substitute for C-17s while building up to the full C-17 complement. The COEA assumes a buildup of C-17s to their full number, not an immediate capability at the full number. With this methodology, the proper differential is \$2.8 billion.

- o **FINDING I: The C-17 Program Cost Continues to Increase.** The GAO observed that, at a maximum production rate of 12 aircraft per year, total program costs would be \$45.4 billion. The GAO also observed that if the maximum production rate were reduced to eight aircraft per year, the estimated total program costs would increase another \$2.6 billion, or to about \$48 billion. The GAO pointed out that in recent years, due to ongoing development and production problems, the Congress restricted the C-17 procurement rate to reduce the level of concurrency in the program. The GAO concluded that the DoD C-17 procurement cost estimates are significantly higher than those in the C-17 COEA. The GAO determined that the potential savings associated with adopting the mixed fleet alternative may be \$2.8 billion to \$4 billion (in constant FY 1993 dollars) greater than the \$10.7 billion previously reported.
(p. 5, p. 26, pp. 30-32/GAO Draft Report)

Now on pp. 4, 22,
and 24-25.

DOD RESPONSE: Partially concur. Costs have increased, as would be expected of any program that has been stretched out, and thus is adversely affected by inflation and low production rate inefficiencies. The GAO did not consider that the NDAA costs used in the COEA were only estimates and may have also increased since that time. Additionally, productivity improvements are being funded on the C-17 program in an attempt to reduce the aircraft's cost. The Milestone III decision will be made using the latest and most accurate cost information possible. To further refine cost estimates, fixed-price proposals will be submitted by the NDAA offerors in 1995. Additionally, it is expected that fixed-price proposals for C-17 Lots VIII through XI and "not-to-exceed-estimates" for the remaining lots will also be available. At that time, i.e., November 1995, it will be prudent to make a decision concerning the most cost-effective acquisition of additional C-17s and/or NDAAAs.

See comment 21.

- o **FINDING J: Minimum Number of C-17s Needed to Fulfill Unique Military Requirements Not Yet Determined.** The GAO concluded that determining whether a mixed fleet is a viable

alternative to a 120-aircraft C-17 program depends on the fleet capability to fulfill certain unique military requirements. The GAO asserted that the COEA was not intended to address that issue in detail. The GAO noted that the DoD has several studies underway that will assess the capability of various fleet mixes and identify the minimum number of C-17s needed to fulfill unique military airlift requirements prior to the November 1995 full-rate production decision. The GAO also noted that the Defense Acquisition Board will consider several factors in deciding whether to continue the C-17 program, including C-17 flight test and reliability results, contractor performance, and the findings of the Air Force's airlift fleet mix study. (p. 5, pp. 32-33/GAO Draft Report)

Now on pp. 4 and 25.

DOD RESPONSE: Concur. The Department has a well-developed strategy to determine the future airlift fleet mix. All of the ingredients will be in place for the DAE's decision at the Milestone III review in November 1995. At that time, the C-17 prime contractor will have completed the two-year probation period imposed by the Department and sufficient technical and cost information will be available on the C-17 and the NDAA candidates. It is expected that the information available for Milestone III will be the most complete and reliable information ever used in making an airlift fleet decision.

* * * * *

MATTER FOR CONGRESSIONAL CONSIDERATION

- o **SUGGESTION:** In light of changes in the C-17's intended role, the results of the DoD cost and operational effectiveness analysis, and continued program cost growth, the GAO suggested that the Congress not support the C-17 program beyond the minimum number needed to fulfill unique military requirements. (p. 6, p. 34/GAO Draft Report)

Now on pp. 4 and 26.

DOD RESPONSE: Partially concur. The Department will not procure any C-17s beyond the minimum number needed to fulfill unique military requirements, unless the C-17 competes favorably against military and commercial alternatives for the remaining airlift requirement. That determination will take into account unique military requirements, such as the timely delivery of outsize and most oversize cargo, along with such capabilities as forced penetration with the airdrop of a brigade of personnel and equipment, enhanced aircraft survivability, ability to operate into small austere airfields, and air refueling. Together, all of those capabilities will provide the

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military commander the ability and flexibility to achieve the military advantage over the enemy. That role is clearly different from what commercial-type aircraft are normally selected for.

The integrated airlift decision in 1995 will look at the most effective manner to fulfill the critical need in airlift. The decision will consider both military and commercial alternatives. The major consideration will be what fleet composition will fulfill the Department's entire airlift requirement at the lowest life cycle cost. The Department is currently executing the steps necessary to be able to make that important decision in November 1995.

GAO Comments

The following are GAO's comments on the Department of Defense's (DOD) letter dated November 18, 1994.

1. Our response to each of these specific issues is set forth in the following notes, which are annotated to DOD's enclosure.
2. A comparison of the C-17's envisioned role with how the Air Force currently plans to operate it clearly shows that it will not be used as originally intended—that is, the C-17 will not routinely conduct intratheater shuttle missions and will rarely land at the brigade rear area. DOD's position is based on the belief that the difference between "routine" and "rarely" is insignificant.

The basis for DOD's statement that more, not fewer, C-17s are needed, when DOD has yet to determine the minimum number of C-17s needed to meet military-unique airlift requirements, is unclear.

3. Contrary to DOD's assertion, we do not state that DOD has deleted intratheater shuttle missions from the requirements for the C-17. Rather, we state that the C-17 will not routinely perform intratheater missions as originally planned. In commenting on our 1994 report (Airlift Requirements: Commercial Freighters Can Help Meet Requirements At Greatly Reduced Cost), Office of the Secretary of Defense and Air Mobility Command (AMC) officials acknowledged that the C-17's intratheater airlift role had been substantially diminished.

4. DOD suggests that it is planning to procure the C-17, in part, to carry out humanitarian missions. This rationale needs to be re-examined in light of the growing cost of the aircraft. Other airlifters can accomplish these missions at a substantially lower cost.

5. Our report does not state or imply that outsize airlift requirements involve only percentages of overall cargo weight. Our findings are based, in part, on AMC's analysis for the 1992 Mobility Requirements Study (MRS), which included all types of cargo and which was based on the MRS time-phased force deployment data. This analysis showed that about 80 C-17s, along with the other airlifters in the fleet, could meet DOD's delivery requirements. A preliminary analysis by AMC indicates that the outsize cargo requirements in the MRS Bottom-Up Review Update will not substantially increase from those used in the 1992 MRS. Therefore, outsize cargo capabilities cannot be considered a basis on which to procure 120 C-17s.

6. The ability to carry outsize cargo was one of the original capabilities on which the C-17 was justified. Our report does not present this capability as the sole justification for the aircraft.

7. We asked for documentation to support this statement. However, the documentation was not provided to us. We subsequently contacted an official from the Institute for Defense Analyses who told us that, of two airlift models used for the cost and operational effectiveness analysis (COEA), one accounted for the inability of commercial aircraft to carry all oversize equipment, while the other model did not have the ability to adjust for item configuration. Moreover, DOD has not provided us with evidence that the oversize cargo issue would have any significant effect on the COEA's outcome.

8. While direct delivery has always been included as a part of the C-17's operational concept, we found that the Army had not incorporated direct delivery into its doctrine. DOD's comments do not dispute this finding.

9. The C-17's operational concept has changed from one that emphasized direct delivery to forward airfields at the brigade rear area to one that stresses more standard airlift operations at the corps rear area. This finding is supported by a comparison of original and current C-17 operational documents. As DOD states, the 1993 C-17 Concept of Operations asserts that the C-17 will rarely direct deliver supplies to the brigade support areas. This is in direct contrast to the 1986 System Operational Concept, which states that the C-17 will routinely land at the brigade rear area, which is closer than the brigade support area to the forward edge of the battle area. (Emphasis added.)

10. DOD acknowledges that the C-17 can only land on approximately 1,400 more runways than the C-5, not the 6,400 airfields it previously had asserted. However, even this airfield advantage should be viewed in the context of major regional contingency scenarios and the fact that the 1992 MRS only identified three small austere airfields that would likely be used by the C-17.

11. We have seen no evidence that the reduction in the number of C-5s from 109 to 104 will have a significant impact on the C-17's cargo-carrying requirements. Furthermore, our report discusses several of the justifications for the C-17, not outsize cargo only.

12. While the decreased Army emphasis on low-altitude parachute extraction system (LAPES) is not unique to the C-17, it eliminates one of the C-17-unique missions—the 60,000-pound LAPES capability.

13. The ability to airdrop equipment bundles and personnel simultaneously is a key military requirement. Joint Chiefs of Staff and Army officials repeatedly emphasized its importance to us during our review. According to AMC officials, the Army's current requirement is not achievable and this C-17 requirement will be reduced.

14. Containerized delivery system testing is still ongoing and no final conclusion can be made at this time.

15. Desert Shield and Operation Vigilant Warrior were significantly different than the MRS major regional contingency scenario, which postulates that an aggressive enemy is attempting to invade Saudi Arabia. In the 1992 MRS, DOD assumed that more airfields would be available for airlift operations than was the case during Desert Shield. This assumption was based specifically on the nature of the MRS threat. The COEA's conclusion that the C-17 is the preferred airlifter was based on an assumption that airfield availability in the MRS scenario would be extremely constrained—to the point where only one major airlift airfield was available—as was the case during the first 6 weeks of Desert Shield. This assumption gave the C-17 an advantage over the other airlifters because of its projected ability to use available space more efficiently than a C-5 or a 747.

In light of the imminent threat to Saudi Arabia assumed in the MRS scenario, we believe a more equitable assumption is the COEA's alternative case, which uses the MRS airfield availability assumption, rather than juxtaposing a Desert Shield-type airfield assumption onto an MRS threat.

In our report on the 1992 MRS, we pointed out that DOD assumed that numerous airfields would be available without determining the effect of a range of airfield availability within the theater of operations. We did not assert that a Desert Shield-type situation was necessarily likely to occur. DOD's response to our report was that, given the aggressive threat assumed in the MRS, more airfields were likely to be available for airlift operations than was the case during Desert Shield. As the COEA shows, various degrees of airfield availability have a significant effect on airlift deliveries. DOD, Air Force, and AMC officials agree that airfield availability for any future scenario is an unknown. Therefore, choosing the Desert Shield

airfield assumption as the likely case in an MRS major regional contingency is, in our opinion, not well grounded.

16. Our statement regarding the COEA's conclusion on airfield availability was correct as stated. The COEA defines "moderate" airfield constraints as the availability of the first 6 weeks of Desert Shield, which we consider extremely constrained. We believe the word "moderate" in this instance is misleading. The availability of only one major airlift airfield represents in our view an extremely constrained availability; to have anything less would be to have no major airlift airfield availability.

17. The COEA's conclusion that the C-17 is the preferred airlifter was based, in part, on an assumption that the C-17 would attain a projected utilization rate that exceeds that of any other airlifter, while the other airlifters in the study were held to demonstrated or, in the case of commercial airlifters, lower than demonstrated rates. The performance of two C-17s on the recent Kuwait mission does not support the use of a sustained 15.2-hour utilization rate in a COEA because that mission was limited in scope. In addition, even if the C-17 attains a high utilization rate during the July 1995 reliability, maintainability, and availability evaluation, DOD has not yet determined how the evaluation results will be extrapolated analytically to justify the 15.2-hour rate for a sustained period of time. Therefore, we continue to believe that, for purposes of a COEA, comparable utilization rates for the C-17 and the 747 would be a more legitimate basis for comparison.

The COEA found that, even under airfield constraints reflecting the first 6 weeks of Desert Shield, the C-17 fleet at a 12.5-hour utilization rate did not meet the MRS requirement.

18. As DOD's comment indicates, a comparison of ground times between the C-17 and modified commercial aircraft has not yet been made. Once the comparison has been accomplished, DOD should know what impact loading and unloading of various aircraft will have on utilization rates.

19. DOD's position contradicts comments provided by officials from the Office of the Secretary of Defense and AMC on our recent report, Airlift Requirements: Commercial Freighters Can Help Meet Requirements at Greatly Reduced Cost, and AMC officials' comments on this report. Those officials acknowledged that, due primarily to the reduction in the number of aircraft from 210 to 120, the C-17 is not likely to operate routinely in an intratheater shuttle role as originally envisioned. DOD's position also

contradicts AMC's explicit intention, as reflected in the 1993 Air Mobility Master Plan, not to use the C-17 for extensive intratheater shuttle missions.

20. In its cover letter, DOD indicated that the COEA had not underestimated potential savings associated with mixed fleet alternatives, but here DOD indicates that the savings were underestimated by \$2.8 billion, not by the \$4.7 billion as we had estimated. These two statements appear inconsistent.

DOD concluded that C-130 operating and support costs must be borne while C-130s are substituted for C-17s until all 120 C-17s are procured. This conclusion was based on the assumption that the C-17 would perform routine intratheater missions in the place of C-130s. As discussed above, AMC no longer intends to use the C-17 extensively for intratheater shuttle missions. The 1993 Air Mobility Master Plan makes no mention of the C-17's intratheater role. The number of C-130s in the inventory has not been reduced as a result of the introduction of the C-17 nor are there plans to do so. DOD officials have not provided any evidence that C-17s will replace C-130s for intratheater missions. Therefore, the C-17 should not be credited with any degree of additional cost savings to reflect such a role.

21. We have modified the report to acknowledge that nondevelopmental airlift aircraft costs used in the COEA were only estimates and may have changed since that time.

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