# GLOBEMASTER III

## Acquiring the C-17

Betty R. Kennedy

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Betty Raab Kennedy

Air Mobility Command Office of History
Scott Air Force Base, Illinois
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Perfect cover digital image credit: Operation Enduring Freedom. Security Forces monitoring airfield activity as the C-17 Globemaster III takes off from Bagram Air Base, Afghanistan, 12 May 2002. (USAF, TSgt Melissa Sanscrainte)

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*Persistent, Resolute . . .*

*Thousands made the C-17 a reality*

*Overall, I think it's probably the best airplane I've flown.*

Colonel George G. London Jr., February 2000
Test pilot and copilot on the first C-17 flight

*Well, like most things if you can look beyond the glossy brochures and if you can look beyond what the politicians and generals say and go to the guys that are flying the airplane and ask them 'Is this airplane a good airplane or is it a piece of junk?' The general answer you get is, 'It's a pretty good airplane.'*

Colonel Walter S. Evans, September 1998
AMST, C-X Task Force, and HQ AMC representative to RM&AE

# FOREWORD

The C-17 holds the distinction of being the premier military airlifter in the world as we move into the 21st Century. It flew for the first time in September 1991 and entered the United States Air Force inventory in June 1993, assigned to the Air Mobility Command. On 17 January 1995, General Robert L. Rutherford declared the C-17 met its initial operational capability with a squadron of 12 aircraft based at Charleston AFB, South Carolina. Today the C-17 is recognized as a world-class, dual-role mobility aircraft…but it was not always viewed as such.

Uncertainty characterized the C-17 program for many years starting with the concept definition phase in the late 1970s and early 1980s. There were debates about the requirement, development problems, program management, cost increases, and the viability of the program. In 1993 the Undersecretary of Defense for Acquisition, John Deutch, placed the program on probation, a first for a defense acquisition program. As the Commander-in-Chief of the United States Transportation Command and the Commander of the Air Mobility Command from 1992 to 1994, I was faced with several critical issues relating to the C-17, to include exploring alternatives to the aircraft. In the end, I came to the conclusion that the C-17 offered the best choice for meeting the Nation's need for global mobility to support the emerging post-Cold War national security requirements.

This conclusion, arrived at during my time at Air Mobility Command, was reinforced when I became the Chief of Staff of the Air Force. It has been gratifying to see the aircraft perform so magnificently during the conflicts and crises of the mid and late 1990s and in the opening phases of the War on Terror.

Ronald R. Fogleman
General, USAF, (Ret.)
Commander Air Mobility Command, 1992-1994
Commander-in-Chief United States Transportation Command, 1992-1994
Chief of Staff of the United States Air Force, 1994-1997

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I also acknowledge the assistance historians provided from the Air Force History Support Office, Aeronautical Systems Center, Air Force Flight Test Center, and XVIIIth Airborne Corps, specifically Dr. James K. Aldridge, Ms. Diana G. Cornelisse, Dr. Paul C. Ferguson, Ms. Cynthia Hayden, Mr. Bruce Hess, Mr. Frederick A. Johnsen, Captain Elizabeth C. Langwell, Dr. Roger G. Miller, Captain Jonathan R. Riddell, Dr. George M. Watson, and Major Bob White.

From among my co-workers at the Air Mobility Command and US Transportation Command, I note the support of Dr. Kent Beck, Dr. Robert deV. Brunkow, Ms. Margaret J. Nigra, and Ms. Kathryn A. Wilcoxson. I also wish to recognize Visual Information Specialist Ms. Ginger Hickey for designing the cover and finalizing the manuscript for publication. Master Sergeant Jason White, Joint Combat Camera Center, expedited the release of photo imagery.

Lastly, the views expressed are those of the author and do not represent an official Air Force or Department of Defense position on the C-17. My goal was to write a history of the C-17's acquisition, documenting the major program aspects to include the negative and the positive in order that the acquisition process might benefit the most. In discussing the exchanges among the Congress, Office of the Secretary of Defense, Air Force, Army, and contractor, I tried to be expansive, yet recognize my shortfalls in doing so—compounded by time constraints. I have watched the C-17 program from a unique perspective—as a staff historian at Headquarters Military Airlift Command and then Headquarters Air Mobility Command. It is my bias, although I also confess to some military service with the Army. Nonetheless, this book should prove useful to those managing future military aircraft acquisitions.

# THE AUTHOR

Betty R. Kennedy is a staff historian with Headquarters Air Mobility Command. In 1982, following military service with the Army Security Agency, Ms. Kennedy began her civil service career. Ms. Kennedy has authored numerous official Air Force histories, studies, and articles. Of significance, she wrote *An Illustrated History of Scott Air Force Base, 1917-1987* and served as the editor for *Anything, Anywhere, Anytime: An Illustrated History of the Military Airlift Command, 1941-1991*. Her published acquisition articles include: "The AMST Program's Lasting Legacy" (*Air Power History*), "Historical Realities of C-17 Program Pose Challenge For Future Acquisitions" (*Program Manager*), and "A Revolution in Air Transport: Acquiring the C-141 Starlifter" (coauthored, *Airpower Journal)*.

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# INTRODUCTION

The acquisition of the C-17, the Air Force's newest military transport, was not a straightforward process. The program encountered political opposition, limited funding, and technical development and program management setbacks, which affected the program's cost, production, and delivery schedule. There were varying degrees of support for the C-17 within the Department of Defense and the Air Force, with many direct attacks. From the beginning, consensus did not exist within the Department of Defense and the Air Force on what type of airlift aircraft was needed. Some officials desired a pure strategic-capable aircraft. Others wanted a tactical airlifter, and still others envisioned a mix of both strategic and tactical. Disagreement surfaced over whether the program should be a new development effort or draw upon existing military and/or commercial aircraft. At the program's inception, the wartime airlift mobility requirement was largely undefined. It took several years before the requirement became quantified in an airlift master plan. As the Cold War ebbed, the mobility requirement underwent refinement and then embraced new strategies. Possessing a good design concept, the C-17 was able to adapt.

Securing the necessary funding for the C-17 was simply an ordeal. While Congress has the responsibility of authorizing and appropriating funds for the Department of Defense, its ability to summarily cut program funding and impose restrictive language was not always the best course for the C-17. That the budget axes of the Department of Defense and the Air Force also fell upon the program further undermined the ultimate goal: timely operational delivery.

The C-17's birthing took place amidst heated competition and the excesses of political influence. The cost of the hours wasted on politics alone would have paid for a good number of C-17s. Personalities determined the program's direction as well. The C-17 program had to accommodate four presidential administrations: Carter, Reagan, Bush, and Clinton. One other macro ingredient was the performance of the manufacturer and the many subcontractors. The good start quickly eroded as sparse funding and indecision dominated the first years. Later, development and management problems impacted the production effort. By the time the Air Force accepted operational delivery of the first C-17 in 1993, thirteen years had passed since the program's inception. The Air Force had obtained the C-141 and C-5 within five years.

While these concurrent exchanges have made acquiring this weapon system a convoluted and difficult process, the plane's performance has been a good news story. Early on, the C-17 confirmed its capability of delivering outsize cargo into a small, austere airfield during Operation Joint Endeavor (Bosnia) in 1995 and 1996. It also established several world records to include short-takeoff-and-landing (STOL). In 1997, the C-17 showed the added value of its ground maneuverability at Libreville, Gabon, during Guardian Retrieval (Zaire). And in September 1997, eight C-17s flew the longest-distance airdrop operation in history, during CENTRAZBAT '97 (Kazakhstan). It was also an impressive direct delivery demonstration. Next, the C-17s performed superbly during Allied Force (Kosovo)—the air campaign against Serbia in 1999. Most recently, the C-17 has given a stellar performance during Noble Eagle-Enduring Freedom—the war against terrorism following the World Trade Center attack in September 2001—and Iraqi Freedom—the war to root out Saddem Hussein and his followers.

# PART I

## ANTECEDENT

# I

# PRELUDE-Legacy of the AMST
## 1970-1979

Although canceled, the Advanced Medium Short-Takeoff-and-Landing Transport (AMST) is significant as the genesis of the C-17 Globemaster III. Initially, the AMST was slated to replace the Vietnam-worn C-130 tactical airlift aircraft. Politics, inflation, and national security priorities, however, redirected the program and ultimately brought forth the acquisition of the C-17. The two programs have many similarities, sharing the same acquisition philosophy as well as facing similar funding difficulties and adverse politics. Additionally, the YC-14 and YC-15 prototypes and the subsequent growth studies served as the starting point for designing the C-17. The AMST also bestowed upon the C-17 its tactical and small, austere airfield characteristics. Lastly, the canceled AMST provided the impetus for a radical change in airlift doctrine. Limited resources, pressing airlift requirements, evolving national security threats, and technological advances eventually drove leaders to reject the rigid segregation of tactical and strategic airlift. The merging of these two missions resulted in the C-17 gaining its dual role and outsize cargo capability. Thus, understanding the C-17 acquisition program commences with the AMST program.

**Vietnam and Mel Price's Support**

Among the findings of the Air Force's Project Forecast study of 1963-1964 were recommendations to develop a CX-Heavy Logistics Support Aircraft, which became the C-5, and a vertical-short-takeoff-and-landing (VSTOL) aircraft[1] to fill the gap between the capabilities of the C-130s and the helicopters. However, the technology required for a VSTOL aircraft was not forthcoming. The Tactical Air Command* in its congressional testimony before the House Armed Services' Subcommittee on Military Airlift in January 1970 openly acknowledged this to subcommittee Chairman Melvin Price[2] (D-IL) one of the staunchest supporters of the armed services' airlift requirements.[3] In 1965, when the Tactical Air Command last addressed Price's subcommittee, the command had defined a requirement for a VSTOL for the 1970s. (Other countries to include the Soviet Union had also sought an advantage by developing VSTOL technology.) The United States' military involvement in Southeast Asia obligated reassessing the requirement. An AMST was needed foremost to replace the war-worn C-130s.[4]

*At this time, tactical airlift resources in the United States were assigned to the Tactical Air Command.

Additionally, the Tactical Air Command was willing "to take a realistic view and admit that the C-130 and its replacement should be operated more rearward to avoid heavy enemy fire, and that aircraft of lesser cost must handle the far-forward requirement."[5] A more forward role for the Air Force's tactical airlift, however, was unlikely given the Army's sizeable inventory of frontline helicopters. Thus, the Tactical Air Command could not see developing the light intratheater transport (LIT) to replace the C-7s and C-123s, even though Air Staff analysis supported a LIT, STOL, and conventional aircraft solution as best meeting future requirements.[6] Had the Air Force persisted, the 1957 DOD directive on service roles and missions and the 1966 McConnell-Johnson Agreement on fixed and rotary wing aircraft employment would have decided the mission dispute in the Army's favor.[7]

Chairman Price and subcommittee members were very receptive to the Tactical Air Command's request for developing a turbofan STOL aircraft with greater payload and capabilities than the turboprop C-130. Originally, the basis for the request came from a USAF Tactical Airlift Center (Air Force Project Corona Harvest) review of tactical airlift operations in Vietnam, which acknowledged the obsolescence of the light transports—the C-7 and C-123—and advocated replacing the aging C-130s, essentially the A and B models worn down by wartime use. That General William W. Momyer, formerly the deputy commander for air operations and 7th Air Force commander in Vietnam, was the commanding general of the Tactical Air Command at the time was not lost upon the subcommittee as it completed its major review of military airlift. After all, General Momyer had gotten approval for the formation of the 834th Air Division to ensure the efficient management and control of airlift within Vietnam.[8] Certainly, no one was more qualified than Momyer to advise on future tactical airlift requirements.

General Momyer had been present during the tactical airlift modernization briefing to General John D. Ryan and Robert C. Seamans, Jr., the Chief of Staff and Secretary of the Air Force, respectively, and when asked for his position, he had non-concurred on the proposed VSTOL LIT course, expressing his belief in a new STOL aircraft to replace the C-130. Based upon his wartime experiences, General Momyer pragmatically informed General Ryan and Secretary Seamans that the Army would continue supplying the front lines via heavy helicopters under its air mobile concept. As a result, intratheater airlift would operate into airfields farther in the rear; a STOL with takeoff and landing performances of around 1,500 to 2,000 feet would suffice.[9] In the 1970s with larger and heavier self-propelled firepower, the Army especially desired the AMST for transporting the 8-inch and 155mm self-propelled howitzers, Vulcan air defense gun, and Chaparral guided missile system. The Army noted that the AMST would transport 23 items, which the C-130 could not. Nor was the C-130 really regarded as a STOL capable aircraft.[10]

The introduction of the C-5A strategic transporter aided the argument, as its 110-ton payload mandated a more efficient theater distribution system. A combination of C-5 and C-141 airlift enabled the rapid deployment of one Army division, an aggregated weight of approximately 30,000 tons (minus the follow-on support units). A new STOL-capable intratheater airlifter was needed to expeditiously redistribute from the main operating base to the forward areas the supplies and equipment brought in by the huge cargo-hauling C-5. A new tactical airlifter would also provide better interface with the strategic airlift system than the current fleet of C-130s, the subcommittee noted, recognizing the value of an efficient logistical support chain. The average payload of the AMST would be 14 tons while the C-130 could carry 10 tons and required a longer runway (3,500 feet). Additionally, with its wide body and STOL capabilities, a new tactical airlifter would be able to transport to the forward area 90 percent of an Army brigade's combat essential vehicles. The C-130 could only haul 55 percent of the vehicles needed.[11]

The subcommittee report further noted that while the Military Airlift Command had placed great emphasis on modernizing its strategic airlift capability by replacing the C-97s and C-124s with the more efficient C-141 and C-5 jet aircraft, "an approved program to modernize the Tactical Airlift Force appears to be nonexistent."[12] General Ryan in his testimony had been vague and somewhat reluctant to disclose modernization plans, even though there had been extensive discussions prior to the hearings. The Tactical Air Command had even written a draft required operational capability (ROC) statement for a medium STOL transport, with the vice chief of staff of the Air Force requesting comments from the overseas commanders.[13]

General Ryan may have reasoned as follows. For one, General Ryan realized modernizing tactical airlift would take funding away from other Air Force programs. He indicated this was the situation in a March 1970 message. Secondly, while the LIT program was favored, it would run into strong opposition from the DOD, as it competed with the Army's helicopter programs. In addition to its CH-47 Chinook and CH-54 Crane helicopters, the Army hoped to develop a heavy lift helicopter (HLH), capable of hauling up to 23 tons. General Ryan was well aware that Army Lieutenant General Richard G. Stilwell, then the Deputy Chief of Staff for Military Operations and formerly a major player in planning and overseeing the massive American commitment to South Vietnam, had pointedly told Price's subcommittee that the Army had no need for the V/STOL, as the Chinooks and Cranes already provided that capability. The venerable Stilwell, with a service record that included the initial Normandy landing and two Korean campaigns, spoke of the Army's concern regarding the near-term obsolescence of the small-payload carrying C-123 Provider and C-7A Caribou aircraft and support for procuring a STOL aircraft comparable to the C-8 Buffalo with a 6-ton payload. A STOL C-130 with its large cargo compartment exceeded the Army's preferences. It was clear from this testimony that the Army did not want to jeopardize the HLH program and only desired to replace not expand its STOL capability. The Army's position was not surprising in light of the recent McConnell-Johnson Agreement,[14] whereby the Army essentially got control of rotary-wing aircraft while the Air Force assumed the same for fixed-wing. The more service-acceptable STOL solution, however, meant the Air Force would concede part of the mission to the Army in the near term and would eventually have to accommodate the Army's desire to coordinate its helicopter supply operations with the C-141 and C-5 at the large, safe air bases. Additionally, the C-5's airlift capacity would be taken up transporting helicopters to the overseas combat theaters.[15]

In the end, Price's subcommittee allayed all concerns. The final report recommended the Air Force procure an off-the-shelf STOL to address the immediate replacement of the C-7 and C-123 (the Army's interest), continue the VSTOL as a research and development program (HQ USAF's desire), and develop the STOL (Tactical Air Command's request) with greater payload and operational capability than the existing C-130. Developing the STOL should receive the "highest priority" in the Air Force's fiscal year 1972 budget, the report stated.[16] The Air Force dutifully complied. Thus, through a somewhat brokered process, Congressman Mel Price got the AMST program underway.

**Required Capabilities**

Aware of the pending discussions on consolidating airlift as well as the need to coordinate Air Force airlift efforts, General Momyer shared his views on a new tactical transport with General Jack J. Catton, the Air Force's commander of strategic airlift:

> The follow-on STOL to the C-130 should have better performance in terms of takeoff and landing, high speed, ability to operate in and out of more rudimentary airstrips and a larger cargo compartment. I do not think this aircraft should be able to accommodate the Army's outsize cargo. Such cargo is primarily represented in their mechanized forces and should be brought into battle by surface means. The new STOL should be optimized for the other tactical features described in order to operate in and out of those relatively forward bases with a minimum of exposure. The size of the aircraft becomes a major consideration because of vulnerability, cramped space on the airfield and limited cargo unloading areas. All of these things plagued us in Vietnam even with C-130s when we got into a major operation.[17]

By May 1970, the Tactical Air Command had finalized a required operational capability (ROC, 52-69) statement for a medium STOL transport. The command sought a rapid self-deployment capability and an employment capability that took a 14-ton load (tracked and towed equipment) into an austere* airfield. Among the essential requirements were inflight refueling, a 2,600 nautical mile unrefueled range with a 19-ton payload, a long-range cruising speed of at least .75 Mach above 20,000 feet, and the ability to operate with a 14-ton (28,000 pound) load from a

*Then defined as semi-prepared surface.

2,000-foot-long by 60-foot-wide runway during the midpoint of a mission. The aircraft would have a cargo handling system compatible with the 463L pallet and a ground loading height of 50-57 inches. Under desirable, the ROC called for front end on/off loading in addition to the rear loading, influenced by the C-5's feature. The ROC sought a rugged aircraft capable of landing and taking off on semi-prepared surfaces under austere conditions, specifying a California Bearing Ratio (CBR) of 6* for soil conditions. Although somewhat unclear as to the type of surface conditions, the ROC sought a backing capability for forward area operations. Airdrop operations and aeromedical evacuation figured in the AMST's mission roles as well. Relying on advanced technologies, a three-person crew—pilot, copilot, and loadmaster—was planned. At this juncture, the AMST could not carry the outsized** M-60A, the Army's main battle tank. The AMST specifications served as the baseline for developing the requirement documents for the much larger C-17.

**Packard's Fly-Before-You-Buy**

The acquisition philosophy of the AMST program rested upon building demonstration airplanes or prototypes with no obligation on the government's part to proceed further. David Packard of Hewlett-Packard championed the concept while serving as the deputy secretary of defense, 1969-1971. The highly respected Packard[18] believed prototyping, which tested and evaluated competing prototypes before awarding the production contract, would hold down development costs. Packard was well aware of the cost overruns[19] of the C-5A acquisition program. The overruns had discredited the total package procurement concept, whereby a contractor was awarded the development, production, and most of the service support contracts up front, enabling an economical production rate, design discipline, cost controls, and program stability. With competition occurring only at the beginning, the winner was forced to be efficient, supposedly. The concept did not factor in the damaging consequences of an extremely low bid.[20]

Under prototyping, a contractor had to prove proficiency before the government committed to production. All of the engineering development and all of the technical uncertainties would be resolved ahead of a major production effort. This concept was commonly known as fly-before-you-buy. Packard desired less emphasis on paper studies and more on developing the hardware, as he called it. He also wanted cost-incentive contracts for major weapon systems. As part of the cost-incentive contract, an exchange would occur, whereby tradeoffs could be made during development. Packard believed many programs got into trouble in the beginning because the military service wanted the latest systems but did not apply cost tradeoffs. He desired good judgment and common sense to prevail; the people who had the

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*The California Bearing Ratio was the system used to classify landing surfaces for aircraft. Silt and clay surfaces rated as low as 3-5 while graded gravel and gravel sand mixes could range as high as 60-80.

**Outsized cargo was defined as exceeding the C-141 but fitting on a C-5.

operational experience needed to work closely with those who understood the technical and engineering aspects. Packard regarded the cost-incentive contract as also enabling cost reductions in both production and life-cycle costs, as the contractor received an award for good performance, a financial penalty for performing poorly. Although he acknowledged a role for systems analysis (touted by Secretary of Defense Robert S. McNamara, 1961-1968), he advocated getting professional military experience into the decision process. Packard believed the Office of the Secretary of Defense (OSD) was too involved in programs and had been guilty of second-guessing the military services. He reaffirmed that the services had the responsibilities for managing programs with the OSD deciding on whether a program should proceed at certain key times or milestones. As a result, Packard generally decentralized and streamlined the acquisition process, returning control to the system program offices (SPO).[21]

David Packard had a lasting legacy upon the acquisition process despite some criticisms. The AMST along with the Light Weight Fighter (LWF; later the F-16 and the F-18) were the first programs selected by the OSD for prototyping under the Packard philosophy. Likewise, the contract issued and the management approach taken for the C-17 reflected Packard's influence.

**Prototypes**

Lieutenant General James T. Stewart, the commander of the Aeronautical Systems Division, released the AMST requests for proposals at the end of January 1972. Each contractor was to provide a technology demonstrator. The Air Force would evaluate the design, technology, and military usefulness of the offers. There was no commitment to developing the prototypes further. Refraining from designing the aircraft by issuing specifications, the Air Force, instead, provided goals, such as a STOL payload of 14 tons, airdropping 80 paratroopers, and a landing gear capable of a California Bearing Ratio of 6—soil consistency of a golf course fairway. Imbued with Packard's philosophy, the Air Force sought the most for its money.[22] In similar fashion, the Air Force would provide guidance and mission performance goals for the C-17 but refrained from designing the aircraft. Those more familiar with the C-17 program can also discern the antecedents of the later CBR/semi-prepared runway controversy.

AMST proposals came from Boeing, McDonnell Douglas, Fairchild, and Bell as well as a joint offer from Lockheed Martin-North American Rockwell. The Air Force completed source selection evaluations by the beginning of July. On 10 November 1972, after receiving OSD approval, Secretary of the Air Force Seamans authorized awarding the Boeing Company and the McDonnell Douglas Corporation contracts, each to build two AMST prototypes. A STOL version of the Lockheed C-130 Hercules, the de Havilland C-8 Buffalo, and an improved Fairchild C-123 Provider lost out in the competition. The Air Force planned for a first flight 35 months after contract award. Initially, the contracts provided Boeing and McDonnell with $96.2 and $86.1 million, respectively. The contractors were to keep their designs to a unit cost goal of $5 million (FY72 dollars).[23] If all went well, the Tactical Air Command would receive its first AMSTs and declare an initial operating capability (IOC) in the mid-1970s.[24] This soon proved optimistic. By mid-1974, the command planned on achieving IOC in 1980.[25]

**Funding, Congress, Politics**

From inception, not unlike the C-17 program, securing funding and support remained a problem. Both Boeing and McDonnell Douglas put their own money into the program, believing the commercial airlines and foreign countries would purchase the aircraft as well. Prospects of foreign military sales to Iran and Saudi Arabia existed. For the first two years, the program received $6 million (FY 1972) and $25 million (FY 1973), but then in December 1973, the House Appropriations Committee decreased the authorization for fiscal year 1974 from $65 to $25 million. The committee, chaired by George H. Mahon (D-TX), was not convinced that the AMST was necessary and stated a modified C-130 could serve the long-term tactical airlift requirements.[26] Politics factored in as well. Losing out in the AMST competition and with no C-130s in the Air Force's budget, Lockheed had sought congressional support.[27] Lockheed's Aeronautics Company was located at Fort Worth, Texas.

This congressional action thoroughly disrupted the AMST program and left the Air Force in an awkward situation. The Air Force had to come up with a legally acceptable solution per its contract obligations as well as satisfy Congress. The Air Force debated whether to proceed with two contractors but knew that it could not terminate one without jeopardizing the prototyping effort and facing criticism for its program management. There were also cost considerations. After much discussion, Secretary of the Air Force John L. McLucas personally decided to continue with the two contractors. A restructuring of the program in March 1974 reduced the funding request for fiscal year 1975, stretched out the program, and increased the prototype development costs from $182.3 to $229.1 million.[28]

There was also pressure to make the AMST a civil-military airplane. Senate Armed Services Committee member Lloyd Bentsen (D-TX) had impressed upon William P. Clements, Jr., the Deputy Secretary of Defense, that the AMST also needed to be commercially marketable or he would withhold his key support. So prompted, Clements sent a memorandum to Secretary McLucas in June 1973. Although the Air Force had in congressional testimony talked of the AMST's commercial application, Secretary Clements wanted to ensure it and requested that both contractors be so informed.[29]

Clements' memo further disclosed service politics when he also directed Secretary McLucas to seek the concurrence of the Army and the Navy on the AMST's configuration, especially the size of the cargo compartment. The Army's AMST project officer at the Air Staff had tried a number of times to limit the cross-section of the AMST to that of the C-130's and C-141's and to reduce the landing/takeoff goals and flotation capability. Simply, the Army desired to protect its heavy-lift helicopter from the AMST.[30] A year earlier, General Momyer had drawn the same conclusion.

> We are fighting a constant battle for the M [Medium] STOL with one obstacle after another cropping up. The last one is the Army contention that a 2,000' field isn't necessary. Such absurdity is almost incomprehensible to a reasonably intelligent person. At one time they argued 2,000' for T/O [takeoff] and landing wasn't good enough since VTOL was required. Now, according to the zealots, 3,000' or better is adequate. It is obvious what is going on—freeze Air Force out of the theater airlift and handle with a direct interface between the heavy lift helicopter and the C-5. The MSTOL is a real threat to the future of the heavy lift helicopter hence the challenge on any grounds.[31]

Amongst the competing service and congressional interests, major command responsibilities for tactical airlift changed. As an outgrowth of the Vietnam experience, the Air Force's Military Airlift Command assumed all tactical airlift assets by 1975. This included the AMST acquisition program from the Tactical Air Command. Prior to this, the Military Airlift Command's primary focus was on strategic airlift, although the command also had the air weather, air rescue, and aeromedical evacuation missions. With the consolidation of strategic and tactical airlift, the Military Airlift Command became the "single manager" for airlift activities within the Department of Defense.

Specifically, when the Military Airlift Command took over the AMST program, the command published in December 1975 a revised required operational capability document (MAC ROC 9-75). Changing the box size to 11.7 by 11.3 by 47 feet (WxHxL) in a cost reduction effort, the Military Airlift Command was mindful that Congress and the OSD would favor the C-130 if it did not improve costs. While the aircraft could still accommodate all of the Army's key equipment, the change in the compartment's length affected palletized cargo hauling capabilities. Other key revisions by the cost-conscious Military Airlift Command reduced the long range cruising speed to .68 Mach at 30,000 feet and above; changed the STOL payload from 28,000 pounds (500 nautical mile combat radius) to 27,000 pounds (400 nautical miles); and increased the conventional theater payload from 58,000 pounds to 62,000 pounds (1,000 nautical miles), which accommodated the weight growth of the self-propelled howitzer. The command desired that the AMST transport a meaningful payload to the theater without relying on limited air refueling resources.[32] As a result, the two contractors evaluated pylon tanks, longer wings, and more powerful engines to meet the basic 2,600-nautical-mile, 19-ton self-deployment mission. Originally, the prototype contracts had primarily asked the contractors to investigate and demonstrate STOL technology and did not specifically request a deployment payload.[33]

## Flight Testing

The first prototype, McDonnell Douglas' YC-15, flew on 26 August 1975; Boeing's YC-14 did so on 9 August 1976. (As a Cold War aside, the Soviet's Antonov AN-72 STOL made its first flight on 31 August 1977.)[34] McDonnell fielded its prototype sooner, taking a "cut and paste" approach by drawing in particular upon its DC-10 aircraft, especially the cockpit. Along with a more conventional look, McDonnell had also selected more appropriate technology. Boeing, on the other hand, took its YC-14 through seven separate design refinements. Boeing's decision to refine its design resulted in a longer wing configuration, which gave the YC-14 a medium-range STOL capability as well as the longer range desired by the Military Airlift Command. The Air Force had allowed the two contractors to establish their own development and first flight schedules. McDonnell Douglas officials adopted an accelerated schedule while Boeing elected to work on their design. With prospects of foreign sales, Boeing was also willing to put in more of its own money. At the time of flight testing, the AMST production program for 277 aircraft was estimated at $5.48 billion, a unit cost of $19.8 million per airplane. Inflation was the main culprit for the increase.[35]

Because of the funding situation, the contractors initially built the prototypes as technology demonstrators and not for mission requirements—specifically to confirm two different powered-lift techniques, namely upper surface blowing for Boeing's YC-14 and the externally blown flaps for McDonnell's YC-15. The externally blown flaps were comprised of large double slatted titanium trailing edge flaps lowered into the exhaust of the YC-15's four Pratt and Whitney turbofan engines. By placing the engines forward of the wing leading edge, the exhaust skimmed the under surface of the wings. A stability control and augmentation system assisted the pilot during STOL operations. Boeing went with a less conventional design. Two large General Electric engines mounted on the top of the wings and a propulsive lift concept of upper surface blowing enabled operations into and out of a 2,000-foot unimproved airfield. Some other lift characteristics were taken from Boeing's 747. The YC-14 went with a highly advanced flight control system to counter the engine out problems at slow airspeeds.[36] In contrast, "the YC-15 demonstrated the ability to cope with actual fuel cut engine shutdowns on steep approach at 80 knots with the stability augmentation system on or off."[37]

AMST flight testing, comprised of a combined developmental test and evaluation and a limited initial operational test and evaluation, concluded in August 1977 when Boeing completed testing. McDonnell had finished its program a year earlier. During flight testing, the prototypes exceeded their performance specification goals. As designed, McDonnell Douglas' YC-15 demonstrated its ability to land on a 2,100-foot runway with no special requirements. The YC-15 flew cross-country, verified ground loading of Army equipment, performed aerial refuelings as a receiver and proximity tests as a tanker, and conducted heavy equipment airdrops, including low-altitude parachute extraction system (LAPES). Testing also included airflow measurements of the cargo ramp and the troop door (YC-14 as well). In May 1976, the YC-15 was flown to England (in-flight refueling), conducting demonstration flights at the Farnborough Air Show, selected bases in Europe, and on returning to the United States. During its yearlong flight testing, the YC-15 made 292 flights, amassing 553.4 hours. Additionally in 1977, McDonnell Douglas tested a new wing to extend the YC-15's range, a control stick (replacing a control wheel), and two different engines including a high by-pass turbofan engine capable of 22,000 pounds of thrust, an increase of 4,000 pounds per engine. Boeing's two jet engines provided 50,000 pounds of thrust each.[38]

Beginning its test program a year later, Boeing adapted more to evolving requirements. Testing Boeing's YC-14 included: load testing howitzers and the AN-1G attack helicopter, heavy equipment airdrops up to 20,000 pounds, STOL landings that exceeded the requirements, a maximum gross take off weight of 213,000 pounds, ground loading the Army's M60A main battle tank (109,000 pounds), semi-prepared soft field runways with a combat offload of a 10,000-pound pallet, and aerial refuelings. The YC-14 with a gross weight of 160,000 pounds achieved a STOL stopping distance of just over 800 feet using thrust reversers at reverse idle. With the same weight applying only the thrust reversers, the aircraft realized a stopping distance of 1,500 feet. Additionally, both the YC-14 and YC-15 performed STOL approaches with a glide slope of nearly six degrees with little or no flare used prior to landing. The landing configuration enabled sink rates of between five and eleven feet per second. Boeing had benefited from McDonnell Douglas' efforts in this area.[39]

At the conclusion of the AMST test program in 1977, the commander of the Air Force Test and Evaluation Command, Major General Howard W. Leaf, expressed his satisfaction with both the YC-15 and YC-14 prototypes. The Air Force Systems Command initiated the source selection process in September 1977, intending to award the production contract in April 1978.[40] But events had already begun to overtake and then reshape the program.

**Shortfall in Strategic Airlift**

Within a year of the prototype source selection award, the Israeli-Arab Yom Kippur War of 1973 disclosed a need for the United States to possess a viable response capability for the Middle East. For its part, the Military Airlift Command, using its C-5 and C-141 aircraft, rushed supplies, ammunition, and equipment to Israel. Hampered by the vast distances (on average 6,450 miles one way), unavailability of en route facilities, and lack of an air refueling capability, the crisis pressed US strategic airlift resources despite their good showing against Soviet airlift aircraft. And although the first naval ship brought in more outsize cargo than had been transported by air nineteen days beforehand, it arrived after the end of the war, dramatically demonstrating the importance of strategic airlift.[41]

In the aftermath, a series of studies in the mid-1970s documented a need for more strategic airlift. Although there were initiatives to increase the strategic airlift capability, war plans still disclosed a shortage.[42] The military's ability to "get there in time" began to dominate thinking, giving rise to what became known as the National Strategic Mobility Dilemma. Given the documented need for more strategic airlift coupled with the recent events in the Middle East and Congress' and OSD's growing viewpoint that a C-130 might do just as well for less money, it was not surprising that the Military Airlift Command, when it published in December 1975 a revised required operational capability (MAC ROC 9-75) for the AMST, broadened the mission of tactical airlift: "The AMST will augment the strategic airlift forces during the initial stages of an international crisis."[43] Further, "The best use of the AMST in augmenting strategic airlift is when full advantage is taken of the AMST's wide-bodied characteristic in conjunction with the cargo-carrying capabilities of the strategic airlift forces."[44]

Moreover, both MAC ROC 9-75 and the subsequent employment concept document for the AMST stated tactical airlift would airland supplies as well as airland/airdrop combat units over "extended distances," specifically to or between theaters of operations. MAC ROC 9-75 also spoke of providing "direct insertion," the seeds of the C-17's direct delivery capability.[45] A Headquarters USAF (Studies and Analysis) study had even concluded that tactical C-130E/H and AMST aircraft could augment the strategic airlift force until hostilities broke out during a North Atlantic Treaty Organization (NATO) contingency. Using tactical assets in the strategic role reduced the procurement of that amount of strategic airlift.[46] Military officials were keen on improving deployment closure times.

**Erosion and Competition**

Politics also persisted. In January 1976, General Paul K. Carlton, Military Airlift Command Commander, penned to his deputy chief of staff for operations: "We and the Army better defend the AMST Requirement better than we have or this [C-130] is what we will get! Comment."[47] Brigadier General Charles C. Irions' staff replied that the Air Staff and the command continued to challenge Lockheed's attempts at the OSD and congressional level to offer a modified C-130. Of Lockheed's military transport line, only the C-130 was still in production, and then mostly for foreign sales. The Air Force had not included the C-130 in its budget requests after 1973, and Lockheed had secured its production line by getting C-130s added to the military appropriations bill.[48] As to the Army's lagging support, Carlton was told the Air Force had pushed hard in the 1970s for the Army's support of a new light intratheater transport and, after having secured the Army's support, dropped the LIT in favor of the AMST. The C-5 program had also created some unfavorable impressions. Additionally, the Army's heavy lift helicopter and the AMST had similar, hence competing, intratheater roles.[49]

In March, General Carlton sent Air Force Chief of Staff General David C. Jones letters to pass on to key Army commanders. Of concern was the Army's input to the decision coordinating paper for the Defense System Acquisition Review Council Milestone II decision scheduled for September 1977. Before the council was the decision to begin the full-scale development of the AMST or cancel the program. The Army, however, was undertaking a review of its tactical airlift requirements, and until the results were published, senior Army leaders provided no voice of support.[50] The best Carlton could do was a statement from Vice Chief of Staff of the Army General Walter T. Kerwin, Jr., who told the House Armed Services Committee in May that the Army "very badly needed the capability."[51]

And there was erosion. In November 1975, the Research and Development Subcommittee of the House Armed Services Committee had conducted hearings on the state of military airlift. The subcommittee's report (released in April 1976) revealed the AMST was no longer the sole replacement for the C-130; Chairman Price had compromised. "Lockheed provided an analysis of C-130 and AMST fuel comparisons. The analysis shows that for a typical 400 nautical-mile-radius, tactical airlift mission use of the C-130 provides fuel savings of about 250 million gallons a year and, at 42 cents per gallon, cost savings of over $100 million." Now a mixture of AMST's and C-130's were regarded as the "best bargain."[52] In light of the Arab oil embargo against the United States and other nations for supporting Israel and the United States' dependence on foreign oil, Lockheed had a powerful argument. Thus, precedent was set with the AMST that Lockheed would repeatedly challenge first McDonnell Douglas and then later Boeing over the C-17 as well. Retrospectively, it was simply a matter of "business is business and companies are in business to make money."[53]

Additionally, in March 1976, the Senate Armed Services' Research and Development Subcommittee provided the Military Airlift Command little support for the AMST and its other enhancement initiatives. Acting chairman Patrick J. Leahy (D-VT) indicated that the Air Force had not properly justified the AMST and recommended against funding full-scale engineering development. Moreover, "it would seem essential that the principal user [the Army] of an aircraft should have a major role in determining if a requirement existed and if so what requirement."[54]

While Lockheed's end run at the AMST could be faulted for the erosion, the AMST competed against other airlift modernization/modification programs and had to accommodate evolving national security requirements. The Israeli Airlift during the Yom Kippur War had highlighted a need for air refueling capabilities and for more strategic airlift to transport outsize loads of tanks and helicopters rapidly. The Military Airlift Command sought funding for an advanced tanker cargo aircraft (ATCA), what became the KC-10. The command also required funding for stretching and adding an air refueling capability to the C-141, fixing the C-5's wings, and procuring a C-XX* strategic airlift replacement aircraft (civil-military).

*The C-XX became known as the advanced civil-military aircraft (ACMA) and should not be confused with the C-X/C-17.

On the latter, General Carlton was especially proud of his several-year effort, believing the C-XX would increase the national airlift capability by two and one-half times. The commercial industry, however, embraced the C-XX in a lukewarm fashion.[55] Carlton and his successor, General William G. Moore, also devoted much energy to an enhancement program for civilian carriers in the Civil Reserve Air Fleet, thereby gaining additional oversize cargo capacity. Congressional support had to be worked. P. K. Carlton laid out his need in the House to Mel Price and in the Senate to Georgia-born, Sam Nunn (D-GA), member of the influential Senate Armed Services Committee and champion of Lockheed's interests.[56] Thus, the inherited AMST was one of many programs advocated by the Military Airlift Command.

**An Outsize AMST**

In March 1976, the Air Staff queried the Air Force Systems Command and Military Airlift Command:

> Could non-STOL derivatives of one or both of the AMST prototype designs be developed to meet the following intertheater airlift missions? (1) Transport without refueling any single type of equipment presently carried by the C-5 over the current unrefueled C-5 range at maximum payload. (2) Transport on a routine basis an M-60 tank weighing 111,000 lbs over the following unrefueled ranges: (A) 4000 NM, (B) 3000 NM, (C) 2000 NM.[57]

As a result, the Aeronautical Systems Division studied the matter and concluded that a strategic derivative of the current AMST prototypes was not viable due to insufficient cargo box size and range performance. A strategic derivative of a redesigned AMST was feasible provided a larger cargo box, new wings, and more powerful engines were incorporated. The Military Airlift Command did not favor growing the AMST to carry more of the Army's outsize equipment "unless it can be assured that these changes will neither degrade AMST STOL capability nor jeopardize the program's completion."[58]

The Military Airlift Command remained keen on maximizing the AMST and pushed its strategic airlift augmentation concept. Boeing and McDonnell Douglas had already redirected their efforts to this end, testing and conducting paper studies. In early April 1977, the command's vice commander, Lieutenant General John F. Gonge, informed Lieutenant General Alton D. Slay, Air Force Research and Development, that "to avoid degrading the acknowledged strategic shortfall, the AMST must be able to transport a meaningful self-support payload to the theater of operations, even though it would have to island hop."[59] This was the reason for revising the minimum essential mission requirements stipulated in the 1970 ROC. The command would not accept less. Moreover, emerging Army concepts called for larger equipment, faster deployments, and more mobility within the theater. A compromised AMST program offering a less than operationally capable aircraft should not be presented as an option, General Gonge advised.[60] Thus, it was not surprising two weeks later when the AMST Configuration Steering Group, which included representatives from the Air Force, Army and Marine Corps and was chaired by Lieutenant General Slay, decided on a longer wing to increase range and on the capability to transport the Army's main battle tank.[61]

In August 1977, the Army finally released its eighteen-month study of tactical airlift requirements. The main conclusion was already known. A tank-carrying AMST offered the Army the "most flexible and efficient tactical airlift system."[62] While the study found the C-130H/IV satisfactory for moving bulk supplies and light units, it "lacked sufficient box size to transport the Army's primary combat vehicles, i.e., main battle tank (MBT) mechanized infantry combat vehicle, self-propelled artillery, division air defense gun (DIVAD Gun), and numerous combat service support (CSS) vehicles."[63] In the 1950s when the C-130 was designed, the Army had more infantry than mechanized or armored divisions. Over twenty years later, the situation was reversed, and the C-130H could only transport between 35 and 55 percent of a mechanized or armored division's combat vehicles. The C-5 provided the Army limited capability, as it lacked airdrop and STOL capabilities, possessed a small fleet size, and was primary a strategic airlifter. Assistant Secretary of the Army for Research, Development and Acquisition, Percy A. Pierre, issued a recommendation in November 1977 that the Air Force proceed with the full-scale development of an outsize capable AMST.[64]

Although not directly stated in the study, the Army hoped to overcome its disappointment with the C-5 by recommending a wide-body AMST. The Army had especially looked forward to the C-5 and openly expressed its expectations. The Army had based its equipment transportation plans around the C-5. Aside from some weight distribution problems with a few pieces of equipment, the C-5 could transport virtually all of the Army's divisional equipment. A rapid response to a Warsaw Pact conflict was paramount in the Army's strategy and hinged on the C-5 and the C-141. Contrary to high hopes, the Army had a C-5 with crippled wings, an oversold austere airfield, and an unproven airdrop capability (suspended during testing). With Secretary of the Air Force Thomas C. Reed just concurring on a new wing box in August 1976, uncertainty overshadowed the C-5 fleet for wartime operations. Moreover, the Army—the primary user—had essentially been left out of the process that had resized the C-5 fleet from 120 to 81 aircraft. Instead OSD systems analysts prevailed with only Secretary of the Army Stanley R. Resor providing comments on the decision. In the mid 1960s, the Army's mobility plans had called for using 96 C-5s, all available C-141s, and 30 fast deployment logistics ships. Congress, however, cancelled the fast ship program.[65] Thus, a wide-body, tank-carrying AMST partially addressed the Army's lift dilemma. The Army soon found, however, that it had thrown its full support to a program on its way out.

Senator William Proxmire, Chairman of the Subcommittee on Priorities and Economy in Government, signaled the state of affairs for the AMST. In hearings on strategic mobility at the end of December 1977, Proxmire chided former Secretary of Defense James Schlesinger's decision to spend billions on airlift as "a hodgepodge of uncoordinated, noncost-effective activities" that had produced a "funny-looking flock of birds."[66] Proximre wanted to know from his first two witnesses—John P. White and Lieutenant General Arthur J. Gregg—how the airlift modernization proposals, first made in 1974, could now be justified.

Spanning a two-year period, the Proxmire hearings revealed preparing for a NATO-Warsaw Pact conflict in Europe remained uppermost with a Middle East response requiring less than full mobilization. This was in keeping with the national security strategy of being prepared to fight one and one-half wars—simultaneously one major and one minor contingency. The DOD possessed in 1977 the capability to airlift 190,000 tons of cargo in a 30-day period and sought through initiatives to increase this to 370,000 tons. However, based upon the DOD's estimates of a significant growth in Soviet conventional forces, this increase still fell short of meeting military requirements for Europe. Lieutenant General Gregg, Director for Logistics on the Joint Chiefs of Staff, impressed upon Senator Proxmire that the military desired an aircraft that would offer some enhanced capability over the C-130. Specifically, Gregg stressed the need for a shorter takeoff and landing capability and the means to move all of the Army's current equipment. In Gregg's view, the AMST was ideal. Proxmire asked if it were not more cost effective and practical to use ground transportation in Europe as the critics suggested. Gregg responded that the AMST provided commanders what they wanted: rapid relocation of combat units.[67] During his testimony, General Alexander M. Haig Jr., Commander-in-Chief U. S. European Command, also foresaw the importance of a wide-body STOL aircraft in a global setting.[68] Military preparedness, however, was costly, and Americans in the fall of 1976 had elected James Earl Carter, who was inclined to decrease military spending.

**Carter Cancels**

The change in Presidents left the AMST unsupported. In his memoirs, President Jimmy Carter remarked that his inaugural speech foretold his desire to instill the American people with limits. In the area of defense practices, President Carter knew what he wanted to achieve: "I was determined to eliminate as much waste in defense spending as possible, to establish proper long-range priorities in the acquisition of highly technical new weapon systems, and to institute efficient management procedures in the Pentagon."[69] He sought both an accomplished scientist and a savvy business manager for the "internecine" service politics. Carter characterized selecting a secretary of defense as one of his most important appointments, and he chose Harold Brown, a physicist with the California Institute of Technology. Carter asked Charles Duncan, a former president of Coca-Cola, to be Brown's deputy.

Late in December 1977, President Carter withdrew funding for the costly AMST in the fiscal year 1978 budget; it halted source selection[70] and placed the program on hold. Support from key members of Congress, however, provided $5 million for source selection in the 1979 DOD Appropriation Bill, to which Carter consented. But a year later the program was no more. Unit costs had doubled from the original $5 million and were expected to double again due to continuing inflation.[71] As directed, the Air Force Systems Command halted source selection in January 1978; cancellation of the program followed on 10 December 1979.[72] Besides the affordability issue of a $9 billion program, Secretary Brown rationalized that in a European conflict, rail and road transportation systems would compete favorably with the speed and responsiveness offered by a STOL tactical airlift system. He also judged the current Air Force and Navy tactical airlift resources along with the available short-range civil aircraft as sufficient for a global war. Thus, there was no immediate need to purchase additional tactical aircraft.[73]

Before the December 1979 cancellation, proponents continued to work for the AMST. Amongst this background, the C-17 program emerged. The Army's senior leadership was especially vocal in championing the AMST. They realized the only other aircraft available for outsize equipment was the C-5, and it could not operate into forward small, austere airfields. Moreover, it was already heavily tasked in deployment plans. Army Chief of Staff General Bernard W. Rogers told the Senate Armed Services Committee that the C-130 could not carry the XM-1 tank, proposed infantry equipment, and other self-propelled vehicles. The "AMST is needed and the STOL capability in particular is needed to get the equipment where we need it."[74]

As to the Air Force's efforts, the commanding officer of the Military Airlift Command, General Moore, politely disagreed in his quarterly report to Defense Secretary Brown with Carter's decision to cancel the AMST. The previous quarter, Moore's statement that the AMST was the replacement for the C-130 had elicited this reply from Brown: "What about new C-130H instead?"[75] Air Force leaders before the House Budget Committee in March 1979 expressed concern over the ability to support forces or rapidly redeploy them within a theater. Air Force Secretary John C. Stetson and Chief of Staff General Lew Allen stated it was "essential to identify and produce a new wide-body tactical airlift aircraft to replace the C-130 and to keep pace with Army requirements."[76]

In September 1979, as the situation deteriorated, Army Chief of Staff General Edward C. Meyer threw in his personal endorsement of the AMST. Meyer remained adamant about retaining the tactical focus of the AMST, although he acknowledged an enhanced strategic capability made the AMST more attractive.[77] In effect, the Army and Air Force were taking their case before Congress, as Secretary Brown had already told Congress in February 1978 that the Carter administration had decided to cancel further development of the AMST and would seek a more cost-effective program.[78]

## Dual Role

As the final months unfolded, it was obvious that the AMST had to be more and more a strategic airlifter with just some tactical capabilities. A shift in airlift doctrine was underway. While there was a sincere attempt to define what kind of airlifter was really needed for wartime requirements, politics and subjective views influenced the process as well. In March 1979, Headquarters USAF issued a program management directive on the "Advanced Medium STOL Transport (AMST) Transition Program." This directive tasked the Air Force Systems Command and the Military Airlift Command to come up with range and payload combinations that would add a strategic airlift capability desired by DOD officials. The joint service AMST Configuration Steering Group met to work the issue. Taking into consideration Army brigade and division movement and closure time requirements, minimum strategic design points were established: the ability to airlift 74,000 pounds of cargo for 2,600 nautical miles, 90,000 pounds for 2,000 miles, or 120,000 pounds for 1,300 miles. The 82d Airborne commander received assurances that airdrop operations would remain unaffected. The Marine Corps reiterated its interests in a tanker/cargo version of a strategically enhanced AMST.[79]

In the spring of 1979, the Air Staff released a study, which advocated a "swing" concept for the AMST.[80] While the Military Airlift Command staff believed the AMST was capable of swinging between tactical and strategic airlift roles, the staff objected to the study's force structure and flying hour reductions and continued to favor the strategic augmentation role. One staffer disclosed the real concern: "The 'swing' concept proposes an aircraft that will 'do all,' and raises a question about the need for future airlift modernization. The C-5 wing modification and C-141 stretch program may be affected, but most certainly the C-XX program will be threatened by 'strategic' AMSTs."[81]

Clearly, support was building within the upper levels of the OSD staff for a new aircraft. After a September briefing, Deborah P. Christie, OSD Director of Mobility Forces Division, previously a nonsupporter of the AMST, found the new strategic capabilities attractive.[82] General Robert E. Huyser, the new Commander-in-Chief at the Military Airlift Command, sensed the moment. To General Alton Slay, now Commander of Air Force Systems Command, he expressed:

> Al, I have followed your exchange of letters with the Chief on the AMST. I have had discussions with Dave Jones and Hans Mark and believe the time is right to move on this program. The desire seems to be to have an aircraft with STOL capability and that will enhance the strategic lift end. I have gone over data from both companies—Boeing and McDonnell Douglas—if what they are putting out is correct, we can have such an aircraft without starting back at ground zero. They say they have what they need from the YC-14 and 15. I believe state-of-the-art technology has us at a

> point where we shouldn't define such an aircraft as tactical or strategic—we just discuss it as an airlifter capable of dual role.[83]

By the end of October 1979, the matter was over; Defense Secretary Harold Brown had decided to improve the strategic airlift capability. He had met with Air Force Chief of Staff Lew Allen and advised him to cease associated activities on the AMST program and proceed with the C-X program, emphasizing strategic airlift as the primary mission, an outsize cargo capability, and a fiscal year 1987 initial operational date.[84] The Soviet invasion of Afghanistan two months later and events in Iran confirmed the course. The United States required a more rapid global response capability. Thus, over a four-year period, the shortfall in strategic mobility reinforced by world events altered the whole basis for justifying the AMST program. From these efforts to recast the AMST for a dual strategic-tactical role with an outsize cargo capacity the C-17 Globemaster III benefited. The C-17 owes much to the AMST.

# PART II

## THE C-17 AMIDST POLITICS AND NATIONAL DEFENSE

# II

## GENESIS-Laying the C-X Foundation
### 1979-1980

The C-X (Cargo Transport Aircraft-Experimental) program arose from high-level discussions by Department of Defense (DOD) and Air Force staffs on expanding the role of the AMST to include strategic capabilities. Although from inception the intent was for the C-X to perform both strategic and tactical missions, DOD and Air Force officials placed the tactical or intratheater capability in a secondary role. And in his report to Congress on the fiscal year 1981 budget, Defense Secretary Harold Brown pointedly stated: "The aircraft will be optimized for inter-theater, not intra-theater missions."[85] A staff officer at Headquarters Military Airlift Command revealed the prevailing climate: the "Office of the Secretary of Defense and Office of Military Budget have created a stampede toward a strategic airlift aircraft to support the Rapid Deployment Force [RDF] and the Secretary of the Air Force and Chief of Staff of the Air Force have acquiesced in it."[86] The future Chief of Staff of the Air Force, General Charles A. Gabriel (1982-1986), was equally adamant about shoring up the strategic airlift shortfall, another former Pentagon staffer recalled.[87]

At this time, the national security strategy contained a statement advocating more long-range airlift. Strategic airlift was crucial at the onset of military operations, although overall sealift hauled the vast majority of the equipment overseas with airlift transporting a mere fraction of the requirement. Countering an attack by Soviet-led Warsaw Pact forces remained paramount even though the 1973 Yom Kippur War had also disclosed the need for a rapid global response capability. Projected transportation requirements for reinforcing the North Atlantic Treaty Organization (NATO) were based upon a congressionally directed *Strategic Mobility Requirements and Programs Study* (SMRP 82). Conducted by the joint chiefs of staff in 1977, the study defined a need to move some 693,000 tons of cargo by the 20th day of a NATO deployment. Based upon the Defense Department's Consolidated Guidance for fiscal year 1979, SMRP 83 documented a requirement for even more long-range airlift.[88] Yet, the Air Force in its *Airlift Modernization: A Different Approach* openly acknowledged the difficulties: "Our failure to get broad agreement as to what the mobility requirement is and how best to satisfy it has caused the traditional advocacy process for airlift modernization to be ineffective."[89] Moreover, with regard to other non-NATO contingencies, well-defined force packages for airlift were lacking. Revised intelligence forecasts, which significantly reduced the warning time for a major NATO-Warsaw Pact conflict, drove the urgency. "Reinforce Europe with ten divisions in ten days" that was what the DOD, Army, and Air Force wanted.[90] The Office of the Secretary of Defense had reported to

Congress that Warsaw Pact forces in Europe outnumbered NATO's by ratios of some 925,000 ground forces to 777,000, 16,000 tanks to 6,000, and 3,000 aircraft to 2,000, and the Soviets were upgrading almost every major weapon category.[91] A command post mobilization exercise, Nifty Nugget, in October 1978, which factored in actual crews assigned and stock levels of spare parts, roundly revealed that airlift assets were inadequate for reinforcing NATO and other simultaneous taskings.[92]

The outnumbering, reduced warning time, and unpreparedness set in motion a host of service initiatives to overcome the deficiencies, and Congress was receptive. More long-range oversize and outsize airlift capability was readily seen as a hedge against the reduced warning time. Theater airlift requirements receded to the background as military and government officials focused their attention on the immediate issue at hand. World events, however, would alter the national security strategy. After the overthrow of the Shah of Iran and the Soviet invasion of Afghanistan, which placed Soviet ground forces within reach of Iran and the Persian Gulf oil fields, the Carter administration began to look beyond the preoccupation with a European-based NATO-Warsaw Pact conflict and its heavy reliance on prepositioned equipment. To ensure the United States' national interests, the military needed the means to project a Rapid Deployment Force anywhere in the world, and a responsive and global-reaching airlift capability would be an essential element. As it came to pass, the new strategic airlifter would enable a rapid response to either Europe or the Middle East, and if need be to the Far East as well.

**Implementing**

Following Air Force Chief of Staff General Lew Allen's session with Defense Secretary Harold Brown, wherein Brown directed canceling the AMST and establishing a C-X program, general officers from the Air Staff, Air Force Systems Command, Military Airlift Command, and Aeronautical Systems Division met in early November to discuss the failures of the AMST program and develop actions for initiating the C-X. As a result, the Air Force established a joint service C-X Task Force on 30 November 1979 to define the requirements for a new transport. An Air Force general, Major General Emil N. Block Jr. headed the group. Organizationally, the task force was under the Air Force Deputy Chief of Staff for Research, Development, and Acquisition, Lieutenant General Kelly H. Burke. Colonel Vincent C. Hughes led efforts on concept development and documentation while Colonel Jerry P. Harmon's team analyzed the requirements. Lieutenant Colonel Bartels spoke for Marine Corps' interests. Colonel Montgomery and Lieutenant Colonel Craig H. Mandeville represented the Army, and an Army Task Force funneled information up to Montgomery and Mandeville. At the general officer level, Block's service counterparts were Major Generals George W. Smith and Fred K. Mahaffey, Marine Corps and Army, respectively. Both served as the director for requirements under their respective deputy chief of staff for operations and plans. Major General Smith was versed in infantry and armored operations and had served overseas in the Pacific, commanding a Marine battalion in Vietnam. Trained in infantry to include the ranger and airborne schools, General Mahaffey had completed two combat tours in Vietnam and had served as a brigade commander with the 101st Airborne Division. He knew the needs of the Army.[93]

Overall, the expertise and orientation of the twenty-member[94] C-X Task Force boded well for the program. Prior to heading up the C-X Task Force, Major General Block had served as the chief of staff at Headquarters Military Airlift Command. Experienced in the world of acquisition, General Block had twice worked on the B-1 program at Headquarters Air Force. He had earned master's degrees in instrumentation engineering, aeronautical and astronautical engineering, and business administration. He had spent four years at Wright-Patterson Air Force Base, Ohio, with the Air Force Systems Command's Aeronautical Systems Division. His first flying assignment was piloting a Douglas C-124, and he later served as the vice commander of the 63d Military Airlift Wing and as the commander of the 438th Military Airlift Wing. Both units flew the Lockheed C-141. During Vietnam, he had piloted EC-47s, another Douglas aircraft. Block possessed a lot of savvy and was widely acknowledged as extremely intelligent. But his bearing was gruff, which generally detracted from the initial C-X efforts and the need to solidify support within the DOD community.[95] It was the program's first encounter with personal dynamics that would be so crucial to its ultimate success.

Air Force C-X Task Force members came from the Air Force, Military Airlift Command, and Air Force Systems Command. They had had strategic or tactical airlift assignments. Most were pilots. Five were C-130 pilots with the combat experience of Vietnam behind them; all except one had been working the AMST program at Headquarters Military Airlift Command. When the AMST program ended, they were simply switched over to the C-X program and went to the Pentagon.[96] A logical reassignment at the time, but in hindsight, these members did much to ensure the C-17 had true tactical capabilities. Two others with C-5 and C-141 backgrounds provided strategic airlift expertise. There was also a helicopter pilot among the group. Besides flying and operational experiences, five other team members offered logistical, financial, public affairs, engineering, and acquisition program management guidance.[97]

The C-X Task Force faced one big challenge: put together the necessary documents and analysis within the space of five months. The program's initial milestones called for issuing the request for proposal to industry on 15 April 1980 and approving the full-scale engineering development on 1 December. Assignment to the task force was full time, and this proved a wise decision. Colonel Hughes' concept and documentation team tackled developing and writing the program management directive (PMD), request for proposal (RFP), mission element need statement (MENS), advocacy package, operation and employment concept, and selection strategy. Hughes' group also responded to congressional requests and performed the necessary funding functions, namely serving as the program element monitor. Colonel Harmon's team did the requirements analysis: range, en route, small airfield operations, offloading, air refueling, current forces capabilities, and the bed down or aircraft basing plan. Lieutenant Colonel Mandeville coordinated Rapid Deployment Force, airdrop, and tank weight issues.[98]

C-X Task Force members were guided by the Defense Department's acquisition directives and regulations. The system acquisition process allowed the secretary of defense to periodically review both the requirement and the progress of the program. Due to the subsequent changes and to provide a general understanding, the acquisition process at the inception of the C-X was as follows. Normally, an acquisition program progressed through four phases—concept exploration, demonstration and validation, full-scale engineering development, and production and deployment—with the secretary of defense or secretary of the air force granting approval to proceed, change course, or terminate as necessary at each milestone. Milestone O initiated the program, Milestone I selected one or more systems for demonstration and validation, Milestone II began the full-scale engineering development effort to include necessary testing, and Milestone III provided approval for the ability to deploy, committing the program to full production. Classified as a major weapon system acquisition and further designated a Defense Systems Acquisition Review Council (DSARC; subsequently Defense Acquisition Board, DAB) program versus a component command program, the C-X required milestone approvals from the secretary of defense unless delegated to the secretary of the Air Force.[99]

Secretary Brown's decision to pursue the C-X was a reverse of the normal acquisition process, where an organization first defined the requirement in a statement of need and then sought service and Defense Department approvals. The C-X was already approved. Additionally, the C-17 skipped much of the demonstration and validation phase because essentially its technology had been proven in the AMST program.

Following Brown's actions, Major General Block issued on 10 December 1979 Program Management Directive For Implementation of C-X Program, which provided guidance on activities leading to the full-scale engineering development decision. The directive authorized the Air Force Systems Command to establish a system program office and develop the request for proposal. Mindful of the AMST record, the directive required the Air Force Systems Command to "investigate all feasible ways to decrease life cycle costs." The Air Force Logistics Command and the Military Airlift Command would assist the Air Force Systems Command in developing an integrated logistics support program to include evaluating an interim contractor support concept. The program management directive also tasked the Military Airlift Command to develop the requirements as well as the employment and maintenance concepts. As to testing, the directive stipulated a combined test force concept for both the developmental test and evaluation and the initial operational test and evaluation with the Air Force Test and Evaluation Center* managing the latter test. Regarding the schedule, the directive called for reaching an initial operational capability of "16 aircraft" not later than the end of fiscal year

*Redesignated Air Force Operational Test and Evaluation Center in April 1983.

1987. The program management directive acknowledged the C-X's emphasis on fulfilling strategic airlift requirements, relying on existing technology, decreasing life cycle costs, and ensuring system reliability, maintainability, and availability.[100]

Moving at a fast pace, the C-X Task Force hosted on 14 December a general officer review, briefing the attendees on the program's progress to date and the approach taken on the C-X requirements for the request for proposal. The approach was novel, as the RFP asked the contractors to fulfill mission scenarios. The aircraft's design would flow from meeting the mission requirements. The Air Force would not dictate a design.[101] Thus, the briefing also sought to get the general officers' acceptance. Yet, there was a drawback. When asked about the new transport, the Air Force had nothing to show and tell. Critics indicated the Air Force was acquiring, so to speak, a pig in a poke, and until there were design proposals from the interested contractors, the Air Force endured some criticism.

By 17 December 1979, the C-X Task Force had a draft mission element need statement ready to forward to Defense Secretary Brown and the Office of the Secretary of Defense staff for comment.[102] Since the C-X was already an approved program, the development of the MENS was, in some ways, an after the fact formality that had to be taken care of. In the end, this was not the case, as the final document was not forthcoming for nearly a year and contained significant changes. In the meantime, the C-X Task Force developed the requirements for the C-X and wrote the preliminary system operational concept.

Armed with the authority to proceed, Lieutenant General Lawrence A. Skantze, then the Commander of the Aeronautical Systems Division, established the C-X System Program Office[103] under the deputy for systems, located at Wright-Patterson Air Force Base, Ohio. On 4 January 1980, Brigadier General (select) Elbert E. Harbour became the director of the C-X SPO. Harbour, a navigator, spent his first years as an electronic warfare officer aboard Strategic Air Command B-52s and B-58s. He subsequently worked in operational testing and acquisition. Before assuming the C-X program, Harbour was the deputy director for the Fighter Attack SPO. Although not an airlifter, Harbour knew the acquisition world. Having a general officer head the C-X SPO provided the necessary rank to facilitate the program. David G. Ward initially served as Harbour's deputy director. Ward was well versed in the acquisition of transport aircraft, as he had been the assistant director of the AMST program.[104] The C-X SPO moved out quickly to the task at hand, issuing as one its first actions on 14 January the sources sought synopsis (SSS) document, soliciting interest from the aerospace industry.[105]

The C-X SPO, however, lacked personnel initially. In December 1979, the AMST SPO had dwindled down to 13 people from which the C-X effort drew upon. By June 1980, the C-X SPO had 51 persons assigned: 14 officers, 2 clerical, and 35 civilians. A full year later (December 1980), the number had only risen to 53, despite an authorized strength of 85. The organizational structure of the C-X SPO changed in April 1980 when the Aeronautical Systems Division reorganized. At this time, the C-X SPO became a directorate under the newly created deputy for airlift and trainers. The engineering, contracts, manufacturing, program control, and logistics divisions in the C-X SPO then merged with their functional counterparts in other SPOs to form functionally-focused directorates under the deputy for airlift and trainers, a position that Brigadier General Harbour also filled. Persons in the functional directorates were then designated as part of the C-X SPO. This arrangement meant that those now working the C-X might also have been handling Lockheed programs for years with a certain natural bias.[106]

**C-X Analysis**

The C-X Task Force spent much time sorting out the requirements, equipment to be hauled, and landing criteria. To identify the workload and the environment, the task force developed mission profiles based upon scenarios in five operational areas: Central Europe, Middle East, Korea, Africa, and South America. Similar to the AMST's performance goals, interested contractors were to design their aircraft to carry out the stated mission requirements in the stipulated scenarios and with the current en route structure. To foster this new approach as well as determine the technical feasibility, the task force members maintained a voluntary liaison with all of the contractors. For the AMST and the C-X, the concept was: "This is what the Air Force wants the airplane to do. You design it to accomplish the tasks." However, the very people within the OSD and Congress that the C-X program needed support from were also the ones that had the most trouble accepting this philosophy.[107]

Additionally, with the focus on a major land war in Europe, many within the DOD and Air Staff thought in terms of a big airplane. Colonel Walter S. Evans recalled:

> The perception of many at the time was that the biggest aircraft, carrying the largest load, was what should be obtained. Sort of an X equals 5 [C-X is a C-5]. But then, there were those of us that said, 'Wait a minute. Let's not lose sight of what happens after the airplane touches down. There's another dynamic here called getting it offloaded, having more than one on the ground at a time to effect an efficient flow. And don't forget that part of the equation.' That proved over time to be a compelling argument.[108]

The C-X Task Force's analysis of airfields was an important undertaking, as it paced the requirement and provided a powerful, objective argument. Colonel Harmon's team initially examined airfields in noncommunist countries. This yielded the number and size of the runways available. A more detailed analysis followed for the five regional areas. The team compiled information on the length, width, surface, and elevation of runways as well as taxiways, ramp space, and weight bearing capacities. In some cases, they even took core samples to determine soil consistency. Data was gleaned from airfield surveys, aerial photographs, airfield sketches, and information found in *Airfield and Sea Stations of the World* books, produced by the government's Defense Mapping Agency. Next, the team assessed airfields on their ability to support mobility operations and the current strategic airlift force. Those airfields deemed not capable were reviewed for use by a notional C-X, with benefits recorded. In light of later criticisms, it should be noted that initially experts in the Pentagon independently developed the threat scenarios from the C-X Task Force's airfield analysis effort, ensuring a measure of impartiality. After preparing hundreds of "spider" charts for the five scenarios, the C-X Task Force members arrived at the desired airfield characteristics for the C-X. The work was tedious, the hours were long, and there were no computers.[109] Recollecting further, Evans disclosed:

> The message there was you could take advantage of a lot more airfields with an airplane that can land on a shorter runway. By doing that, you can go closer, you can reduce your exposure, and you offer the user a lot more flexibility in where he wants his cargo. We saw C-5s, frankly, as being able to go to Rhein-Main or Ramstein [Air Bases, Germany] offload their cargo, and then have the cargo road marched over land. And we saw the benefit of an airplane like the C-X, as it was specified then, to be able to go forward to that 5,000 or 4,000-foot strip and unload the cargo there. So Bob Cole and I did an analysis that kind of said if you could build an airplane that lands on a 3,000-foot runway, you gain a lot more airfields in the world. So 3,000 feet became the break point. If you looked at the dispersion of airfields in that dimension, there was a break in the line. It was like a knee curve there. And then it decreased dramatically, as runways became longer and wider. In the European scenario, there was a number. In the Southwest Asia scenario, there was another one. It wasn't so much runway length and width as it was the ability to turn around and get off the runway. That was very important.[110]

Through the airfield analysis the task force looked to one airplane to perform both airlift missions: strategic and tactical. Getting cargo and personnel deliveries closer to the user became known as the direct delivery concept. It offered the airlift community a whole new paradigm.

**C-X Task Force Analysis on Number of Available Airfields**

| Runway Length x Width | Africa | Central Europe | South America | Middle East | Free World Minus US |
|---|---|---|---|---|---|
| >5,000' x >150' | 127 | 50 | 144 | 133 | 847 |
| >5,000' x >90' | 686 | 254 | 520 | 400 | 3,645 |
| >4,000' x >90' | 1,125 | 305 | 1,149 | 536 | 5,938 |
| >3,000' x >90' | 1,900 | 446 | 2,759 | 681 | 10,083 |
| >2,000' x >90' | 2,969 | 740 | 5,057 | 747 | 16,192 |

Source: Briefing, AF/RD, C-X Task Force, C-X An Airlift Aircraft," circa January 1980.

The airfield environment selected as best integrating the C-X with the existing airlift resources was described as a "small, austere airfield." At a minimum, the task force characterized it as having semi-prepared, compacted surfaces, a length of 3,000 feet, a width of 60 feet (with end of the runway turnarounds, otherwise a 90-foot width), and a taxiway width of 50 feet. Once this was in hand, the task force defined the landing, ground maneuvering, and operational characteristics. It logically followed that the small, austere airfield would essentially determine the size—wing span and fuselage length—of the C-X while the combat scenarios and available aircraft technology would drive the range and payload capabilities. A notional C-X took form: a 400,000-pound aircraft capable of carrying a 120,000-pound payload 2,400 nautical miles and a 100,000-pound payload a distance of 2,800 nautical miles. The first en route airfield on the way to Europe or the Middle East determined the distance; Lajes in the Azores was just less than 2,400 nautical miles away.[111]

**Preliminary Concept**

The airfield analysis aided the task force in developing the preliminary system operational concept (PSOC). The PSOC laid out how the Military Airlift Command and the Air Force Logistics Command intended to employ the C-X. The document also provided the performance requirement for the Air Force Systems Command to issue the request for proposal to industry. Essentially, the C-X would complement the existing airlift forces as well as go beyond the current concepts of operation. While the C-5, C-141, and the commercial aircraft in the Civil Reserve Air Fleet (CRAF) program transited great distances, they could only land at a large rear area airfield at a main operating base (MOB). The C-130 operated in the small, austere airfield environment but, like the C-141 and commercial aircraft, could not haul outsize cargo. Additionally, in response to the perceived Soviet threat, the Army's firepower and support equipment for its mechanized infantry and armored divisions had increased in size and weight, thereby adding to the outsize cargo requirements. The PSOC elaborated further:

> Consequently, the C-X force must be an effective carrier of outsize cargo, as well as other categories, in the intertheater (long range) and intratheater (austere environment) airlift mission areas. Accordingly, a basic C-X mission will airlift outsize/oversize heavy firepower/equipment from CONUS/overseas locations over long distances (with air refueling, if required) directly into small, austere airfields close to the battle area, offload, and recover to a theater MOB. When time urgent movement to battle areas via ground Lines of Communication (LOCs) is constrained by an inadequate road/rail system or enemy action, a portion of the C-X force will shuttle outsize firepower and other cargo forward to small, austere airfields before reverting to the intertheater mode. It is precisely this combination of outsize, long range, and intratheater airland performance that is essential to capitalize

> upon the characteristics of the existing airlift system and significantly expand its ability to rapidly close/resupply or reinforce a modern US combat force anywhere in the world. This is primary in the design and employment of the C-X force as an integral part of the total airlift system.[112]

Besides its main role as a strategic-tactical hauler of outsize cargo, the C-X would provide airdrop and extraction capabilities. In this capacity, the preliminary operational system concept envisioned the C-X aiding the establishment of a forward airhead. Other assignments included augmenting special operations missions. The C-X would deploy special operations forces over long distances to an objective area, airlanding and/or airdropping personnel and supplies from high or low altitudes. As to aeromedical evacuations, the C-X would transport selected patients on the return flight ("back haul") from forward staging areas to main aeromedical support facilities within a theater or to major medical facilities in the theater or the United States, just as the C-141 did.[113]

"The C-X system design should stress proven state of the art technology, reliability, simplicity, ruggedness, and ease of maintenance incorporating redundancy features to the maximum extent practicable."[114] Part of the intent was to avoid the C-5's problem with too many working parts in the main landing gear, kneeling, and dual doors, Colonel Evans related. Through automating and redistributing duties, the system design should also reduce the size of the crew required. The goal was a crew of two pilots and one loadmaster. Although deferring reliability and maintainability thresholds until the full-scale engineering development phase, the intent was for the C-X to exceed current C-130 and C-141 reliability and maintainability rates. The concept called for rapid repairs as the norm to include changing out critical components with minimum support equipment and manpower at forward and austere environments. "The C-X system components or subsystems should take advantage of existing commercial and/or military equipment when its design and performance meet C-X mission requirements."[115] Thus, the C-X was to be an aircraft of its time not beyond its time. Such a philosophy would expedite the fielding of the C-X, and this was in keeping with the administration's desire to address the airlift shortage posthaste. Later, as the program encountered one delay after another, critics chided the C-X for not being more technologically advanced.

Issued on 22 January 1980, the PSOC defined performance criteria of airlifting a maximum of 130,000 pounds (three infantry fighting vehicles or one combat-configured M-60 or XM-1 tank at 2.25Gs*) and landing on a 3,000-foot-long runway or less, using maximum breaking and idle reverse and carrying a payload of at least 100,000 pounds. The austere runway would be either paved or unpaved with an unpaved surface rated at CBR 9 and able to sustain 100 passes. The aircraft would have an unrefueled range of at least 2,800 nautical miles carrying a payload of no less than 100,000 pounds or 75 percent of the maximum aircraft cabin load at 2.25Gs.

*The gravitational force or pull of the earth.

The C-X would also be capable of backing up a 3 percent grade with a 130,000-pound payload, making a 180-degree turn on a 90-foot-wide runway, operating from a 60-foot-wide runway with turnaround areas, and performing airdrop requirements. The aircraft would be able to operate in a "moderately hostile" environment. The personnel airdrop goal was for at least 100 combat-equipped paratroopers exiting the aircraft plus four standard equipment bundles in 55 seconds as well as the airdrop/extraction of vehicles weighing up to 50,000 pounds. The minimum acceptable long-range cruise airspeed was .70 Mach. The C-X would have a peacetime utilization rate of 2.5-3.5 hours per day—up to 10.0 hours per day during sustained wartime operations with a surge capability of 12.5 hours for up to 45 days. A limited initial operational capability would be achieved when the "first squadron" entered the active force; the expected IOC date was fiscal year 1987.[116] The joint C-X Task Force reasoned that the ability to fly directly into small, austere airfields improved force deployment and employment, enhanced the flow of aircraft by decreasing ground lines of communication, made for less competition for space in the theater, closed the combat force or cargo on time (and at the right place), and made interdiction by the enemy more difficult.[117]

Defense Secretary Brown's review of the PSOC brought forth requests to advance the IOC from fiscal year 1987 to 1985 and to increase the range of the aircraft by 20 percent. Increasing the range drove the gross weight of the aircraft to some 480,000 pounds while changing the IOC compressed the schedule. As a result, funding long lead items for production would occur while the aircraft was still in engineering development, making the program more vulnerable to risks and concurrency problems. Brown also gave his approval of the small, austere airfield requirement.[118] Other revisions required the C-X to land in 3,000 feet or less (maximum breaking and full reverse thrust with maximum payload), changed the unrefueled range to 2,400 nautical miles (with a payload of at least 120,000 pounds or 92 percent of the maximum aircraft load at 2.25G), revised the backing up grade to 1.5 percent, specified a service life of 30,000 hours, and stipulated that the size of the cargo compartment would accommodate at least the width of an XM-1 tank and the length of three infantry fighting vehicles (operational configuration). The revised PSOC called for developing schedules for total aircraft buys of 150 and 200 aircraft. Over the next months, the PSOC incorporated more adjustments with each amending the C-X program management directive. Defining and refining the request for proposal mission scenarios resulted in many of the revisions to the PSOC as well as the MENS.[119] Later criticisms that the C-17 was not meeting some of its performance specifications failed to acknowledge the directed changes and the "living" document aspect of the PSOC (subsequently termed the system operational concept).

**Murray Finds Fault**

After completing the PSOC, the C-X Task Force built an extensive briefing, and the selling portion of the program began. Surprisingly, the most resistance came from the Department of Defense. After receiving a presentation from Major General Block, Russell Murray II, the Assistant Secretary of Defense for Program Analysis and Evaluation, took issue with the C-X Task Force's airfield analysis in a 3 March 1980 memorandum to Air Force Secretary Hans Mark. Murray, an aeronautical engineer, had first worked missile programs for Grumman Aircraft and then had joined the Kennedy administration as a system analyst. With a sharp mind, calling things as he saw them, Murray laid out his criticism.

> As I understand it, the Air Force analysis asserts (if only implicitly) that the C-5 would be unable to use any field with a runway less than 5000' long and 150' wide. If it passes that filter, the field must also have turnoffs gently enough to be negotiable by the huge C-5, taxiways wide enough to accommodate its track, and at least a quarter of a million square feet of ramp space, or the C-5 is simply barred from using it.
>
> The CX (let me call the USAF choice that), on the other hand, is assumed to be able to get into any field with a runway at least 3000' long and 90' wide, and having perhaps a quarter the ramp space assumed necessary for the C-5.
>
> Under those ground rules, it's not hard to understand why the analysis shows so many more fields available to the CX; 5000'x150' runways are much less common than 3000'x 90' runways. The Air Force data shows ratios ranging from 5:1 (Middle East) to over 19:1 (South America). And if that's as far as you dig into this, the CX might well look like the better choice. But is it?
>
> Airfield availability was just as big a consideration—perhaps bigger—back in the '60s when we included in the specs for the CX-HLS a requirement to operate not from 3000'x 90' runways, but from unprepared fields—no runways at all, just a specified California Bearing Ratio for the soil. The CX-HLS, of course, became the C-5 with its awesome 28-wheel landing gear precisely to meet that spec. Yet we now seem to be asserting—if only implicitly—that the C-5 cannot operate at all unless it has a 5000'x150' runway, long-radius turnoffs into wide taxiways, and 6 acres of ramp. I just can't believe that, and I don't think you ought to either.[120]

Murray proposed revising the airfield analysis to account for the C-5's "actual" capability. For example, he wanted to let the C-5 run off of the runway in the process of turning, cut the corner in turning off to a taxiway, or let it park partly on and partly off the paved ramp space. Using aluminum planking for the turnarounds, taxiways, and ramps, Murray believed the C-5 could negotiate those areas at less than full thrust. Murray wanted to look at operating from unprepared surfaces as well. While Assistant Secretary Murray acknowledged the C-5's tendency to blow planking around and that it had incurred foreign object damage to its engines operating from a dry lake bed, he asserted that ever since the discovery of its weak wings, "we've been babying it, and I doubt that we really understand its capabilities—or lack thereof." Nor did Murray believe the C-X would use ramp space more efficiently. If the C-5 carried twice as much the C-X but had doors on both ends to the C-X's one, then off loading should take about the same time. Additionally, an updated C-5 should be able to back up just as well as a C-X. With a new engine and the same thrust reverser designed for the C-X, why not, he reasoned.[121]

There were other operational issues. While the C-5 was larger than the C-X, Murray wondered if both aircraft were not too large, hence more vulnerable, operating near the forward edge of the battle area. It appeared to Murray that the C-X was more dependent on tanker aircraft than the C-5 because the C-5 had more range. His preliminary results gave the C-5 the undiscounted life cycle cost advantage—from 15 to 30 percent while the Air Force had estimated 5 to 10 percent.[122]

Nor was Murray satisfied with the C-X's schedule, labeling it too compressed and concurrent, and therefore set up for delays and cost overruns. Although he acknowledged the technical risk was low, he pointedly objected to the new IOC date of August 1985 and wanted provisions to ensure the contractor would meet this date. The Air Force desired to have the first production C-X in May 1984 in 51 months time. Murray stated the aircraft industry's record showed otherwise: 53 months for the B-747 (which benefited from the C-5), 70 months for the DC-10, and 75 months for the L-1011. In his view, there was no need to spend $12 billion on the C-X until the Air Force spent more time on these issues.[123]

"As you know, I also started out believing that a C-5 or a C-5 derivative aircraft would be the right way to proceed. After looking at all of the arguments with great care, I am now quite convinced that we need something different," Secretary of the Air Force Hans Mark replied. With a doctorate in physics from the Massachusetts Institute of Technology, Hans Mark expressed his confidence with the C-X Task Force's analysis. In fact, he had performed a similar airfield analysis for the AMST when he headed the Ames Research Center, National Aeronautics and Space Administration. He informed Murray that Block's analysis was "much superior." Moreover, "if one assumed that an updated version of a C-5 could operate in this airfield environment, it would not affect the validity of the airfield analysis." Mark asserted that the C-5 tests on unprepared surfaces had to be terminated before completion because of runway and aircraft damage. "The results of these tests plus the operational experience we have gained over the past 12 years have shown that the C-5 is not compatible with the small, austere airfield environment because of size and operating characteristics. I know that originally we thought C-5's should be able to do that but we were wrong."[124]

Nor did Mark think much of Murray's idea of using planking and off runway operations. He counseled, "If wartime planning requires part of the airlift force to operate under less than prudent risk conditions (such as off runway/taxiway operations), the success of the total airlift mission would be jeopardized. One reason the C-X is preferable is that we can plan to perform the airlift mission without inducing the risks associated with off runway/taxiway operations, which are more pronounced in adverse weather (snow, rain, mud)." Only if extreme wartime conditions dictated, did Mark feel off runway/taxiway operations were warranted. Moreover, even if the Air Force lifted the C-5's runway restrictions, Secretary Mark asserted "we know of no case in which the C-5 could operate where a C-X could not."[125]

As to the difference of opinion on cost and IOC, Mark informed Murray that his people had used the actual inflation rates while the OSD staff had used the inflation indices for the period 1969-1978. Mark provided further substantiation that the C-X would not require more air refueling support than the C-5. Thus, Murray's figures should show a 7 percent difference in life cycle costs for a force that was substantially larger than the C-5 fleet. As to the revised initial operational capability date of 1985, Mark countered that two of the contractors were not starting from scratch and had already accomplished a considerable amount of wind tunnel testing. "Since the technical risk is low I believe the 1985 IOC is attainable with the proper funding and support." Secretary Mark further informed Assistant Secretary Murray that the Air Force's analysis did address and resolve the many issues he had raised. It was now time to proceed with the acquisition of the C-X.[126]

Murray made his comments believing "the C-5 may not have been accorded even-handed justice in the comparison." While not then an advocate of the C-5, Murray saw himself "merely its temporary public defender for lack of anyone else to play that role—surely Lockheed doesn't dare." Such differing opinions—the arguments and comparisons—between the two weapon systems became an ongoing and intense issue over the course of the C-17's acquisition. Russell Murray was right in believing "we must be able to explain precisely why we chose one alternative over the other."[127] However, the "OSD and the Air Force must be in agreement on what they want when they come before Congress. We can't stand another Mark-Murray debate in Aviation Week," Colonel Vincent Hughes advised.[128]

**35 Million**

Members of Congress voiced criticism and skepticism as well. Support for the infant program was far from assured as the C-X funding request progressed through the House and Senate Armed Services Committees, the House and Senate Appropriations Committees, and their subcommittees. In March 1980, Representative Richard H. Ichord (D-MO), Chairman of the House Armed Services' Research and Development Subcommittee recommended denying the C-X fiscal year 1981 funding request for $80.7[129] million in the President's Budget. Representative Ichord laid out the subcommittee's position to Defense Secretary Harold Brown. Ichord cited the millions of dollars spent on weapon system programs only to end up terminated, singling out the $7 billion for a manned penetrating bomber, $240 million for the AMST, and $350 million for the prototype of the Surface Effects Ship. "There are many of us who believe that in view of our strategic mobility deficiencies, our nation could be better served by procuring hardware that is readily available rather than embarking on another research and development program that may again lead nowhere."[130] Thus, Ichord and his subcommittee had serious concerns over the start of a $12 billion program. "In conclusion, the Subcommittee decision on the C-X came down to a matter of priority followed by requirements and technical issues. The C-X—a future system—simply could not be supported in the absence of funds for the procurement of sealift assets that are needed to satisfy our near- and intermediate requirements. Beyond the matter of priorities, the case for the C-X per se has not been made to our satisfaction."[131]

The subcommittee's recommendation became the bellwether. On 27 March 1980, the House Armed Services Committee voted 22 to 17 against the DOD's appeal to restore C-X development funding. W. Graham Claytor Jr., the Deputy Secretary of Defense, and Dr. William Perry, the Undersecretary of Defense for Research and Engineering, had been unable to persuade the committee. Some missteps occurred during their testimony, however. Claytor remarked that the C-X was not a firm decision while Perry countered Defense Secretary Brown's accelerated IOC date by recommending fiscal year 1986 due to the risk involved. Marine General P. X. Kelly, Commander of the Rapid Deployment Force, gave strong testimony, however.[132] The vote was especially troublesome, as the committee's chairman was Melvin Price (D-IL), a staunch supporter of the military and its airlift programs with Headquarters, Military Airlift Command located in his home district. Without question, Russell Murray's memorandum to Air Force Secretary Mark, which advocated considering the C-5 as a potential alternative to the C-X, was ill-timed and damaging as Congress considered the President's Budget.

General David C. Jones, Chairman of the Joint Chiefs of Staff, rallied the joint chiefs, and they sent a memorandum to Defense Secretary Brown. In their view, the C-X with its outsize capability offered "maximum operational flexibility by performing both the intertheater and intratheater missions." The program was an integral part of other mobility initiatives, namely pre-positioning and fast sealift. "The Joint Chiefs of Staff endorse the requirement for an airlift aircraft that embodies outsized cargo capability, intercontinental range and small austere airfield capability." Without the aircraft, the United States "could fail to achieve its purposes or even be defeated."[133] Jones had subscribed to the RDF concept and worked to speed up its implementation. He regarded the C-X as a necessary part of the RDF. General Jones' support came ahead of his own career. After the failure to rescue the hostages held by Iran, Jones became the focal point for a few conservative members of Congress venting their displeasure with the Carter administration's defense policies. At this time, General Jones was up for reappointment as chairman, and several congressmen threatened to block his reappointment. This did not come to pass, and General Jones continued as chairman until June 1982.[134]

Major General Block also had his turn. Block went before the House Appropriations' Subcommittee on the Department of Defense in May 1980 seeking congressional approval to realign a mere $1.5 million from the canceled AMST program for use on evaluating C-X proposals and contract preparations. The session was a rough one and followed on the heels of the House Armed Services Committee vote. Representatives Jack Edwards (D-AL) and Norman D. Dicks (R-WA) dominated the hearings, expressing their annoyance. Block found himself having to explain to Edwards why the Air Force had not funded a half a billion dollars for C-5 spare parts, which meant the C-5 could not sustain its wartime requirements. Edwards was very direct.

> . . . what I am trying to get at is, here you are talking to me and to us about this massive new program for cargo planes when you are not even supporting the primary cargo planes you have. Are we just simply going to start a brand new plane, because that is the thing to do, and then immediately start underfunding it? I would feel a lot happier if you came in here and said we need $511 million to get the C-5 back on track. After you did that, then you came to me and said we need a C-X. It seems like we are always out there flirting with the will o' the wisp for something and we are not doing our homework day after the day on keeping these things going.[135]

Representative Dicks wanted to know: why the Air Force had not completed source selection of the AMST when Congress had provided the funding; what the impact would be to proceed with the AMST at some future time; why a bigger airplane was not sought in the first place; and if the XM-1 tank got heavier, would the C-X have the same problem?[136] With the Boeing Company based in Seattle, builder of the AMST YC-14 prototype as well as the large commercial B-747, Dicks' interests were obvious.

As the President's Budget progressed through Congress, the C-X received a measure of support from the Senate Armed Services Committee. In June, the committee voted to provide $50 million but restricted C-X spending to $10 million until after the Department of Defense performed a mobility requirements study. Deputy Secretary of Defense Claytor wasted no time issuing a memorandum initiating the *Congressionally Mandated Mobility Study* (CMMS). He advised Hans Mark, David Jones, William Perry, and Russell Murray: "First, we must complete the study promptly if we are to avoid delays in the critically important C-X program. And second, the study must be totally objective and credible."[137] Deputy Secretary Claytor revealed that the Senate Armed Services Committee supported in principle the administration's goal of securing more long-range strategic lift but was "not convinced that the C-X concept proposed by the Air Force should be supported to meet new long-range strategic lift requirements. The committee believes that fulfillment of these requirements should be based upon a careful analysis of total lift demands, taking into account existing resources and potential enhancements—

to include airlift, sealift, and prepositioning." [138] Nor was the committee convinced that the C-X concept of airlifting heavy armor into remote, small, austere airfields was valid.[139] Among the critics was Senator Sam Nunn (D-GA), who had the Lockheed Martin Aeronautical Systems in his state, builder of the C-5 and C-141. Nunn had requested that the Air Force answer 101 questions before the committee met; the questions attempted to discredit the C-X while promoting the C-5. The C-X Task Force expended some weeks answering Nunn's questions.[140] During the authorization conference, representatives from the House and Senate Armed Services Committees agreed to authorize $35 million for the C-X program, provided the secretary of defense certified the requirement and completed the CMMS.[141] Thereafter, the C-X awaited the decisions of the House and Senate Appropriations Committees.

Reiterating many of the subcommittee's criticisms, the House Appropriations Committee chided the Air Force for underfunding spare parts for the C-5 fleet and the witnesses for not articulating clearly enough how the C-X complemented other airlift, sealift, and prepositioned plans. The House Appropriations Committee was only willing to provide $20 million for the C-X while the Senate Appropriations Committee was more generous, recommending $35 million. In December 1980, during the conference session between the House and Senate Appropriations Committees, Congress finally provided $35 million for the C-X program but placed restrictions on spending and directed the secretary of defense to certify that the program met congressionally stipulated requirements before it obligated funds. The conference report also presaged the rough road ahead: "This does not constitute agreement to the start of a several billion dollar program to develop a new airlifter. To the contrary, the conferees emphasized if the studies required by the 1981 Authorization Act substantiate a need for additional airlift, consideration should be given to all alternatives."[142]

### Mark And Perry Misstep

"The C-X task force and those that wrote the C-X RFP better understood the 'systems' aspect of the airlift mission than any of their predecessors in the requirements business."[143] In February 1980, following the development of the preliminary system operational concept, Lieutenant General Lawrence A. Skantze released a draft of the C-X request for proposal. Contractor comments and refinement of the requirement resulted in the C-X SPO updating the RFP throughout the summer months with the final request for proposal issued in October 1980. Originally, the Air Force had hoped to release the final request for proposal in April, but the lack of early funding by Congress and OSD delays had impacted the schedule. The RFP had an ambitious initial operational capability date of fiscal year 1987. The intent was to address the airlift shortfall immediately, and existing military and civilian aircraft, mainly Lockheed's C-5 and Boeing's 747, were considered in addition to developing a new military transport. The Air Force placed great emphasis on the wartime mission, life cycle costs (what would be spent on fuel, crews, and maintenance), the production schedule, and on the adequacy of the program. Technical proposals from industry were due to the SPO on 16 January 1981 with contract award in July 1981, following a three-month source selection process. Forty-eight months from the contract award was the first flight![144]

Alternative aircraft gave the Army some concerns. "We're having a hard time staying tactical!" General John W. Vessey Jr., the Vice Chief of Staff of the Army, expressed to General Huyser in September 1980 when the Army heard of proposed changes to the request for proposal, that made the outsize airdrop and low-altitude parachute extraction system (LAPES) capability a price option and the 90-foot turnaround a desired versus required feature.[145] The Air Force Logistics Command had estimated weight savings of 2,000-3,000 pounds by not having an airdrop capability on the C-X.[146] In Vietnam, during the siege of Khe Sanh, LAPES had been especially invaluable. Now, it was under siege. Vessey pressed the matter with the vice chief of staff of the Air Force: "The Army considers the airdrop/LAPES of outsize cargo, identified in the RFP as up to and including LAPES of an Infantry Fighting Vehicle/Cavalry Fighting Vehicle and small austere airfield operations as firm, essential requirements."[147] While he could understand the influences of the alternative aircraft, he requested that "every effort" be made to ensure the C-X remained capable of tactical operations into the small, austere airfield environment.[148] General Huyser assured General Vessey that his support of Army requirements remained as firm as ever—"The tactical capability that has been carefully interwoven into our C-X package will not be compromised."[149] He was well versed on the Army issues and believed "that the new descriptions have not degraded the mission effectiveness of the C-X. I say this because all potential designs are required to operate through the small, austere airfield environment, and the outsize/LAPES requirement is compatible with each of the C-X designs that I have reviewed."[150]

Nevertheless, the Office of the Secretary of Defense alarmed the Army as well. Deputy Secretary of Defense Claytor, approved the C-X mission element need statement on 28 November 1980, formally documenting the requirement and granting the Air Force authority to identify and evaluate potential solutions. Claytor stipulated that the secretary of defense would have final approval over the choice of a new C-X aircraft or a derivative of an existing transport (to include commercial) or a mix thereof. Other OSD changes made the requirement for small, austere airfield capability dependent on if there would be penalties to executing the primary mission—strategic airlift—and deleted from the MENS recognition of the studies documenting the intratheater airlift shortfall. Thus, the final mission element need statement was somewhat inconsistent with the request for proposal and source selection plan. Since the MENS would have to be updated prior to the Defense Systems Acquisition Review Council II, reinstatement of the small, austere airfield requirement would be possible if favored by the new Reagan administration.[151] On its concerns, the Army would prevail.

Also in the fall of 1980, politics and the pressing need to fulfill the airlift shortfall almost crash-landed the C-X program. In October, just as the Air Force was ready to release the request for proposal, Assistant Secretary of Defense Murray questioned the mission scenarios in the RFP and asked the Air Force to restudy them. General Robert J. Mathis, the Assistant Vice Chief of Staff of the Air Force, intervened, ending what could have been a considerable program delay. Having done its work, the C-X Task Force had disbanded. Any further study of the scenarios would have had to wind its way through the responsible parties at Headquarters Air Force and Air Force Systems Command.[152]

Soon after the Air Force Systems Command let the formal C-X RFP, the program incurred an unexpected assault. Perhaps, well-intended and full of zeal to solve the airlift shortfall, Secretary of the Air Force Hans Mark and Under Secretary of Defense Dr. William Perry personally called the chief executives of the three main bidders, informing them that in addition to the RFP, the DOD also wanted proposals for alternative designs based upon existing aircraft, namely Boeing's 747 freighter, Douglas' DC-10 (military version KC-10), and Lockheed's L-1011 and the military C-5. Industry officials expressed surprise at the calls, and senior Air Force officers learned of them after the fact. There were legal questions, as the request for proposal specifically stipulated that alternatives must be capable of performing the operational missions in the scenarios. Thus, Mark's and Perry's efforts, if acted upon, would have jeopardized the C-X source selection process. Generals Allen and Mathis attempted to minimize the damage. At first, officers proposed a memorandum, explaining the redirection implied by Mark and Perry. This course appeared favored until General Mathis inquired if the C-X was a military transport plane. Assured that it was, he then asked if the 747 or the DC-10 could do the job. Assured that they could not, Mathis purportedly said something like "Then what the hell are we playing around with Band-Aids for?"[153] General Mathis soon had an action memorandum drafted for Lieutenant General Kelly J. Burke, the Air Force's Deputy Chief of Staff for Research, Development, and Acquisition.[154] Coordinated by Secretary Mark and signed by General Allen, the memorandum was a policy statement on the C-X program:

> The objective of the C-X program is to develop and acquire a military airlifter, either a new design or a derivative of an existing aircraft responsive to the requirements stated in the RFP. Should nearer term additional airlift capability be acquired, an interim solution based on commercially available wide-bodied aircraft can be recommended as a separate program. The C-X solicitation and the near term interim airlift capability requirement would require simultaneous consideration. However, any selection of a near term airlift option must be kept separate from the C-X source selection process.[155]

Executing the policy proved awkward. Brigadier General Harbour followed with a letter to Boeing, McDonnell Douglas, and Lockheed on 8 December 1980 advising that the near term desire for additional airlift was separate and distinct from the C-X program and its source selection. At the same time, Harbour informed them that his KC-10 directorate would inquire on behalf of the Air Force for commercially available wide-bodied aircraft that could satisfy the near-term requirement.[156] Brokered under difficult circumstances, the memorandum got the C-X program off the ground again, but it left the door open for an interim solution to the airlift shortfall.

**Which One?**

Over the summer of 1980, Boeing had proposed that the Air Force purchase commercial freighter aircraft, B-747Fs, as a near-term solution. According to Boeing officials, Secretary of the Air Force Mark and Under Secretary of Defense Perry were receptive to an interim 747F solution. Their interest in the 747F explained to some extent their actions at the release of the request for proposals. Clearly, senior-ranking Air Force and OSD leadership had not fully endorsed the C-X. Aware of Boeing's offer, officers at the Military Airlift Command believed the command's position needed restating. As a result, Vice Commander Lieutenant General Thomas M. Ryan Jr. wrote to Lieutenant General Skantze, the Commander of the Aeronautical Systems Division, with copies forwarded to the Air Force directors for research and development and plans and operations as well as to the vice commanders of the Air Force Systems Command and the Air Force Logistics Command. Through this approach, General Huyser hoped to solidify support for the C-X before the source selection process. Ryan's letter laid out why the 747F was unacceptable. Wide-body commercial freighters were not compatible with the operating requirements of small, austere airfields. An aircraft in this environment needed to backup, offload without mechanized materiel handling equipment, taxi on semi-prepared surfaces, and maneuver on congested parking ramps. Additionally, the 747F did nothing to address the shortfall in outsize cargo. With their oversize capacity, freighters essentially represented a partial solution and best served in the Civil Reserve Air Fleet.[157]

Yet, efforts by the Military Airlift Command, which sought through a Civil Reserve Air Fleet enhancement program to obtain more oversize strategic airlift, compounded the situation and even fostered an interim solution. In 1974, the Military Airlift Command had initiated the enhancement program, which would modify commercial wide-body passenger aircraft to accommodate oversize cargo by strengthening the floors and installing cargo handling systems and cargo doors. Funding and interest from the airlines were lagging, however. In late March 1980, with Secretary Mark believing the enhancement initiative was doomed for lack of support from the airlines and with the Air Force director of budget signaling his intent to reprogram the enhancement funding, General Huyser pressed hard to save the program. In August, the command finally secured a contract with United Airlines to modify one DC-10-10.[158]

Huyser's actions had an up side and a down side. While the initiative attempted to secure more oversize capacity from airlines in the CRAF program, the initiative threatened the C-X program. If commercial wide-body aircraft could provide the military more strategic airlift, then why did the military need to spend money on a C-X? The C-5s could provide the required outsize capability. So ran the arguments. General Huyser noted to Lieutenant General Ryan "we must walk the line with care."[159] Perhaps, initially, General Huyser simply had not entertained the thought that the Civil Reserve Air Fleet initiative could compete with the C-X and its military requirements. The command's solution to the airlift shortfall contained four courses: the CRAF enhancement program, fixing the C-5's wings, stretching and adding an air refueling capability to the C-141, and the C-X program. But critics and astute businessmen in the aircraft industry saw it differently. Commercial aircraft could certainly perform a portion of the C-X's mission, especially hauling oversize cargo into large airfields. Thus, besides the C-5, the C-X was competing against commercial aircraft.

Sagacious counsel also abounded. William H. Tunner, commander of the famed "Hump" Airlift to China during World War II, the Berlin Airlift, and the Korean Airlift, provided his thoughts to Air Force Chief of Staff General Allen and General Huyser in September 1980. As Commander of the Military Air Transport Service, Lieutenant General Tunner had championed before Congress modernization efforts, which eventually brought about the C-141 and the C-5 acquisitions. He understood the business of airlift and was its most eminent spokesperson. "I cannot help but add that the new transport should be very large indeed. It should be a plane that could be a commercial as well as a military type with few alterations when the commercials are ready for it." "If you cannot eclipse the C-5 because of available engines, then accept the inevitable of two fleets to move your military requirements—one an extra large C-5 type and the second, a smaller wide bodied type, to move loads to and from the large planes if necessary."[160]

General Huyser, a bomber pilot during World War II and Korea, also supported commercial-military airlift ventures but for the next generation of airlifters that would follow at the beginning of the twenty-first century. "I think it would be most productive for our nation to have a joint military/civil airlift aircraft development program. We need to get a more economical operating aircraft. We have to have more efficiency."[161] As much as General Huyser worked to ensure the C-X, his initial counsel would have been different, essentially along the lines of General Tunner's second recommendation. "I have said before Congress that if we had all the money in the world and I was not physically constrained on how much I could spend on airlift, I wouldn't necessarily pick the C-X. I would pick a larger AMST than was tested, and I would pick a modern updated C-5 type aircraft—two airplanes," General Huyser related in a 1980 interview.[162] Interestingly, with this statement it was clear that Huyser, despite his strong supportive efforts for the Army's requirements, had not made the transition to the new paradigm—direct delivery, nor had the senior Army leadership. Army Chief of Staff General Bernard Rogers had told Congress in 1978 that "trying to design an aircraft to perform both types of missions will likely result in one that is not efficient in either role."[163]

And as Secretary of the Air Force Hans Mark brought his service to a close, he remarked to General Huyser that "the discussion now seems to center around not whether we need to have more airlift, but which aircraft would be best for fulfilling the requirements we have. I remain completely convinced that we should develop a new aircraft that is in the 400,000 pound class, has intercontinental range and has the capability to use very austere facilities at the destination."[164] Mark hoped the new administration would recognize the importance of continuing the C-X program. With the presidential election decided, there was uneasiness in Headquarters Military Airlift Command as well, Major Walter S. Evans advised General Huyser and the senior staff:

> With the heavy emphasis on offensive strategic forces and apparent lack of understanding of airlift and mobility issues by Reagan transition people, the C-X program could slip into a study mode or otherwise become directed towards a less than optimum solution. If funding is reduced or redirected, we will be faced with charges that the Air Force and the administration cannot agree and tempt Congress to delay the program.[165]

Evans' counsel proved on the mark. Source selection was another worry facing the program. Colonel Vincent Hughes was blunt about it: "Our part—make damn sure that the airplane that comes out of source selection is the one the user wants."[166]

Within its first year, the C-X program had incurred most all of the contentious issues it would face in the years ahead. Uncertainty characterized the program, and a new presidential administration only added to it. In succeeding years, competing interests, sparse funding, and program management and developmental problems placed the C-17 program on a teeter-totter, and as the program seesawed, per unit cost, production, delivery, and the IOC date all became affected.

# III

## UNCERTAINTY-IS THERE A C-17? 1981-1988

On 20 January 1981, Ronald Reagan took the oath of presidency. His administration would differ from Carter's. Wary of the Soviet Union, Reagan had campaigned for a strong national defense. "Unless we demonstrated the will to rebuild our strength and restore the military balance, the Soviets, since they are so far ahead, have little incentive to negotiate with us."[167] During Reagan's tenure, the United States' national security policy sought to deter the Soviet Union anywhere on the globe. Senior officials reasoned the United States had to prepare for a protracted conflict because the Soviet Union was doing the same. America's nuclear forces must prevail, forcing the Soviet Union to seek an early termination of hostilities.[168] Thus the Reagan administration placed a greater emphasis on reviving the capability of its strategic forces over its conventional resources, although both benefited greatly from increased funding. A series of regional problems, however, resulted in conventional military responses in Lebanon, Grenada, and the Persian Gulf area. And the task of getting there fell to strategic airlift and sealift.

As Reagan had done during his tenure as governor of California, he appointed and surrounded himself with prominent businessmen. President Reagan openly acknowledged the influence these men had on selecting the top people in his administration.[169] Reagan chose as his secretary of defense Caspar W. Weinberger, a Harvard-trained lawyer and World War II veteran who had been active in California politics. Before his appointment as secretary of defense, Weinberger had been the vice president and general counsel for the Bechtel Group of Companies in California. Although Weinberger had a reputation as an economizer, he vigorously subscribed to Reagan's plans on increasing defense and shared with Reagan the belief that the Soviet Union was an imminent threat to the United States and that defense programs had been slighted in the previous administration. Weinberger left the internal management to his deputy secretaries: Frank C. Carlucci, III (1981-1983), Paul Thayer (1983-1984), and William H. Taft IV (1984-1989). When Weinberger stepped down as secretary of defense in 1987, Carlucci was his heir. Weinberger also recommended to President Reagan for appointment the service secretaries. President Reagan selected Verne Orr as secretary of the Air Force. Like Weinberger, Orr had served Governor Reagan and had been part of Reagan's presidential campaign committee. Orr was a businessman and a partner in his family's car dealership.[170] With service in the Navy during World War II, Orr could just as well have been the secretary of the Navy.

Mindful of weapon systems costs and congressional displeasure over procurement fraud, waste, and abuse, Defense Secretary Weinberger instituted reforms in the acquisition process. And while Weinberger desired to retain centralized control of policy formation, he sought a more decentralized execution. In this vein, he allowed the service secretaries and the chiefs of staff more authority in making recommendations and added the service secretaries as members of the Defense Resources Board, the top management group overseeing the military's programs.[171] With the Reagan administration, however, the C-17 found itself out of favor. Among Reagan's "kitchen cabinet" was William Wilson, an investor and Lockheed Corporation executive.[172]

Greater emphasis on a rapid response capability to the Middle East also brought about improvements in military organizational structures. On 1 October 1981, the Rapid Deployment Joint Task Force (RDJTF) became a separate command with responsibilities for Southwest Asia, and on 1 January 1983, the Department of Defense redesignated the RDJTF the United States Central Command, a unified command.[173] These actions further signified that the military's focus had become more regional, although defending Europe remained a primary task. The lack of visibility over deployments during the Nifty Nugget exercise brought forth the Joint Deployment Agency in 1979. It was soon apparent that a command versus an agency could provide the necessary authority to make deployments work. After several years of study, to include service resistance, President Reagan signed National Security Decision Directive No. 219 on 1 April 1986 directing the establishment of a unified command to provide global air, land, and sea transportation. The United States Transportation Command came into existence over the course of 1987 and comprised the Army's Military Traffic Management Command, the Navy's Military Sealift Command, and the Air Force's Military Airlift Command (MAC).[174] While strategic airlift remained central to the execution of mobility requirements, the type of aircraft required became a subject for debate.

**Congressionally Mandated Mobility Study**

Defense Secretary Caspar Weinberger could not proceed with the C-17 until he had the results of a new requirements study, the *Congressionally Mandated Mobility Study* (CMMS). The Department of Defense Authorization Act of 1981 directed that the secretary of defense submit to Congress a comprehensive study of the military's mobility requirements. The act further stipulated that the secretary of defense certify the C-X as necessary for national security before funding would be released. When Defense Secretary Harold Brown testified before Congress in June 1980, Senator John C. Stennis (D-MS), Chairman of the Senate Armed Services Committee, stated the committee needed to know "whether or not a rigorous plan has been developed to allow our forces to be properly supported if they are called on to deploy to the Persian Gulf region. Do we yet know how best to spread the logistics load among airlift, sealift and prepositioning—given the special requirements in that part of the world?"[175] The *Congressionally Mandated Mobility Study* exerted enormous influence, as its recommendations provided the basis for determining the force structure the United States required for contingencies during the 1980s. For nearly a decade, it and the ensuing *DOD Sealift Study* (March 1984)[176] were "the" definitive studies, and Congress largely funded the services' programs according to the recommendations.

The task had been daunting. As a result, Secretary Weinberger forwarded the *Congressionally Mandated Mobility Study* to Congress on 30 April 1981, over two months late. With inputs from the services, the Office of the Secretary of Defense and the joint chiefs of staff had undertaken the study. Made public in May, CMMS concluded the United States fell short in all of its mobility programs: airlift, sealift, and prepositioning. The study only addressed non-nuclear war, and the forces deployed were limited to those programmed[177] to exist in 1986. Although CMMS documented a larger shortfall, the study recommended achieving a fiscally constrained goal of 66 million-ton-miles per day* (MTM/D) in strategic airlift capability before 1990. The airlift capability projected for the baseline year of 1986 was 46 MTM/D, and Congress stipulated that half of the additional 20 MTM/D would be in outsize cargo. The classified mobility study was based upon the analysis of four scenarios: a regional conflict in the Persian Gulf, a Soviet invasion of Iran, a NATO-Warsaw Pact conflict, and a contingency in the Persian Gulf with a precautionary reinforcement of Europe. Indirectly, the study mentioned tactical airlift requirements. Besides the 20 MTM/D of additional airlift capability, the study recommended a course that provided: 130,000 tons of prepositioned munitions and resupply in Southwest Asia, maritime prepositioning ships for a third-brigade-sized Marine Air-Ground Task Force, dedicated roll on/roll off shipping with a capacity for 100 kilo tons, and provisioning of adequate support to the Army's D-day force in Europe through a combination of prepositioning, host nation support, and other programs negotiated with European allies. Only through a combined, complementary, integrated, and balanced approach would the United States possess adequate security. For airlift to remedy the entire shortfall in Scenario II, an invasion of Iran, would have required approximately 600 C-5 equivalent aircraft. Such a solution was simply too costly.[178]

As much as the *Congressionally Mandated Mobility Study* highlighted the interdependence of airlift, sealift, and prepositioning, the study spoke approvingly of an outsize and austere airfield capable aircraft. With vast expanses and limited infrastructure, the Southwest Asian scenarios especially supported such a conclusion.

> The proper outsize/oversize mix for airlift is scenario dependent. Over the entire deployment about 30-40% of unit equipment is outsized. Since only

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*Ton-mile equals one ton moved one mile. It is a gross measurement of airlift capability based on aircraft numbers, average payload, daily flying hours, average speeds, and one-way productivity.

> about a third of the baseline force airlift capacity is outsized, it would seem that any addition to current lift capability would require a proportional addition to outsize capability. However, for the scenarios considered, cargo requirements in the first 15 days do not have these 'standard' outsize fractions. For Scenario I, the outsize fraction is 20%; for Scenario II it is 16%; for Scenario III, it is 27%; and for Scenario IV it is 22%. This means that baseline oversize and bulk capacity could be substantially increased without adding any outsize capability. Achieving added capability by purchasing existing commercial freighters could be economical even considering the additional capacity needed to make up for the lack of austere field capability. On the other hand, there are diminished benefits to adding additional oversize capability without providing adequate balance with outsize capability. In addition, such an option would provide nothing for intratheater airlift and would provide no flexibility to handle a larger outsize fraction in other scenarios which may be of interest in the future. These conclusions are not intended to preempt the source selection process on types of aircraft, but rather provide some rationale supporting acquisition of derivative systems that could be acquired earlier to be balanced with the later acquisition of an outsize system. Clearly the acquisition of an outsize system that also efficiently carries bulk and oversize cargo produces the greatest benefits.[179]

Hence, despite the obvious promotion of the dual-role C-X, the door was left open for more C-5s and commercial wide-bodied aircraft. The document also seemed to accept an interim- and long-term solution to the airlift shortfall. While solving the strategic airlift shortfall remained a high priority, the *Congressionally Mandated Mobility Study* equally disclosed a need to improve sealift capability. As a result, competition for DOD mobility dollars existed between the two, especially as the federal deficit grew in the 1980s.[180]

**Homework Left Undone**

"In the budget wars of the Pentagon, you had to keep it simple—cheap is good; big is better; therefore, it is good. This all made sense to the non-operationally oriented analysts in PA&E and GAO [OSD Program Analysis and Evaluation and General Accounting Office]. Now, overlay those arguments with the fight for dollars to support prepositioning and sealift. Everybody, the Navy, the Army, the Air Force, are all trying to cut up this pie. There was only so much money willing to be spent on mobility," Colonel Melvin Barrett recalled from his days at the Pentagon.[181] The C-5 was big; the C-5's unit price was cheaper than the C-17. Add in a little politics and the operational arguments for the C-17 even with its dual mission role and austere environment capabilities could not carry the day.

Throughout 1981, Congress made it clear that the C-X did nothing to solve the immediate need for more airlift capability. Senator Howard W. Cannon (D-NV), member of the Senate Armed Services Committee, apprised General Robert E. Huyser, Commander in Chief of the Military Airlift Command: "I am sure you are aware that there is a feeling on the Hill that the Air Force did not do its homework in selling this airplane. May I suggest a concerted effort to correct that impression. I, personally, support the CX as does Barry Goldwater [R-AZ], but we need a lot of company to embark on another so called C-5 endeavor."[182] General Huyser characterized the period as the "wolves are after the C-X program" and informed his C-X staff that we need "every ounce of support we can get if we expect to have a C-X."[183] In March, General Huyser expressed his frustrations to Generals Paul "P. X." Kelley and Vol Warner, the Commanders of the Rapid Deployment Joint Task Force and US Readiness Command, respectively, as he requested their continued support. To Warner, Huyser wrote:

> Elements in OSD are advocating B-747s or KC-10s as solutions to the airlift shortfall. On the Hill, sealift advocates are confusing the C-X solution by asserting that the C-5 is really the quote cost-effective unquote airlift shortfall answer. We are being hamstrung in our efforts to sell [the] C-X by not having the support that a completed Congressionally Mandated Mobility Study (CMMS) would generate—completion date now slipped to 1 May 81. We are also handcuffed by not being able to give real figures for the C-X and make comparisons with the C-5 due to being cloaked with the mantle of secrecy required by the C-X source selection process.[184]

P. X. Kelley had resolutely stated his preference for the C-X before the Senate Armed Services' Sea Power and Force Projection hearings.[185] Huyser expressed his appreciation but wanted more from Kelley during an upcoming C-X briefing to Defense Secretary Weinberger. "I believe a strong commitment by him is imperative if the program is to survive on the Hill. I'm confident that with your continued, powerful enunciation of the need for the C-X, we will get his unwavering support and will also convince the congressional committees that the C-X is the only real solution to our airlift deficiencies."[186] The briefing, however, never got past Secretary of the Air Force Orr, who at this juncture remained unconvinced about the C-X.[187]

The Senate Armed Services Committee recommended authorizing only $1 million for the C-X research and development effort, a reduction of $244.7 million from the President's Budget request for fiscal year 1982. However, the one million kept the program alive and allowed the source selection effort to proceed. It was the best Barry Goldwater could muster from his Senate colleagues. Sam Nunn (D-GA), William Cohen (R-ME), and Carl Lewis (D-MI) opposed the C-17.[188] The House Armed Services Committee followed a similar path and voted to cut the request by $225.7 million, stipulating that $150 million go for purchasing wide-bodied aircraft, namely KC-10s, B-747s, or C-5s. Chairman Melvin Price faced a committee largely undecided on the C-17. Like Goldwater, he could only momentarily prevent the C-17's death. Generals Huyser and Kelley scored one during their appearance before the House Appropriation Committee in early June on the rapid deployment force, thereby securing a measure of support for the C-X.[189] Huyser was working against the clock, however. While General Kelley would go on to become the Assistant and then Commandant of the Marine Corps and strongly support the program from that level, General Huyser, who retired on 1 July 1981, would have to continue the fight from retirement.[190]

A revised President's Budget request of $169.7 million for C-X research and development funding fared no better in the fall of 1981. The Senate and House Authorization Conference session did not fund the C-X program but did authorize $15 million for airlift enhancement studies and $50 million for an airlift augmentation program to procure wide-bodied aircraft. The Senate and House Appropriations Committees were generally like-minded. Senator Thomas Eagleton (D-MO), representing McDonnell Douglas' home state, possessed enough clout to remove language in the Senate Appropriations Committee bill, which would have eliminated the C-X from consideration. In the end, the Senate and House Appropriations Conference session denied the President's request and instead provided $50 million in procurement funds for wide-bodied aircraft and $15 million for studies on airlift enhancement and C-X alternatives.[191]

Contrary to Cannon's advice, the Air Force was still giving the wrong impression by year's end. In commenting on Congress' actions, Secretary of the Air Force Verne Orr publicly remarked in early November:

> I don't think you can fault Congress for doing this because it's unreasonable to expect Congress to authorize large sums for airlift without knowing what they will be spent on. The airlift choice will be between McDonnell Douglas C-17—chosen as the C-X, if there is to be one—a modified Lockheed C-5 and Boeing 747 and McDonnell Douglas DC-10 wide-bodies. The Air Force may recommend one of these planes or a mix of them. If a mix is chosen, it probable will be the C-17 plus a wide-body or the C-5 plus a wide-body, with only a 'small possibility' of seeking all three.[192]

In spite of the Air Force's indecision, more specifically Orr's, the Army fully backed the C-X during the budget process. The Air Force could not fault the Army as it had done with the AMST. General Edward C. Meyer, the Chief of Staff of the Army, wrote his counterpart, General Lew Allen: "The Army fully supports C-X development and early operational fielding. We stand ready to do what we can. I believe that it is vital for the Air Force and Army to stand firm on the C-X so we can get an airlift aircraft that meets our wartime requirements."[193] General Warner and General Kelley as well as their successors, Army General Don A. Starry and Army Lieutenant General Robert C. Kingston, respectively, championed the need for the C-X.[194] And towards the end of November 1981, the service chiefs of staff made a last-effort appeal to Senator Majority Whip Theodore "Ted" F. Stevens (R-AK), the chair of the Defense Subcommittee, to include the C-17 as part of the funding for airlift alternatives, thereby keeping the program alive.[195] Their timing also coincided with Weinberger's submitting the certification to Congress.

**Picking The Winner**

As the new Reagan administration took form, the Air Force was conducting a source selection competition for the C-X aircraft. Previously, Lieutenant General Lawrence A. Skantze, Aeronautical Systems Division Commander, had released the final C-X request for proposal (RFP) in October 1980.[196]

On 14 November, the Air Force Systems Command approved the C-X contract strategy paper. This document assessed the overall risk in the C-X program as low because the C-X design used existing technology, the three potential manufacturers had established technological bases on previous aircraft, the aircraft would have commercially certified engines, and the C-X would have standard avionics and use commercial or government equipment. The contract strategy paper acknowledged that the initial operational capability date of fiscal year 1987 was a "principle" risk as a result of the overlap in the full-scale engineering development and the production phases. Thus, there existed potential concurrency problems. Furthermore, the schedule, due to concurrency and inflation, posed cost risks. As its name implied, the paper also provided the contract strategy. The full-scale engineering development and production option 1 contracts would be firm-price, incentive-fee contracts while the follow-on production options (also called lots), interim contractor support, and spares contracts would be firm fixed-price contracts.[197] The C-X request for proposal required each of the interested manufacturers to develop a unit price matrix with target, maximum, and minimum quantities specified. This was similar to the KC-10 program. Taking one lesson from the C-5A's total package procurement, Brigadier General Elbert Harbour, the C-X System Program Office Director, did not elect to obtain price options beyond fiscal year 1986 during source selection.[198]

Secretary of the Air Force Hans Mark approved the C-X Source Selection Plan in December 1980. Brigadier General Harbour followed with a source selection procedural document. Organizationally, the secretary of the Air Force elected to retain source selection authority. Lieutenant General Skantze as the Commander of the Aeronautical Systems Division was the chairman of the Source Selection Advisory Council* with Brigadier General Harbour, as the Director of the C-X SPO, serving as the chairman of the Source Selection Evaluation Board. The board consisted of four panels—operational utility, design approach, program adequacy, and life cycle cost—and a contract negotiation team. Under the panels were the item and factor evaluators with Army civilian Maurice Gionfriddo heading airdrop features evaluations. The source selection board was multi-command and multi-service. It was an extensive and thorough undertaking, involving well over a hundred

*Member organizations were Aeronautical Systems Division, Air Force Systems Command, Military Airlift Command, Air Force Logistics Command, United States Air Force, Office of the Secretary of the Air Force, US Army, and US Marine Corps.

people. The Strategic Air Command sent a representative for "alternate" missions that included considering the C-X for battlefield surveillance, communications relay, cruise missile carrier, tanker, and airborne command post operations. In addition to the advisory council, other organizations assisting Brigadier General Harbour and the source selection effort were the Air Force Contract Management Division, Air Force Flight Test Center, Air Force Inspection and Safety Center, Air Force Test and Evaluation Center, Air Force Wright Aeronautical Laboratory, Federal Aviation Administration, and the National Aeronautics and Space Administration.[199]

**Source Selection Evaluation Criteria**

**Operational Utility**

En route performance
Departure/arrival mission performance
Ground operations
Alternate missions
Airdrop/LAPES
Crew compartment
Reliability
Maintainability
Availability
Logistics support analysis
System supportability
(+ austere and forward airfields)
Safety

**Design Approach**

Performance verification
Structural design
Landing gear design
Configuration design features
Flight stability and control
Propulsion
Secondary power
Avionics
Cargo/crew compartment design
Airdrop features
Support equipment
Survivability/vulnerability
Environmental impact

**Program Adequacy**

Program management
Design to life-cycle cost plan
System test planning
Engineering planning
Manufacturing/production planning
Manufacturing technology planning/producibility
Quality assurance
Integrated logistics support planning
Interim contractor support planning
Spares provisioning
Data management planning

**Life-Cycle Cost**

FSED costs (R&D 3600)
Weapon system costs (production 3010)
Other support costs (using and supporting command incurred costs)
O & S costs (3400)
Realism, reasonableness, and completeness

Source: HQ ASD, Source Selection Plan For C-X, 6 December 1980.

Per the plan, the source selection authority (secretary of the Air Force) would select the contractor by "an integrated assessment" of the proposals. "The integrated assessment will be based on the Government's determination of the overall value of each proposed system to satisfy Air Force needs, judged in terms of capability in comparison with system costs." It would also entail evaluating the "risks involved with the design, subsystem integration, manufacturing process and proposed program of each contractor, including the offeror's analysis of know risks as provided in the RFP." The plan acknowledged that the task was inherently subjective. The Air Force retained the right to award the C-X contract on other than the lowest price offered or the best life cycle cost.[200]

Along with the operational utility criteria, the mission scenarios detailed in the preliminary system operational concept and the request for proposal represented the minimum operational performance desired. Essentially, contractors were to design a C-X aircraft that could perform four mission scenarios: a mid-range air refueled mission; a long-range, nonstop mission; a long-range, unrefueled mission; and a theater redeployment. The long-range, nonstop mission, for example, entailed flying 6,300 nautical miles from the main base to the deployed base or small, austere airfield. The range between the deployed base and the austere airfield was 500 nautical miles. Aerial refuelings would be used instead of stopping at en route bases. Theater facilities available included two deployed bases and three austere airfields. The mission called for airlifting, within 25 days, a mechanized brigade (20,000 short tons* of which 12,000 tons were outsize) and an air assault brigade (9,000 short tons of which 1,000 tons were outsize). The average utilization rate was 16 hours per aircraft per day. Daily sortie rates stipulated the use of a specified number of C-5s, C-141Bs, and C-130s. The mid-range air refueled mission spanned a distance of 3,200 nautical miles while the long-range, nonstop mission's longest leg was 2,400 nautical miles.[201] Thus, for each mission the contractor needed to come up with the number of C-X aircraft required. The designs offered by the contractors flowed from the mission scenarios and the system specifications in the C-X RFP. But it was not that simple. The proposal was an extensive document containing hundreds of pages, and the capabilities desired were extensive.

In light of future discussions on outsize equipment and weight growth, the C-X, at this juncture, was required to transport the following major items. The list also included shop vans, heavy-duty trucks, semi-trailers, and water and fuel trucks. The weights of these vehicles varied between 15,000 and nearly 46,000 pounds. Additionally, there was the requirement that the C-X be able to haul three infantry or cavalry fighting vehicles, a grand total of 145,500 pounds.[202] Those associated with the early days of the program remarked that the C-17 was essentially designed for hauling rolling stock.[203]

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*A short ton is 2,000 pounds; a long ton is 2,240 pounds, and a metric ton is 2,204.6 pounds, precisely 1,000 kilograms.

| Nomenclature | Configuration | Weight |
|---|---|---|
| XM-1 Tank | Operational | 130,000 lb. |
| M-60A2 Tank | Operational | 117,200 lb. |
| M-60A3 Tank | Operational | 119,500 lb. |
| Division Air Defense Gun System (DIVAD) | Operational | 108,300 lb. |
| Multiple Launch Rocket System | Operational | 50,000 lb. |
| Infantry Fighting Vehicle XM-2 | Operational | 48,500 lb. |
| Cavalry Fighting Vehicle XM-3 | Operational | 48,500 lb. |
| Tractor D8K-85-8 | Reduced AR-220-10 | 86,422 lb. |
| Howitzer Medium Towed 155 MM | Operational | 15,150 lb. |
| AH-64 Helicopter | Minimum Reduction (142 in. height) | 12,620 lb. |

By the end of January 1981, Boeing, McDonnell Douglas, and Lockheed had submitted technical and cost proposals with the final amended offers due in June and a revised desired contract award date of 10 August. The C-X Source Selection Board took up its official duties on 19 January 1981. Over the next two days, the three potential manufacturers presented their proposals to the board.[204]

Essentially, Boeing and McDonnell Douglas dusted off and expanded upon their tactical AMST prototypes while Lockheed submitted a wide-body C-141. Boeing's design incorporated technology and experience gained from its YC-14 and its commercial, intercontinental, three-engine B-727. Unlike the YC-14, Boeing's C-X was a three-engine aircraft. McDonnell Douglas proposed a bigger YC-15. Lockheed combined what it had learned from its C-141 and C-5A aircraft and offered a high wing aircraft with four engines on the wings. Both Boeing's and McDonnell Douglas' designs had winglets. All essentially presented an air refuelable plane with the same wingspan and length of a C-141B model but with outsize equipment carrying capability of the C-5A. One C-X Task Force member recalled that they generally did not regard Lockheed's C-X design as a serious effort, for "Lockheed's corporate decision makers in Burbank, California, were from the very beginning wanting to sell the Air Force more C-5s."[205]

On 24 April 1981, Secretary of the Air Force Verne Orr informed Senator John G. Tower (R-TX), Chairman of the Senate Armed Services Committee, that Lockheed's C-5 proposal could not meet the minimum requirements of the C-X request for proposal. "It does stand alone and remains a contender as one of the options for airlift augmentation as a part of a possible mix with other aircraft. Programs being considered by the Air Force for the overall airlift mix continue to be combinations of the C-5 or C-X for all classes of cargo, including outsized, and commercial wide-bodies, KC-10, and enhancement of the Civil Reserve Air Fleet (CRAF) for bulk and oversized airlift."[206] As a result, Lockheed pressed with a C-5 advertising campaign, namely in *The Wall Street Journal*, *Armed Forces Journal*

*International*, and *Air Force Magazine*. Likewise, OSD issue papers had more C-5 questions.[207]

Orr's letter revealed a confused state. He was not convinced about the C-X and expressed this again in late June during an airlift procurement strategy meeting. Subsequently, he canceled the briefing scheduled for the Defense System Acquisition Review Council principals. A few days prior, and obviously of little avail, Secretary of the Army John O. Marsh Jr. had lunch with Orr, stressing the need for airlift and reaffirming the value of the C-X against the C-5. Over the next several weeks, Orr's position changed. In July, Secretary Orr received a briefing on the urgency of meeting airlift mobility requirements recommended by the *Congressionally Mandated Mobility Study*, and in early August, when briefed by Brigadier General Harbour on the source selection, he began to support the C-X concepts of direct delivery, outsize cargo, and intratheater airlift. The turning point came in mid-August when Secretary Orr got behind the C-X. Some credit for Orr's change appears due Colonel John C. Swonson Jr., Colonel Vincent Hughes' replacement at Headquarters MAC, who briefed Orr on the acquisition strategy at this time.[208] Thereafter, it was a matter of deciding upon Boeing's or McDonnell Douglas' proposal.

On 28 August 1981, the Air Force announced McDonnell Douglas' design as the winner. In September, the C-X became designated the C-17.[209] The C-17 was a larger and heavier version of Douglas' AMST YC-15. Recalling the selection several years later, Colonel Robert Cole remarked, "it had every capability the Task Force had hoped for. The size growth was due to the way McDonnell Douglas chose to satisfy the RFP scenario requirements and they won the competition based on four factors—operational utility, life cycle cost, design approach, and adequacy of their development and production program."[210] Even though Boeing's aircraft had a larger wing, which usually meant more range, "the McDonnell Douglas design beat the other two by a mile, by a mile. The other two had very low payloads and could still only barely get to the 2,400-nautical-mile range."[211] Low payloads translated into buying more aircraft, which was unlikely given the political climate and funding limitations. Moreover, Lieutenant General Charles L. Johnson II remembered from his days on General Harbour's staff that besides meeting the closure times of the scenarios—and that was the requirement, McDonnell Douglas designed an aircraft big enough to carry a 172,000-pound payload 2,400 nautical miles, exceeding the preliminary system operational concept's requirement of 130,000 pounds. Thus, in actuality, McDonnell Douglas provided more capabilities, but this was soon forgotten after source selection, and the payload and range of 172,200 and 2,400 nautical miles "stuck in everybody's head."[212]

Powered by four Pratt and Whitney JT10D turbofan engines (each rated then at 37,000 pounds of thrust),* McDonnell Douglas offered an aircraft capable of a maximum gross take-off weight of 570,000 pounds and a design payload of 172,200

*Current C-17 specification data is contained in Appendix III.

pounds (at 2.25Gs) for 2,400 miles. The plane would have a long-distance cruise altitude of at least 28,000 feet with an air speed of .77 Mach. The C-17 would land on a small, austere airfield of less than 3,000 feet with a 172,200-pound payload and take off again with a 70,000-pound load. Bettering the specifications, the highly maneuverable C-17 would perform a three-point star turn in 73.5 feet. It would accommodate 102 paratroopers and up to 40 A-22 containers for airdrop missions with a total airdrop payload of 110,000 pounds and a single unit payload of 55,000 pounds. Typical C-17 loads envisioned were three infantry fighting vehicles at approximately 49,000 pounds each; one combat fighting vehicle at 48,000 pounds and one M-1 tank at 122,000 pounds; or one M-60 tank at 114,000 pounds and two M-113 armored personnel carriers at 20,000 pounds each.[213]

McDonnell Douglas had proposed an aircraft with proven technology. This favorably impressed source selection officials as well. The C-17 would use advanced composite structures fielded in the F-18, DC-10, AV-8B, and B-767, realizing weight and fuel consumption savings. The externally blown flap, supercritical wing, and thrust reversers represented technology tested in the AMST program. The externally blown flaps and directed lift control spoilers lowered airspeed and reduced takeoff and landing distances, enabling safe and routine operations into and from small airfields. Besides in-flight deceleration and rapid braking, thrust reversers made backing and ground maneuvering easier, especially under restricted conditions. The winglets came from design efforts on the DC-10, KC-135, and Gulfstream III programs. Both the winglets and the supercritical wing reduced drag, weight, and fuel requirements. Winglets also allowed for parking more aircraft in a confined ramp area, greatly improving the MOG factor (maximum number of aircraft on the ground). As previously stated, the turbofan engines were commercial engines and offered substantial savings in fuel and maintenance costs. The cockpit incorporated features from the F-18, the DC-9-80, B-757, and B-767. Computer technology and electronic displays would enable a two-pilot crew. The integrated digital autopilot and stability augmentation improved flying qualities by reducing the need for components. And with the head-up display providing critical flight information, pilots could make precision landings into small airfields. Using a 5-degree glide slope, a pilot could touchdown within 150 feet of a selected spot with the maximum payload.[214]

An ambitious schedule lay ahead for the C-17. The proposed schedule called for a first flight in July 1985. Dedicated initial operational test and evaluation would commence in June and end in September 1985. Airdrop testing would follow from August 1985 until December 1986. The Milestone III production and deployment decision was planned for late September 1985 with an initial operational capability date of September 1987 for 12[215] aircraft. This schedule never came to fruition. Both the first flight and IOC dates were off by some six years.[216]

Despite the selection, almost another year passed before McDonnell Douglas and the Air Force signed the C-17 contract. Secretary Orr had indicated during the source selection announcement and again in November that awarding the contract remained pending approval of the overall airlift plan and Secretary of Defense Weinberger's certification to Congress.[217] The C-X PSOC had called for developing schedules for a total aircraft buy of 150 and 200 aircraft with a decision on the total number of C-17s by the production contract award.

**Toward The Interim Solution**

Within weeks of the Air Force selecting McDonnell Douglas' design, Lockheed, astutely assessing the situation, submitted an unsolicited proposal for a fixed-price contract of $4.18 billion (1980 dollars) to provide 44 (later 50)[218] C-5Ns. Lockheed's *C-5 Airlift Augmentation Proposal* (September 1981) posed a serious challenge to the C-17. "This proposal offers the proven airlift capability to help satisfy the additional outsize/oversize airlift requirements identified by the *Congressionally Mandated Mobility Study* (CMMS) much sooner than any other approach, at much less cost, with no R&D funding, and no technical or cost risk to the Government."[219] Lockheed intended that the C-5N (what became the C-5B) would haul half of the 20 million ton-miles-per-day, leaving the remainder to "cargo capable widebody CRAF airplanes."[220]

Besides the attractive price of $95 million a copy, Lockheed promised a first aircraft delivery in December 1984 and an initial operational capability date of 1986, two years earlier than the C-17's. Lockheed also claimed the C-5N would be from 1.6 to 1.9 times more productive than the C-X in the CMMS mission scenarios, as its aircraft was an efficient airlifter of outsize, oversize, and bulk cargo. Because of its productivity, Lockheed projected cost savings of between $1.6 to $3.1 billion in acquisition costs and $2.1 to $7.1 billion in life cycle costs. Comparing the C-5N to the C-X request for proposal, the C-5N would transport a 244,000-pound payload 2,400 nautical miles to the C-X's 120,000 pounds for the same distance unrefueled. For short runway operations, the C-5N would deliver a 271,000-pound payload to a 4,000-foot forward airfield. Using maximum effort landing procedures, the C-5N would land a 203,250-pound payload using just under 3,000 feet of runway; the C-X request for proposal called for a 100,000-pound payload under the same conditions. The C-5N also hauled more outsize equipment per load, transporting two M-1 main battle tanks, or six infantry fighting vehicles, or six AH-64 helicopters.[221] Additionally, Lockheed asserted: "an examination of real-world airfields, rather than the generic parking ramps used in the RFP, indicates that there are relatively few airfields worldwide in which the C-X could operate and the C-5N could not."[222] As to austere airfield operations, "the Air Force has recently completed a series of off-runway tests to verify the capabilities of the C-5. The results clearly demonstrate that the C-5 can operate under austere conditions."[223] However, citing Vietnam policy experiences, which restricted the C-130s more than the C-7s and C-123s during hostile conditions, Lockheed doubted that both the C-5N and the C-X, which cost five to six times more than a C-130, would operate routinely into forward areas. Thus, why the ado over austere operations? The C-5N would be an upgraded, more state-of-the-art C-5A with over 100 system improvements. One attractive enhancement cut the maintenance manhours per flying hour from 74.1 for the C-5A to 39.6 for the C-5N. Another upgraded the General Electric TF39-1A engine to the TF39-1C, reducing the engine removal rate by 50 percent. Lockheed also offered a new simplified landing gear system, further curtailing maintenance down time.[224]

The Military Airlift Command expressed skepticism after reviewing Lockheed's offer. Lieutenant General Robert F. Coverdale, the Vice Commander of the Military Airlift Command, advised Lieutenant General Kelly H. Burke, the Air Force Deputy Chief of Staff for Research, Development, and Acquisition, that the proposal "is inaccurate and misleading in some areas. Lockheed obviously based their conclusions primarily on load classification numbers* (LCN) and excluded all of the primary airfield constraints, such as runway length, width, surface, taxiway width, and available parking."[225] Lockheed ignored the weight bearing capacity of the areas adjoining the runways and taxiways. With its large size and lacking a backing up capability, the C-5N would have to use these areas on most airfields with runways no greater than 3,000 feet by 90 feet. Disputing Lockheed's claim that there were few airfields in Central Europe or Southwest Asia that met the combined length and strength criteria, General Coverdale asserted there were over 900 airfields that met or exceeded the C-X requirement of greater than 3,000 feet, with most meeting strength requirements for contingency operations. As to the 3,000 by 90-foot runway with 50-foot taxiways and parking areas as small as 75,000 square feet, there were 276 airfields in Central Europe and Southwest Asia (113 and 163, respectively). Based upon just the runway width (79 feet for the C-17 versus 148 feet for the C-5N), the C-17 could use 194 airfields to the C-5N's 82. At this time, the Military Airlift Command's regulations did not allow off runway, taxiway, and parking area operations for the C-5, as such operations could not be supported in war plans. And based upon the results from the C-5A Operational Utility Evaluation, the Air Force Test and Evaluation Center concluded that C-5A off pavement operations needed real-time onsite soil strength data to avoid rutting problems. Thus, when the total airfield environment was considered, the C-17 had a three to one advantage over the C-5N.[226]

The Military Airlift Command and the C-17 System Program Office also questioned Lockheed's delivery schedule, as the initial operational capability date

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* Ground flotation is the measure of an aircraft's ability to operate on an airfield surface of a defined strength. Load classification number is the classification of the aircraft stress load on rigid pavement. It includes the load, tire pressure, tire footprint, and number of tires. It is also used to define the specific runway capabilities. The aircraft to pavement LCN ratio is an indicator of permissible takeoff frequency to runway damage. The California Bearing ratio is the unpaved runway load bearing capability: CBR 9, sandy clay with good subgrade; CBR 40 poorly graded gravel and clay with good subgrade and subbase; CBR 60 well graded gravel with good subgrade and subbase; CBR 100 crushed limestone with good subgrade and subbase. The relationship between LCN and CBR is not well defined.

was based upon receiving approval between November and January 1982. There was also an assumption that subcontractors could tool and provide parts on time. Moreover, the TF-39 engine was currently out of production. Despite Lockheed's claim to the contrary, there was good reason to believe that Lockheed would have to expend some time researching and developing, especially for the new skin, fasteners, and strengthened wing. Lockheed's assertion of a four percent increase in the thrust of the TF-39-1C engine for critical takeoffs turned out to be a change in the maximum temperature margins. Lockheed used 2.0G limits to show additional capability when 2.25G was the minimum stated in the C-X request for proposal. In sum, Lockheed's "proposal is an excellent piece of marketing," one Military Airlift Command staff officer advised.[227]

As feared by the Air Force, Air Force Systems Command, and Military Airlift Command, Lockheed's offer and the subsequent visits by both Lockheed and Boeing officials with Dr. Richard D. DeLauer, the Deputy Secretary of Defense for Research and Engineering, caused the program to become unsettled for several months. Dr. DeLauer was a key figure in providing Congress the requested certification and Department of Defense endorsement, and he was not satisfied that the C-17 was the right decision, considering the available options. It did not help that Boeing's June offer of 747s had not reached his desk. Even though the Air Force Systems Command and the Air Force reaffirmed all previous analyses, DeLauer held up forwarding the congressional certification to Carlucci for months, requesting the Air Force analyze and reanalyze the C-5N and the C-17. In a 30 October meeting with Air Force representatives, Deputy Secretary DeLauer concluded with a recommendation to purchase C-5Ns and KC-10s. At an early December news conference, DeLauer publicly stated his reservations.[228] Thus, while the Air Force had decided on the C-17 with McDonnell Douglas as the contractor, the Office of the Secretary of Defense apparently had not.

Finally, on 7 December 1981, as stipulated by Congress in the Department of Defense Authorization Act for Fiscal Year 1981, Secretary of Defense Caspar W. Weinberger certified:

> 1. that the national security requirements of the United States for additional military airlift capability merit initiation of the C-X program;
> 2. that the magnitude and nature of the military cargo and material to be airlifted to the Indian Ocean area and other areas of potential conflict are sufficiently well-defined to permit identification of a deficiency in military airlift capability;
> 3. that the magnitude and characteristics of military cargo and material to be transported by air to such areas are sufficiently well-defined to provide clear justification and design parameters for such aircraft; and
> 4. that plans for such aircraft are sufficiently well-developed to make such full-scale engineering development both economical and technically feasible.[229]

Secretary Weinberger, however, closed on a cautionary note: "The Department has not yet reached a final decision on which of the various alternative aircraft programs to pursue."[230] Secretary Weinberger was heeding the advice of Dr. DeLauer. Late in November, DeLauer wrote Weinberger that although he generally favored the Air Force's preference for the C-X over the C-5 or the 747, he was concerned about proceeding with the C-X program for several reasons:

> While recognizing a requirement for more airlift, Congress is reluctant to start a development program for a new aircraft. Experience shows that development programs usually cost considerably more than initial estimates and Congress has a perception that commercial aircraft can do the job at a much cheaper price. We should consider carefully whether there is sufficient chance of the program failing in Congress and thus not redressing the airlift shortfall to justify the risk of proceeding with this new development. Additionally, I am concerned about controlling procurement costs for the C-X after the initial aircraft buy.[231]

Nevertheless, DeLauer recognized Weinberger needed to indicate to Congress support for improving airlift to preserve funding and had drafted the certification with the caveat.[232]

At this juncture, Major General Perry M. Smith, the Air Force Director of Plans, weighed in with the operational commander's view. Writing to the influential Dr. James P. Wade Jr., the Principal Deputy Under Secretary of Defense for Research and Engineering, Smith offered some "informal and personal observations concerning the C-17/C-5 debate." He had formerly commanded a tactical fighter wing in Europe and had worked closely with the Army. Smith noted: "Since any airlift aircraft will reduce the shortfall and can be made to appear the most attractive by scenario manipulation, the best long term solution for the nation may become obscured by a deluge of salesmen, brochures, and argumentation."[233] Furthermore,

> My eight years of operational experience in NATO and review of the other CX/CMMS scenarios lead me to only one conclusion: The Air Force accurately described the national airlift aircraft requirement in its C-X MENS and RFP. The requirement for a military airlift aircraft that can carry outsize, oversize, or bulk cargo over intercontinental ranges; operate on main operating bases without degrading the launch, recovery, or service of combat aircraft, even while subject to enemy attack; support operational commanders at the small, austere airfields in the battle area; and deliver by all known means (airland, airdrop, extraction) is still valid.
>
> We need an outsize airlifter that can operate when we are at war and the bombs are falling on very busy airfields in overseas areas. During my 2 years at Bitburg, the C-5 landed there once to deliver the F-15 simulator. It

could not get off the runway since the taxiways were too narrow. Even if it could get off the runway there was practically no place to park it without seriously interfering with peacetime operations. Needless to say the wing commanders at Hahn, Bitburg, Zweibrucken, Sembach, etc., would not have much trouble choosing between C-17s and C-5s for the outsize airlifter of the future. I would be remiss if I didn't reflect their point of view. Certainly the operational commander's concerns should have some weight in the decision calculus of OSD.[234]

Wade was to carry the message to his boss, Richard DeLaurer. However rational and sound the viewpoint, the time for favorable consideration had become superseded by politics and funding realities.

**Carlucci Decides**

Taking into account congressional actions and OSD staff recommendations, Deputy Secretary of Defense Frank Carlucci informed Secretary of the Air Force Verne Orr on 22 December 1981 that he was postponing the Air Force's request to select the C-17 until the Air Force completed further analysis. Carlucci directed the Air Force to prepare no later than 8 January 1982 a system analysis study of the C-17 and all alternative proposals, ranking each in terms of military utility, acquisition costs, life cycle costs, production schedules, and relationship to the Civil Reserve Air Fleet.[235] The Air Force's position became finalized the last week of December 1981. Air Force Chief of Staff General Allen held two meetings on 30 December; discussions centered on the C-17, KC-10, and Civil Reserve Air Fleet programs. On 8 January 1982, Secretary Orr briefed Carlucci. In attendance were Dr. DeLaurer, the service secretaries, and key military staff officers. Orr told Carlucci the Air Force sought in the near term 40[236] KC-10s and in the long term 134 C-17s (with a revised initial operational date of 1988). Orr would also pursue additional CRAF enhancements and aircraft modifications.[237] This position would soon be changed.

**1981 Air Force Ranking of Airlift Candidates**

| Aircraft | Program Risks | Outsize Cargo | MHE | Maneuver-ability | Intra-theater | Maintain-ability | Man-power | Military Utility |
|---|---|---|---|---|---|---|---|---|
| C-17 | 4 | 2 | 1* | 1 | 1 | 1 | 1 | 1 |
| C-5N | 3 | 1 | 2 | 2 | 2 | 4 | 4 | 2 |
| B-747 | 2 | 3 | 4 | 4 | 4 | 3 | 3 | 4 |
| KC-10 | 1 | 4 | 3 | 3 | 3 | 2 | 2 | 3 |

*1 equals excellent.

Source: Hearings, House Appropriations, DOD Appropriations For 1983, Part 7, 97th Cong., 2d sess., 1982, p 24.

The end of January 1982, Deputy Secretary of Defense Carlucci decided in favor of the C-5N, and Weinberger agreed. The service secretaries and the military leaders were simply to comply.[238] Selected as the official spokesperson, Lieutenant General Kelly Burke stood before the press in the Pentagon briefing room on 26 January and provided the rationale for the Weinberger-Carlucci decision. Burke explained the about-face: "in the process of presenting the airlift issues to the Deputy Secretary of Defense and the Secretary of Defense, they were, I think, powerfully struck by our argument that there is a compelling and urgent need for airlift. They directed us to go back and reexamine both of these [C-5N and C-17 programs] with a different financial assumption and that was that you would lay out the program where neither are restrained by funding limitations."[239] With unrestrained funding, the C-5N could simply be delivered faster than the C-17 by approximately three years because it did not need to go through an extensive research and development phase. Burke acknowledged the loss in short and austere airfield capabilities. But rationalized: "It's a swap. It's a somewhat better capability that you forego in favor of a much earlier availability of a good capability."[240] For the good capability, Burke said the Air Force would be spending $8 billion (then year dollars)[241] for the C-5Ns over the next five years versus the $5.5 billion planned. While General Burke did an excellent job fielding the questions during the press briefing, he equally left no doubt that he was personally still interested in the C-17: "Well, my regret is that we didn't get started on this earlier and with a whole lot more vigor than we did. I wish that it had been received with welcome arms when it was first presented to Congress and that we were now two years down the road to a C-17."[242]

On 5 February 1982, Secretary of the Air Force Verne Orr announced an airlift enhancement program. To the Army and Navy service secretaries and to the chairman of the joint chiefs of staff, Orr provided further details in a memorandum. "As the FY 83 budget process drew to a close, the Secretary of Defense, in recognition of our continuing serious shortfall in airlift capability, was able to make available significantly increased funding in the near term for airlift acquisition. Based on this, I decided on a near term airlift enhancement program which provides for the acquisition of 44 KC-10's (to be considered mobility assets), and 50 C-5's."[243] Orr's plan included a "modestly paced" research and development (R&D) effort to preserve the C-17 as the long-term solution. Secretary Orr had changed his previous position, reasoning that the C-5 could be operational sooner than the C-17, thereby providing an immediate 3.8 MTM/D capability. He was now willing to buy existing, less-advanced systems, having been convinced that the nation's need to address the strategic airlift shortfall warranted such measures. Secretary Orr was also mindful that Congress had eliminated research and development funding for fiscal year 1982 but would provide funding for a near-term program.[244] The new Reagan administration was also inclined to spend money on addressing the airlift shortfall. Thus, Orr's shift to the OSD position became shaped by the knowledge that funding was there for the taking, if the Air Force would settle on more C-5s and KC-10s. Purportedly, Carlucci had made this point with Orr. Lieutenant General Burke confirmed that doubling airlift funding had swayed the Air Force from the C-17 to the C-5.[245]

Additionally, Secretary Orr stated in his memorandum that he was no longer fully committing the Air Force to the long-term solution: "This effort [reprogramming C-17 R&D funding] will also preserve the option of initiating a C-17 development program in FY 84 if we later deem it appropriate as part of our long term airlift acquisition plan."[246] General David C. Jones, the Chairman of the Joint Chiefs of Staff, replied: "In summary, I support your decision on near-term airlift acquisition and, further, intend to continue emphasizing the need to program a more complete airlift posture for the 1990s. In this timeframe, we must be ready to begin replacing the C-130 and the C-141 aircraft. We must pull together—I support your efforts."[247] Jones also stated his belief that "airlift aircraft with C-17 features will be needed in the future."[248] General Jones' comments revealed the C-5 decision as myopic and lacking in providing a comprehensive solution.

The near-term airlift decision proved controversial and raised legal questions. Clearly, the government damaged its integrity. Missouri Senators John C. Danforth and Thomas F. Eagleton, republican and democrat, respectively, came together to defend McDonnell Douglas' interests. The two Yale and Harvard-trained lawyers "strongly question the legality of setting up a competition among different potential suppliers, choosing a winner of the competition and then arbitrarily awarding the contract on a 'sole source' basis to a loser of the competition."[249] In an internal memo, William H. Taft IV, then the Defense Department's General Counsel had forewarned in December that deciding upon the C-5B after the C-17 had won the airlift design competition might bring legal claims by the aircraft manufacturers. In fact, John T. Sant, McDonnell Douglas' General Counsel had hinted such in a letter to Taft.[250] Moreover, as McDonnell Douglas' official press statement claimed, the decision shammed the government's acquisition policy. "To overturn the judgment of the Air Force evaluators and to reject endorsements from the Army and Marine Corps is to make a mockery of the competitive procurement process. It undermines the competitive nature of doing business with the government and is simply contrary to the government's own established procurement practices."[251] But with the F-15C/Ds in production and new KC-10s and F-18s, McDonnell Douglas had a consolation prize, making it difficult to pursue legal recourse.

William H. Gregory, the editor-in-chief of *Aviation Week and Space Technology* was equally pointed in his criticism: "Last year the Air Force completed a competitive source selection and chose Douglas to build its entry as the C-17 . . .. What the winning contractor had won was the right to build an unfunded airplane."[252] Gregory also revealed that much of the uniformed Air Force found out about the decision after the word leaked out following congressional notification to Danforth and Eagleton. And the decision came after three of the five joint chiefs of staff generals had just written a letter endorsing the C-17 to the Defense Subcommittee chair, Senator Ted Stevens. Gregory, however, did see some merit for an interim program but chided the process:

> Despite Carlucci initiatives—the Defense program for improving the acquisition process—the C-17 reversal was hardly an example of the promised placing of more decision-making into the hands of the services. The image of the Pentagon decision-making process is now sinking to the level it had in the days of the Carter administration.
>
> Credibility of the Carlucci initiatives with industry is evaporating. Companies who invested as much as $50 million in the C-17 competition only to face it turning into nothing should the C-17 development not go ahead are going to think long and hard before investing any more research and development money in what may be will-of-the-wisp programs.
>
> If the Defense Dept. had no intention of going ahead with the C-17, it could have saved much money and much face for the services in dealing with industry by stopping the competition in the first place. Congress will undoubtedly have some tough questions about this kind of airlift decision-making in a year when a burgeoning Defense budget and a burgeoning federal deficit are political hot potatoes.[253]

The potatoes did not take a year to heat. Efforts were already underway to redress the decision, and politics was the means.

**B-747 Vs C-5B**

Following the controversial C-5B announcement, Boeing's chairman, Thornton A. Wilson, submitted another unsolicited proposal to Defense Secretary Weinberger. Wilson regarded the rewinged C-5s as being able to handle the outsize requirements stipulated in the *Congressionally Mandated Mobility Study*. Thus, the proposed procurement of 50 C-5Bs and 44 KC-10s[254] would meet deficiencies in bulk and oversize cargo—the same role 747 freighters could fulfill. Essentially, Boeing offered four options: 69 new B-747-200Fs for $59 million a copy (1981 dollars); 48 new B-747-200F, for the same unit price; 50 modified and refurbished B-747-100/200 for $44 million per aircraft (1982 dollars); and 50 modified and refurbished B-747-100/200 plus 36 747 tanker/cargo aircraft for $44 million and $48 million (1982 dollars), respectively. The Air Force could have either new 747s, which would provide the equivalent of both the C-5B and KC-10; new or used 747s, which would give the equivalent airlift of 50 C-5Bs; or used 747s, which would furnish the equivalent of 50 C-5Bs and the KC-10's cargo/tanker capability. Depending upon the course selected, Boeing proclaimed that the Air Force could obtain the 747s from three to four years sooner than the near-term solution, avoiding acquisition costs of up to $6.9 billion dollars. Additionally, there would be even greater savings in operating and support costs. Boeing guaranteed the service life of the modified 747s for over 20,000 flying hours or ten years, whichever occurred later. The downturn in the airline industry and the subsequent need for working capital had enabled Boeing to put together the attractive offer.[255]

The proposal merited consideration. Although the Air Force had not selected Boeing's B-747 freighter as an alternative to the C-17, it had come in second to McDonnell Douglas' KC-10. There were issues, however, which General Lew Allen explained to Senator John Tower, whose Armed Services Committee was expressing interest in a 747 freighter alternative:

> The principle attraction to this offer is that the used aircraft could be presumably purchased at lower cost and would have sufficient life to provide many years of service to the Air Force. A major concern is that the 30 747's identified by Boeing as available for this purpose, 12 are owned by US firms and are already available to us in emergencies for passenger and bulk cargo carriage. The other 18 are foreign owned and consequently they would represent additional capability. But by acquiring these aircraft a collateral result may be to improve the financial and competitive position of these foreign carriers relative to US flag carriers.[256]

Allen disclosed that he desired Tower to support the interim solution, as the Air Force regarded meeting the outsize requirement the "most serious deficiency." General Allen further revealed: "In particular, acquisition of used 747's (or for that matter, used DC-10's) might be an attractive alternative to the expanded CRAF freighter program we have planned and funded in 1984-87."[257]

Boeing's offer directly challenged Carlucci's and Orr's decision to procure C-5s and KC-10s in the near term. It was a challenge Boeing was willing to wage. In 1965, during the selection of the CX-HLS, Thornton Wilson, then the Vice President and General Manger of Boeing's Military Airplane Division, had hoped to land what was touted as the aviation industry's biggest and most lucrative aircraft venture. The winner would dominate the aviation industry for years to come. Boeing and Douglas had invested millions in the CX-HLS venture only to lose to Lockheed's C-5A. A few years earlier, Boeing as well as Douglas Aircraft* had also vied for building a new strategic airlifter and lost to Lockheed's C-141.[258]

Replying to Wilson on 6 May, Deputy Secretary Carlucci maintained commercial freighters "more appropriately belong in the CRAF rather than the Air Force organic airlift force."[259] This decision was in keeping with the National Airlift Policy, the *Presidentially Approved Courses of Action* (1960), which the government and the Congress had agreed on following a desire by some segments of the airline industry to take over most of the military's air transportation business. Per this policy directive, the military's air transport operations were confined to airlifting "hard-core" military requirements. Modernization programs, which fielded the C-141 and the C-5A, were justified on this basis. The policy further decreed that commercial

*In April 1967, the McDonnell Aircraft Corporation and the Douglas Aircraft Company merged to become one corporation, McDonnell Douglas.

carriers in the Civil Reserve Air Fleet program perform the remainder of the military's airlift business.[260]

Wilson was not finished and answered Carlucci's letter on 11 May. Boeing's analysis of Scenario I (Persian Gulf), which was the most demanding one in the *Congressionally Mandated Mobility Study*, had resulted in almost identical values for either 50 C-5Bs or 48 747s.

> Therefore the statement that 50 C-5Bs provide more capability than an equal cost force of 747s is not supported by the facts. Based upon the Boeing firm fixed price commitments for <u>both</u> procurement and 20-year operations and support costs, the life cycle cost of 50 C-5Bs as defined by the USAF would provide a fleet of 83 747Fs. Therefore evaluation of equal cost fleets for airlifting CMMS defined forces strongly favor the 747 solution by the 'brigade days' measure as understood by Boeing.[261]

Boeing continued to press its case, and as a result, a real battle ensued in the Senate between C-5B proponents and those who favored the B-747. Both Lockheed and Boeing could count on members of Congress to represent their interests and line up support. Georgia Senator Sam Nunn (D) was the foremost C-5B supporter while Washington Senators Henry "Scoop" Jackson (D) and Slade Gorton, III (R) teamed to block reopening the C-5 production line, submitting an amendment that purchased B-747s instead. The amendment kept the request for KC-10s. Senators Danforth and Eagleton from Missouri, home to McDonnell Douglas, and Senators Nancy Kassabaum (R) and Robert Dole (R) from Kansas, the state where the refurbishment work for the B-747s would have been done, sided with Jackson. Senators John Glenn (D-OH), and Jake Garn (R-UT) supported the C-5B. The Republican Charles Percy (IL) went along with the Reagan administration's request for C-5Bs but openly championed the C-17, keeping the Air Force and his St. Louis-based neighbor—McDonnell Douglas—happy. The Republican Whip, Alaska Senator Ted Stevens, championed the C-17 as the "final and best" solution and even attempted to provide more money for the C-17. The influential Stevens ended up siding with the B-747 proponents because the aircraft could be available right away with the C-17 to follow. Going against the recommendations of its Armed Services Committee and the President's near-term program for 50 C-5B aircraft, the full Senate attached the Jackson-Gorton amendment by a voice vote to the Fiscal Year 1983 Department of Defense Authorization Bill.[262]

The turn of events was surprising. Those offering an explanation mentioned Braniff International suspending airline service the day of the vote. There was Boeing's mass appeal to its many subcontractors, Senator Jackson's standing and influence,[263] and the support of airline presidents. The lack of last-hour efforts by Air Force officials for the C-5B did not help as well.[264] One could also add the mounting budget deficit.

Washington Representative Norman D. Dicks (D) would introduce an identical amendment to the full House of Representatives. In June, the House Appropriations and Armed Services Committees held hearings. The sides became drawn. Right before the House voted in July, President Ronald Reagan sent a letter to key members of Congress. He laid out his desires: 50 C-5Bs to reduce the shortfall in outsize cargo capability, 44 KC-10s to increase air refueling and cargo capability, an expanded Civil Reserve Air Fleet Enhancement program, and lastly C-17 research and development funding to preserve the option of procuring the C-17 in the late 1980s to provide outsize capability and as a potential replacement for the C-130s and C-141s. "In summary, I hope you will agree that the Department of Defense should not be required to substitute commercial aircraft that do not meet our needs. There are no savings if what we buy will not do the job that needs to be done."[265] At this time the Military Airlift Command flew a C-5 to Andrews Air Force, Maryland. As the congressional members watched, Colonel Donald Dessert and crew knelt the C-5, offloaded a Cobra helicopter, and were airborne again in five minutes. With its cargo deck 18 feet off the ground, the B-747 could not compete.[266]

President Reagan effectively ended Boeing's run at the near-term solution, and the House voted by more than a two-to-one margin for the Defense Bill, which included the C-5Bs.[267] The secretaries of the Air Force and the Army and the chiefs of staff of the Air Force had done their part as well by making personal appeals. On 4 June, Secretary Orr had solicited the help of the powerful Mel Price, Chairman of the House Armed Services Committee. Subsequently, Price had received letters from Army Secretary John Marsh and General Lew Allen. General Allen also had written Representative William L. Dickinson (R-AL) on 14 June.[268] Dickinson had chided the witnesses appearing before the House Armed Services Committee for their flip-flop with these words: "We have some corporate memory, here, while you fellows come and go, but everything used to sell the CX was what he [General P. X. Kelley] used to sell the C-5."[269] In the Senate, William S. Cohen (R-ME) was equally pointed in his remarks.[270]

The letter from Secretary Marsh was especially revealing as it laid bare the about-face the Army was making on behalf of the Air Force:

> I am writing to emphasize the Army's strong support for the C-5 aircraft. The Army needs the C-5 to accommodate our outsized and extremely heavy military cargo and weapon systems.
>
> The Chief of Staff, General Meyer, has stressed in testimony and in letters to other members of Congress the need for additional aircraft capable of moving outsized cargo in both inter-theater and intra-theater operations. The C-5 was specifically designed for this purpose and is the only aircraft in being that can give us this capability.[271]

The Army's compromise was not General Meyer's. A few weeks later, the *St. Louis Globe-Democrat* quoted General Meyer's remarks at the Air Force Association's national symposium: "The C-5 and the 747 would not do the job and are not competitive [with the C-17]." The forum was a show of support for the C-17. Away from Congress and within the embrace of the Air Force community, Military Airlift Command Commander General James R. Allen candidly said that additional C-5s would not completely solve the strategic airlift shortfall nor remedy the growing deficit in intratheater requirements.[272] In fact, with 50 C-5B and 44 KC-10s, the military was still short by some 14-16 MTM/D in meeting the 66 MTM/D goal.

Meanwhile, from late spring until mid-summer 1982, the OSD, Air Force, and Lockheed had campaigned to prevent Congress from overturning the near-term solution, lobbying so hard in fact that the General Accounting Office disclosed, and Congress took action on, allegations of collusion between the government and Lockheed. Senator William Proxmire (D-WI) had requested the investigation, following the press gaining a computerized printout which detailed what became daily strategy meetings between Deputy Secretary of Defense Carlucci; Brigadier General Guy L. Hecker Jr., the Director of the Air Force Office Legislative Liaison; Lockheed President Lawrence O. Kitchen; and four other Lockheed officials. Assistant Secretary of Defense (Legislative Affairs) Russell Rourke and Secretary of the Air Force Verne Orr had direct knowledge of the meetings.[273] The fall months were filled with congressional hearings on the alleged illegal lobbying. The General Accounting Office was also bringing its investigation to a close. On 29 September 1982, Charles A. Bowsher, the Comptroller General of the United States, reported his findings to Representative Jack Brooks, Chairman of the Committee on Government Operations.

> We found that an extensive and cooperative effort was made by officials of the Air Force, the Office of the Secretary of Defense (OSD), the Lockheed Corporation, and several other Defense contractors and subcontractors during the period May 14, 1982, through July 22, 1982, to influence members of the House of Representatives, and later the House and Senate conferees, on the proposed $10 billion procurement of the C-5B aircraft. We found that this effort was initiated and directed by officials of the Department of Defense and that material, but undeterminable, amounts of appropriated funds and Government resources were spent for the purpose of influencing this procurement appropriation authorization measure which was pending before the Congress. Certain actions taken by Air Force and OSD officials to influence the Congress through the use of contractors were improper and violated the Federal appropriations act restrictions which prohibit the use of appropriated funds for publicity and propaganda purposes designed to influence legislation pending before Congress. Also, the Defense Department may have exceeded the limitations on the funds it can spend

on legislative liaison activities contained in the Defense Appropriation Act of 1982.[274]

The GAO report further disclosed that Lockheed officials had estimated lobbying costs of some $496,000, and there were additional advertising costs of $265,190. Lockheed initially regarded these costs as reimbursable. The report rendered that such reimbursements were prohibited by existing appropriations acts and urged the government to ensure Lockheed, Boeing (whose estimated lobbying and advertising costs were substantially less), or other contractors claimed no lobbying expenses. Government and Lockheed officials denied any wrongdoing.[275] In his testimony before the House Armed Services' Subcommittee on Investigations, Deputy Secretary Carlucci proclaimed, "It is our firm conviction that neither the Office of the Secretary of Defense nor the Air Force engaged in any improper or illegal lobbying activity."[276]

Although the report turned over its findings to the Justice Department for action, it noted a lack of successful prosecution. It further recommended that Congress write permanent legislation forbidding such lobbying and that the secretary of defense issue revised guidelines. What was proper conduct was well known. Government official working on behalf of their agency could provide information and correct misinformation. They could advocate for their programs even urging members of Congress to introduce, pass, or defeat legislation. They could not provide assistance with appropriated funds to a non-Federal person or organization for lobbying. They could not employ a cooperative lobbying effort with an outside party, such as a defense contractor.[277] Human interpretation resulted in missteps into the gray areas. The investigations made all parties exercise more caution.

The battle between Lockheed's C-5B and Boeing's B-747 raged again during the House and Senate conference session in August. After a disagreement, all of the procurement decisions were up for rework. The conferees considered giving all of the money to the C-5B program or dividing the money among the C-5B, B-747, and the C-17 with the C-5B getting the lion's share. They settled on the latter, authorizing $847.5 million for one C-5B and the start of the production line, $144.8 million to buy three B-747s for military modification, and $1 million for C-17 research and development. The disagreement left Senator Ted Stevens with an opportunity to oppose any appropriations for the C-5B, provided he obtained the votes.[278] In the end, when the Senate and House appropriations committee members met in late December 1982, the C-17 received $60 million. This represented a compromised victory for Senators Eagleton and Stevens,[279] who had sought $100 million. By year's end, it was also well know that Deputy Secretary of Defense Carlucci would be leaving government service.[280] He left office shadowed by claims of colluding with Lockheed officials.

In the aftermath of the C-5B-B747 contest, there remained hard feelings between the Office of the Secretary of Defense and Boeing as well as between Boeing and the other defense contractors. There was a riff as well as mistrust between OSD and

Air Force officials. The Office of the Secretary of Defense had prevailed upon Air Force leadership to accept the C-5B. Senior service officials had lost face publicly with their inconsistent statements. As to the members of Congress, the fray was well remembered. All of the politics, unfortunately, had little to do with providing the men and women of the armed forces with the best possible resources to conduct their missions.

**Low-Level Development**

Subsequent to Deputy Secretary Carlucci's interim decision, the Air Force published Program Management Directive #12, providing the guidance for expanding the airlift technology base, namely the low-level development activities. By May 1982, the C-17 System Program Office had refined the approach, and Brigadier General Harbour briefed Air Force Systems Command Commander General Robert T. Marsh. General March and Dr. Alton G. Keel, the Assistant Secretary of the Air Force for Research, Development, and Logistics, were in agreement by the end of June. Rather than incorporating more generic airlift technology, C-17 low-level development activities centered on the following:

- composite wing study
- high and low speed wind tunnel tests (drag reduction, externally blown flaps, and winglets)
- structural loads model testing
- engine/nacelle/thrust reverser model testing
- defining structural criteria
- initial avionics and the cockpit layout design
- developing external structural loads
- cargo and cockpit mockups.[281]

Secretary Orr authorized Brigadier General Harbour to award the McDonnell Douglas Corporation, Douglas Aircraft Company at Long Beach, California, a "modestly paced" research and development contract. Orr specified that the contract would be based upon the C-17's design, "focusing on those technical advances in the C-17 which also have benefit to other airlift programs."[282] Harbour awarded the $31.6 million contract on 23 July. The funding came from the unobligated fiscal year 1981 C-X research and development appropriations.[283] In his memorandum, Secretary Orr reiterated his caveat that this action preserved the option of proceeding with the C-17, if "we later deem it appropriate as part of our long-term airlift acquisition plan."[284]

These decisions had robbed General Harbour of the source selection team's expertise, as the team normally built up a SPO after selection. Harbour put the best face on the situation and rallied the few members—seven—that now comprised the C-17 staff. His message was: no one should jump ship. The ship—airplane—was not sinking; it was just going to require a lot more hard work to keep the program moving along. But it would be there. General Harbour believed in the source selection process; he maintained the right aircraft had been selected. He simply instilled his people to carry on.[285]

When McDonnell Douglas completed the modestly paced engineering program towards the end of 1983, the C-17 System Program Office continued the low-level development work, extending it from October to April 1984. The Office of the Secretary of Defense had released the funds authorized by Congress for reprogramming. Efforts centered on continuing wind tunnel testing, developing the thrust reverser, integrating avionics and flight control systems, analyzing internal loads and structural loads for major components, sizing for primary structures, engineering mockups, working on the cockpit display simulator, and conducting structural development tests. At this time, C-17 models completed all aerodynamic wind tunnel tests under the low-level development contract, amassing approximately 4,000 hours.[286]

The C-17 also benefited from emerging technology similar to what the commercial industry was just beginning to do. Lieutenant General Johnson recalled from his first tour at the C-17 SPO that although the size of the wind tunnel still drove the size of the models, microtechnology enabled so much more to be known about the whole airplane as well as the critical areas of the wing, fuselage, and T-tail.

> The models that we built were models unlike what had been done on any aircraft because they were so precise. The measurements that we were able to do from these models were because of microchips and digital technology that was coming on board in the early 80s. Today, we just take it for granted, but back then that was really neat stuff. We learned more about the aircraft's design and its airflow and what happens to the wings when the doors open at the back end and the gear is coming down. It was incredible. So that was $30 million well spent, and we felt very confident that this was a solid designed jet—the blown flaps, the size of the wing. McDonnell Douglas' design was to keep the wing shorter so you had ground maneuverability. So was there an adequate tradeoff because this was a big airplane with a shorter wing? And it all proved out in the wind tunnel test. It was a real, real success story, actually kind of a little know success story.[287]

The wind tunnel tests showed that the whole T-tail lost structure when the cargo door was opened. So the engineers beefed up the tail. The wind tunnel data points answered how thick and how long to make the wings. What size winglets and at what angle became known during wind tunnel testing. While testing yielded a good understanding of the airflow around the fuselage and wings, it could not introduce another object, such as a paratrooper, into the airflow and predict the results. At this time, there was nothing to suggest a major problem. The vortex off of the wing tip was a known and common aircraft phenomenon. The inability of the wind tunnel to generate a true full-up vortex or be in a real air mass masked the later personnel airdrop deficiency. Overall, wind tunnel testing did what it was suppose to do.[288]

As the wind tunnel data became available, it demonstrated to those people that favored the aircraft as well as the "doubting Thomases" that the C-17 was a solid airplane with great potential and a lot of capability. It was this type of factual data that also helped the program get to the Milestone II (full-scale engineering test and development) stage.[289]

Other significant activities during the low-level development program were the technical interchange meetings and the fabrication of mockups. The meetings proved invaluable by allowing for an exchange among the interested parties—McDonnell Douglas, the C-17 SPO, technical personnel, as well as the Military Airlift and the Air Force Logistics Commands. These sessions enabled a smooth transition to the preliminary design reviews later on. The mockup program was equally successful and could point to seven finished mockups: full-scale fuselage, 20-foot cargo loading system, empennage, flight deck/forward fuselage, wind leading edge, landing gear pod, and propulsion subsystem. There were "form and fit" trials of major subsystems. In September 1984, Air Force loadmasters and Army and Marine drivers spent two weeks demonstrating cargo and vehicle loading of Army and Marine unit equipment items to include outsized items like the M-1 tank. The demonstration validated the cargo compartment's dimensions, equipment tiedown pattern, and utility. It also proved the compatibility of the basic floor configuration with containers and commercial pallets. On another level, it underscored the benefits of developing a team effort.[290]

The C-17 System Program Office performed a program review of the C-17's engine with Pratt & Whitney in September 1982. Eleven PW 2037 engines comprised the development program. In December 1983, the engine was type certified at a sea level thrust rating of 37,600 pounds. By June 1984, the engines had amassed 7,913 hours and 24,300 cycles. When flight testing of the B-757/PW 2037 engine ended in October, the engine met or exceeded Federal Aviation Regulation 25 requirements for aircraft certification. Company officials estimated that the PW 2037, which the Boeing Aircraft Company had on its commercial B-757 aircraft, would have some six million commercial service hours by the time the C-17 met its initial operational capability date.[291]

**Airlift Master Plan And Validation Report**

Two documents in the mid-1980s substantiated the requirement and solidified support for the C-17. In September 1983, some two years after the release of the *Congressionally Mandated Mobility Study*, the Air Force finally followed with a much-needed *US Air Force Airlift Master Plan*. Signifying consensus within the Air Force community, both Verne Orr and General Gabriel cosigned the memorandum announcing the plan to the service secretaries, chiefs of staff, Marine Corps commandant, and unified and specified commanders. The master plan outlined the Air Force's commitment to modernizing its military airlift force structure, fulfilling CMMS' 66 MTM/D goal for strategic airlift, and retaining no less than the current intratheater capability of 9,000 ton miles per day (T/D). Like the *Congressionally Mandated Mobility Study*, the *US Air Force Airlift Master Plan* predicated a globally aggressive Soviet military for the foreseeable Cold War future. Airlift performed a crucial and indispensable role in the rapid delivery of forces and material during the United States' responses to worldwide threats. In determining the best force structure to meet anticipated airlift requirements, such factors as the military utility, operations and support costs, manpower, force stabilization, and force modernization were considered.[292] Besides the rapid deployment requirements levied by the recently established United States Central Command, the Air Force was also mindful of new developments in the Army's warfighting concepts. The Army's AirLand Battle increased heavy equipment and outsize cargo requirements as well as required rapid mobility. And if the High Technology Light Division,[293] which possessed the tactical mobility and firepower of a heavy division but the airlift and sustainability needs of a light division, became a reality, its deployment would require the equivalent of 1,000 C-141 sorties, minimizing outsize airlift missions. But as divisional airlift requirements dropped under the light concept, corps airlift requirements would rise, as the corps would now supply more assets to include outsize equipment. Both depended upon additional intratheater airlift for insertion, extraction, and support. Integrating intertheater and intratheater airlift took on added importance. The C-17's direct delivery capability fit well with the Army's evolving warfighting doctrine.[294]

After reviewing the options, the Air Force planned as the best course to retire 54 C-141s and 180 C-130s, transfer 180 C-141s to the reserves, and acquire 180 C-17s (210 total inventory) by 1998. The master plan regarded the C-17 as an "inter- and intratheater" airlifter with a direct delivery role, capable of small, austere airfield operations. This recommended force structure would meet the 66 MTM/D-requirement and increase the intratheater capability from 9,000 to 16,000 T/D. The C-17's lower life cycle costs due to fuel efficiencies and better reliability and maintainability more than offset the acquisition costs. Moreover, in its dual role, the C-17 eliminated the need to replace the 180 C-130s being retired, so the thinking went. The other option in contention retired 54 C-141s and 180 C-130s, transferred 180 C-141s to the reserves, and procured 156 C-5Bs and 180 C-130s. While this alternative could meet delivery and modernization requirements, it did not provide advantages in military utility, program costs, and manpower. The master plan touted the C-17 solution as costing $16.1 billion less, requiring 14,800 fewer people, and providing 7,000 more intratheater ton-miles than the C-5B/C-130 alternative. Although the fiscal year 1988 programmed intertheater capability was projected at 48.5 MTM/D, the C-17 would have to provide more than 17.5 MTM/D due to aircraft retirements. Changes in crew-ratios, erosion of aircraft service life, and inadequate funding could easily affect the master plan's projected MTM/D capability depicted below.[295]

**Fiscal Year 1988 Programmed Intertheater Airlift Capability***

| No. | Aircraft Type | MTM/D |
|---|---|---|
| 215 | C-141B | 14.2 |
| 64 | C-5A | 11.0 |
| 44 | C-5B | 7.5 |
| 39 | W-Body CRAF (747) | 6.0 |
| 28 | N-Body CRAF (DC-8) | 2.4 |
| 19 | CRAF Enhanced (747) | 2.9 |
| 41 | KC-10 | 4.5 |
| | **Total** | 48.5 |

Source: Plan, HQ USAF, *US Air Force Airlift Master Plan*, 29 September 1983, p III-10.

Beyond 1998, the long-range recommended force structure entailed: retiring 180 C-141s as they reached their service life between 2010 and 2015, acquiring at least 40 additional C-17s for the reserves or active/reserve associate units, retaining 114 C-5s, maintaining a minimum of 144.9 million passenger miles per day (MPM/D) and a minimum of 11.3 MTM/D in the CRAF, and preserving the option of adding more C-17s or a "new technology airlifter" to meet future airlift requirements. The long-range portion that addressed CRAF contributions also stated that the military and civilian sector might need to jointly develop a "new technology Advanced Civil Military Aircraft."[296]

Additionally, per the Fiscal Year 1984 Department of Defense Authorization Conference Report, the Military Airlift Command issued in November 1983 *Validation of the Requirements Concepts and Design for the C-17,* which Secretary of Defense Weinberger with the concurrence of the joint chiefs forwarded to Congress early in 1984. This document provided another extensive program review and recertified that the C-17's requirements, concepts, and designs were all valid. The C-17 was the most cost-effective solution, and 210 aircraft were needed for national security.[297] Joint Chiefs of Staff Chairman John W. Vessey Jr. informed Secretary Weinberger that the Army-Air Force's revalidation of the long-term airlift requirements and the Air Force's master plan were in sync, and, along with the *Congressionally Mandated Mobility Study*, they provided a baseline for quantifying intertheater airlift. The joint chiefs, Army General Vessey further related, supported an aircraft that could perform all manner of inter and intratheater airlift missions to include direct delivery, austere airfields, and airdrop or low-altitude parachute extraction system (LAPES) of outsize equipment. "The revalidation placed major

*Not all of the intertheater or strategic airlift force was available. Historically about ten percent of the force was needed to satisfy other requirements.

emphasis on the need to enhance the forward delivery of combat units and on the need for intratheater airlift."[298] Vessey, who imaged himself after his hero General Omar Bradley, had distinguished himself in battle during World War II and Vietnam. For the former act, he had won a battlefield commission. In the late 1970s, he had been willing to cast his career to the wind when he opposed President Carter's proposal to withdraw forces from Korea during congressional testimony.[299] Had he not liked the C-17, General Vessey would certainly have said so. Rather the documents suggest that the wording of Vessey's memorandum once again expressed Army concerns that the C-17 might be used solely for intertheater airlift.[300] Nevertheless, the joint chiefs' and Vessey's memoranda were a strong endorsement of the C-17 by the entire military community. Politics, however, only heeded the words of those it chose, be they generals or street urchins.

**Subterfuge**

While the master plan and the validation report displayed service consensus, attaining the C-17 was not assured. Lockheed challenged the C-17 on 22 February 1984 with an unsolicited proposal, specifically seeking to complete testing on the C-5's direct delivery into austere airfields. "The purpose of these tests," Lockheed CEO Lawrence Kitchen disclosed, "would be to demonstrate and validate the full operational capabilities required by the Air Force in the original design for the C-5A as well as the enhanced capabilities exceeding the original requirements."[301] The Air Force had suspended testing in 1970 when problems developed with the C-5's wings. Lockheed offered to perform its portion as part of the C-5B fixed-price contract at "no additional cost to the government."[302] Per the statement of work, Lockheed sought to demonstrate over the course of a thirteen-month program the following:

- airdrop 60,000 pounds in a single load
- airdrop four 60,000 pounds sequential loads
- concurrently, evaluate the computer air release point (CARP) capability inherent in the triple inertial navigation system
- qualify cargo loads not previously demonstrated
- operate from austere/unpaved airfields
- airdrop container delivery system (CDS) loads
- demonstrate low altitude parachute extraction system (LAPES), up to 60,000 pounds
- demonstrate backing up
- demonstrate heavy weight operations.

More specifically, the heavy weight demonstration entailed C-5s taking off at 837,000 pounds and air refueling up to 920,000 pounds. There would be at least one C-5 landing with a gross weight in excess of 875,000 pounds. Lockheed hoped to begin the tests in June 1984.[303] In light of the C-5's original performance specifications, Lockheed's request seemed reasonable. In fact, some C-5 pilots felt the Military Airlift Command had "babied" the aircraft for years, that it was certainly more capable.[304]

But skepticism abounded, especially among senior officers. Testing results and fourteen years of operational experience had left the commander of the Military Airlift Command, General Thomas M. Ryan Jr.,[305] convinced that further evaluation would only "demonstrate marginal improvements." The C-5's limited ground maneuverability would disrupt instead of enhance operations at small, austere airfields. This view, General Ryan formally shared with Air Force Chief of Staff General Gabriel in March 1984.[306] On 23 March, Lieutenant General Robert D. Russ, Air Force Deputy Chief of Staff for Research, Development, and Acquisition, indicated there was no need for further testing, except for backing and heavy weight operations.[307]

Lockheed's proposal, which attempted to prove the C-5 had similar small, austere airfield capabilities as the C-17, sparked intense congressional debate over the performance characteristics and costs of the two weapon systems. The General Accounting Office stepped in, attempting to give an unbiased and factual accounting of the two aircraft using Lockheed and Air Force data. But the GAO's *Review of Performance Capabilities of the C-5 and C-17 Cargo Aircraft Including Small Austere Airfield Operations* (July 1984) could not settle the dispute, as the disagreement transcended reason. Politics and business interests prevailed. In trying to compare program costs, data from the March 1984 Selected Acquisition Reports for the C-17 and C-5B gave the unit flyaway costs (to include R&D) as $100.3 million (1984 dollars) for the C-17 and $141.0 million (1984 dollars) for the C-5B. The reports listed the total program costs as $39.75 billion for 210 C-17 (then year dollars) and $9.34 billion for 50 C-5B aircraft.[308]

Throughout 1985, congressional and media debate over the merits of the C-5 versus the C-17 continued. In February, as the full-scale engineering decision was being made, Lockheed Chairman Roy A. Anderson proposed additional C-5Bs at an attractive fixed-price contract of $97.5 million per copy for 12 C-5B for a fiscal year 1988 option and $94.5 million per copy for 12 C-5Bs the succeeding fiscal year (1984 dollars).[309] As agreed, in light of the publicity the offer would generate, Air Force Secretary Verne Orr forwarded the proposal on to the chairmen of the four key defense committees: Senator Barry Goldwater, Senate Armed Services Committee; Representative Les Aspin (D-WI); House Armed Services Committees; Senator Ted Stevens, Senate Appropriations Committee Defense Subcommittee; and Representative Joseph P. Addabbo (D-NY), House Appropriations Committee Defense Subcommittee.[310] Orr informed them that the Air Force had no intention of procuring more than 50 C-5Bs. "There are other procurements which we feel have a higher priority."[311] Nevertheless, the unit cost of the C-5 and the C-17 became a matter of great scrutiny, if not the only issue. Especially when in July, Lockheed offered additional unit price reductions of $6.0 and $5.9 million, respectively.[312]

Lockheed officials persisted, and in January 1986 at the start of the fiscal year 1987 budget discussions, Lockheed extended to the end of the year its fixed-price offer, which contained price and production schedule inducements.[313]

The debate also aired extensively in the printed media with journalists remaining impartial or taking sides. The arguments became quite sophisticated when several policy analysts took up the issue and pursued a deliberate anti-C-17 campaign. At the forefront were Dr. Jeffrey Record and Dr. Kim R. Holmes. Both were well regarded and associated with prominent research organizations—the Institute for Foreign Policy Analysis and the Heritage Foundation, respectively—which were known to be pro defense.[314] In January 1986, Jeffrey Record published *US Strategic Airlift: Requirements and Capabilities* followed by *Determining Future U.S. Tactical Airlift Requirements* in 1987. Holmes wrote *Closing the Military Airlift Gap*, which was released in January 1986. Record employed subtleties as he dug at the C-17.

> The issue is not whether the C-17 is a technically sound strategic airlifter possessing residual tactical airlift capabilities—it is—but rather (1) whether such residual capabilities are in fact relevant to future U.S. tactical airlift capabilities, which remain unspecified, and (2) whether alternative airlift force mixes to the present Airlift Master Plan might provide a more timely and cost-effective means of satisfying the CMMS' stated strategic airlift objective of 66 MTM/D, as well as satisfying future U.S. tactical airlift requirements which have yet to be specified.[315]

At other times, Record was more direct.

> Money and manpower—specifically the need to pay for and man the planned C-17 fleet—are the real reasons for the intended retirement of 180 C-130s, as it is for the Airlift Master Plan's proposed early retirement or transfer to the reserves of the entire C-141 fleet of 234 planes, still the mainstay of U.S. strategic airlift capabilities. Even the Air Force does not deny the useful service life of the C-141 could be extended from 45,000 to 60,000 flying hours, or fifteen years at normal peacetime utilization rates, for a total fleet cost of less than one billion dollars. To be sure, the C-141 is not as productive as the C-17, but the cost of keeping the C-141 in the fleet is so much less expensive than the C-17 that many experts believe it would be foolish to retire the C-141s instead of extending their service life.[316]

In concluding *Determining Future U.S. Tactical Airlift Requirements and Capabilities*, Record advocated abandoning the recommendations of the *US Air Force Master Plan*, which retired a portion of the C-130s, and pursuing instead Lockheed's C-130 High Technology Test Bed (HTTB), a modification/upgrade program.[317]

Kim Holmes, too, took issue with the *US Air Force Airlift Master Plan*, raising many questions. "Is a new generation strategic airlifter necessary?" he asked. Holmes insinuated not, especially since the new C-5B would be in service into the next century. He characterized the C-17's direct delivery capability as "the dual-capability dilemma." "The C-17 is supposed to fly tactical air sorties between strategic airlift missions. In a major war, however, it is questionable whether the new and expensive C-17 will be available for tactical combat support roles." As to cost, Holmes offered: "To be sure, the Air Force claims that its plan will be $16 billion less than alternatives based on the C-5. Yet by some calculations, adding 101 C-5Bs to the fleet to meet the Pentagon's goal of 66 MTM/D airlift capability would cost at the most $16.8 billion." Moreover, Holmes claimed that for a cost of some $300 million to extend the service life, the Air Force could keep the C-141 in operational service, a course less expensive than the $37.2 billion C-17 program.[318]

Holmes also discussed the merits of the C-17 and the C-5. Both aircraft were designed to meet intercontinental and austere mission requirements. Holmes disputed the airfield arguments. "Even if the C-5B still needs 4,000 feet to land, operationally it barely will be at a disadvantage compared to the C-17. The reason: only a tiny fraction of airfields in Europe, Northeast Asia (Korea and Japan), and Southwest Asia are between 3,000 and 4,000 feet long and thus can accommodate the C-17 but not the C-5." Holmes argued that the C-5B actually reduced airfield congestion, as it hauled more cargo (261,000 to the C-17's 172,200 pounds), thus requiring fewer aircraft. Moreover, the C-5's front and rear doors enabled it to move in and out of airfields quickly, further reducing congestion. Holmes concluded by recommending the Air Force cancel the C-17 program, procure more C-5Bs and KC-10s, retire no C-130s, and extend the service life of the C-141.[319] In March 1986, Holmes presented his proposal before the Senate Armed Services Subcommittee on Seapower and Force Projection.[320] The pens of Record and Holmes proved effective against the C-17.

It came as no surprise that Dr. Record was then a consultant to the Lockheed Corporation and had been a legislative assistant to Senator Sam Nunn, 1976-1980. Dr. Holmes had worked as a senior fellow at the Institute for Foreign Policy Analysis along with Dr. Record.[321] And it was probably no coincidence that Dr. William M. Leary (University of Georgia) in "Strategic Airlift: Past, Present, and Future" (*Air University Review*, 1986) essentially wrote the C-17 off as a canceled program due to the need for fiscal constraints. Drawing upon Record's paper as a reference, Leary concluded: "The C-5B remains a viable financial and political option, and no one questions the Galaxy's superiority to the C-17 as an intercontinental transport. Tactical airlift will suffer the most without the C-17, but there are other possibilities."[322]

Lockheed excelled in its support base. From Lockheed's perspective, it was following good business practices. The corporation was in business to sell their airplanes and make money. From the military's viewpoint, especially those working the C-17 program, it was "subterfuge" and taken personally.[323] In hindsight, battlehardened four-star generals and their staffs also needed to be shrewd businessmen from the program's inception. Military leaders did go on the C-17 offensive, however.

The Air Force, especially the Military Airlift Command, countered with rebuttals, publishing *The Case for the C-17* (1986), *C-17 Production: The Operator's View* (1987), and *Airlift: Protecting America's Interests Worldwide* (ca 1990). The new commander of the Military Airlift Command, General Duane H. Cassidy (1985-1989), realized the need for what he termed a "pro-active" campaign. If unanswered, the papers, which disputed the recommendations of the Air Force's master plan, could bring on the demise of the C-17 program, especially as Congress grappled with the 1985 Balanced Budget and Emergency Deficit Control Act (Gramm-Rudman-Hollings). His predecessor, General Ryan, had made office visits to some 60 members of Congress within a period of a few months, championing why the C-17.[324]

Both Generals Ryan and Cassidy proved quite adept at securing program support from Congress and the Department of Defense. With fighter pilots in senior general officer positions, Air Force circles also had to be worked.[325] General Cassidy recognized that the Military Airlift Command could not obtain the C-17 by itself. He actively sought assistance from his four-star colleagues. Cassidy and General Russ had been at the Air Staff at the same time, working closely together. Equally supportive were General Larry D. Welch, then Air Force Chief of Staff, and General John T. Chain Jr., then Commander of the Strategic Air Command. Both understood the program from their previous assignments as Air Force vice chief of staff and deputy chief of staff for plans and operations, respectively. "Welch was the guy who made it work."[326] In 1984, as the vice chief and chair of the Air Force Council, Welch was the "prime supporter" at a critical juncture, according to Cassidy who had served as the deputy chief of staff for manpower and personnel.[327] Outside the Air Force, General Cassidy had the support of John O. Marsh Jr., Secretary of the Army, and Army Chiefs of Staff Generals John A. Wickham Jr. and Carl E. Vuono. General Cassidy and General Vuono cemented their C-17 bond testifying before Congress on several occasions. When General Vuono subsequently became the Army Chief of Staff, he was already behind the C-17 program. With prior airborne and congressional experience, Secretary Marsh understood the Army's airlift needs and funding issues well. His long tenure, 1981-1989, as service secretary worked to the C-17's favor. Marine Corps General P. X. Kelley was a staunch supporter of the C-17 from the get go. General Cassidy had served as Kelley's commander of airlift forces (COMALF) when Kelley commanded the Rapid Deployment Joint Task Force.[328]

Before Ryan and Cassidy, General James R. Allen had been adept at structuring the C-17 program so it was programmatically sound and not conflicting with other "near and dear" Air Force programs. General Allen had also sought to bolster the C-17 cause within the Air Force, securing on short notice in 1983 an assignment at Headquarters United States Air Force (USAF) for his Deputy Chief of Staff for Logistics, Brigadier General Alfred G. Hansen. As the Air Force Director for Logistics

Plans and Programs, Brigadier General Hansen would have a seat on the Air Staff Board, which worked the program objective memorandum process. Allen had picked a capable person for a tough job. Previous to Hansen's assignment, the command had the brief tenure of Major General Block's as the Director of Plans (1980-1981). Outside of this, the Military Airlift Command relied on colonels, lieutenant colonels, and majors[329] to carry the C-17 program forward. General Hansen recalled that he was the only person who spoke up for the C-17 during his tenure on the board, February 1983-May 1985. Board members almost killed the program on a couple of occasions. At this time, the C-17 program was competing with the F-15E for Air Force funding.[330] Allen was also fortunate in Colonel Thomas D. Pilsch's assignment to Lieutenant General Russ' staff and Colonel Vernon J. Kondra's selection as the chief of the mobility forces division and chairman of the Mobility Panel. As chair, Kondra could sponsor a particular briefing or issue up to the Program Review Committee and, if successful, up to the two-star Air Staff Board and the three-star Air Force Council, chaired by the vice chief of staff of the Air Force. Prior to Kondra, Colonel Jimmie L. Jay had tended the infant C-17 on General Huyser's watch. Later, Generals Ryan and Cassidy benefited from the expertise of Colonels Robert A. Larsen, Larry D. Parsons, Smith Barnum, William J. Begert, Harvey Shelton, and Donald A. Streater as they served as the chief of the mobility forces division.[331] In this manner, the Military Airlift Command commanders gained a toehold, establishing an airlift voice at Headquarters USAF. With Generals Ryan and Cassidy so successful in building C-17 support, especially with Congress, some friction resulted between the command and Headquarters USAF.[332]

Succeeding commanders of the Military Airlift Command, later Air Mobility Command, also spent an inordinate amount of time sustaining the C-17's support base. A military command would normally "sell" its acquisition program to the staffs at the Air Force and the Office of the Secretary of Defense and then testify before Congress on the requirement, program's progress and funding requests. The public campaign and the constant need to justify the C-17 program before Congress were new roles for which the Military Airlift Command was at first unprepared. It had been years since the command last acquired a major weapon system—the late 1950s for the C-141 and the 1960s for the C-5. With both entering the operational environment during the Vietnam Conflict, support was more forthcoming from all parties—the Air Force, Department of Defense, and Congress. The programs also progressed at a rapid pace. The Air Force released the C-141 request for proposal in December 1960, and on 17 December 1963, the C-141 made its maiden flight. The decision to build the C-5 came in December 1964, and the C-5 flew for the first time on 30 June 1968.[333] The C-17 was not so fortunate.

### Milestone II Nod

On 25 July 1983, the Air Force issued Program Management Directive #14, which tasked the C-17 System Program Office to restructure the program, anticipating the Milestone II full-scale engineering development (FSED) decision. The delays in awarding the FSED contract had nullified McDonnell Douglas' pricing in their June 1981 Best and Final Offer proposal. Additionally, the funding profile and production delivery schedules required adjustments. McDonnell Douglas submitted a contract restructuring proposal in February 1984. By October, the C-17 System Program Office had reached a negotiated settlement, but the contract was put on hold until the Defense Systems Acquisition Review Council (DSARC) approved Milestone II. To support the DSARC, the Air Force Comptroller (Management Analysis), as directed by Congress, requested an Independent Cost Analysis (ICA) autonomous from C-17 SPO's cost estimate and therefore, providing a measure of assurance. The ICA, which based it projections on the DC-10 program, yielded a total program estimate of $37.992 billion (then year). Major General Harbour also submitted a decision coordinating paper to the Air Force Systems Acquisition Review Council (AFSARC) in October 1984 prior to his briefing to Dr. Thomas E. Cooper, the Assistant Secretary of the Air Force for Research, Development, and Logistics and the presiding chair of the council. The paper detailed the program's events, cost, status, projected performance criteria, and pending decisions. Harbour assessed the overall technical risk of the C-17 program as low and reiterated previous statements as to why it was so. The schedule called for a Milestone II decision in the first quarter of fiscal year 1985 and a Milestone III production decision in the first quarter of fiscal year 1988.[334]

Following the AFSARC Milestone II briefing, Dr. Cooper advised General Larry D. Welch, the Air Force Vice Chief of Staff, that "the decision of the AFSARC is to begin FSD but to address several issues related to concurrency and cost prior to entering any production phase."[335] Specifically, Dr. Cooper directed:

- "scrub" the C-17 requirements and specifications to ensure the aircraft had the minimum essential to accomplish the task
- look for innovative approaches to obtain as much competition as possible in the program
- establish a program configuration baseline with a cost cap
- reduce program concurrency
- determine the cost of the warranty program to include engine warranties
- evaluate a 150 versus a 210 aircraft buy
- compare the C-17 cost against other major aircraft programs.

Dr. Cooper also desired preliminary data before the DSARC session, just a few weeks away. He sought to put the C-17 program in the best possible light.[336] Headquarters Military Airlift Command began a scrub of the requirements and specifications while the C-17 System Program Office took up the other issues. To reduce concurrency and program costs, the SPO developed three options: FSED unchanged with production re-profiled; FSED accelerated by six months with production re-profiled and increased funding; and FSED accelerated by one year with production re-profiled (accelerated by one year) and increased funding. The first option proved to be the recommended alternative in reducing concurrency, as it impacted the IOC date the least. A reduced buy of 150 aircraft yielded a total production cost of $25.8 billion ($148 million a copy) compared to $33.8 billion ($140 million a copy) for 210 aircraft. And at this stage, against the C-5A, C-5B, and the B-1, the C-17 compared favorably; its unit flyaway cost was the lowest.[337]

On 2 November 1984, Major General Harbour briefed the Defense System Acquisition Review Council, presenting the Air Force's case for the C-17 full-scale development before Dr. Richard DeLauer, presiding. Harbour and his staff put together a very credible, well-reasoned briefing. General Harbour also made the decision to invite the "users" to present the operational need for the C-17, and these briefings prepared by the Military Airlift Command and the Army were well received.[338]

The C-17 program reached Milestone II on 15 February 1985 when Secretary of Defense Caspar Weinberger signed the memorandum approving the long-awaited full-scale engineering development decision. Besides the approval, the memorandum mandated actions on the concerns raised during the Defense Systems Acquisition Review Council session, specifically directing:

- reexamine the production program by 1 July
- perform a new operations and support cost estimate by 1 July 1985
- increase the maximum pallet capability to 18
- maintain the capability to carry six 20-foot containers
- report on the Army/Air Force containerization study by 1 July 1986
- restructure the development program to reduce risk and cost
- revise the *Test and Evaluation Master Plan* by 30 May 1985
- submit the second source production certification report to Congress.

Secretary Weinberger was also concerned about defensive systems, electromagnetic pulse protection, and special/covert operations, as meeting these requirements could significantly impact RDT&E and procurement costs. He requested status reports by 1986. At this time, Weinberger noted additional issues that required resolution before initiating C-17 production: completing the *Worldwide Intratheater Mobility Study*, sorting out the C-17's inter/intratheater role, submitting the maintenance manpower plan, and reporting on using contractors for maintenance and supply support for both the C-17 mini-squadron (through 100,000 fleet flying hour) and for the entire C-17 fleet, similar to the KC-10 fleet.[339] That Dr. Cooper had anticipated some of these concerns boded well for the C-17.

**C-17 Buy Schedule at FSED Phase**

| FY88 | FY89 | FY90 | FY91 | FY92 | FY93 | FY94 | FY95 | FY96 | FY97 | FY98 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 4 | 6 | 10 | 20 | 29 | 29 | 29 | 29 | 29 | 23 | 210 |

**C-17 Delivery Schedule at FSED Phase**

| FY90 | FY91 | FY92 | FY93 | FY94 | FY95 | FY96 | FY97 | FY98 | FY99 | FY00 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 5 | 8 | 15 | 26 | 29 | 30 | 29 | 29 | 29 | 7 | 210 |

Source: Point Paper, HQ MAC/XPQA, "Impact of Proposed C-17 Cuts in the FY 87 POM," 15 July 1985.

The Air Force was also aware of questions over the C-17's cargo compartment size before the November DSARC meeting. McDonnell Douglas had even performed analysis. During the DSARC, Dr. Milton J. Minneman, from the office of the Under Secretary of Defense for Research and Engineering, officially asked if the C-17's fuselage should be made wider and/or longer to accommodate more 463L pallets, as the aircraft's payload capacity was not fully utilized. Specifically, Dr. Minneman asserted that widening the C-17's cargo compartment 12 inches* would greatly increase the aircraft's pallet-carrying capability as well as its operational flexibility, more than offsetting the modest two percent increase in life cycle cost.[340]

While a reasonable question with the potential for great gain, especially since the C-141's fuselage had been stretched for similar reasons, this idea did not prove out. Stretching the C-141 had increased pallet and unit equipment capability. As validated during the loading demonstration in 1984, the C-17 was already optimized for unit equipment, and the Army's and Marine's requirements had not changed significantly. Widening the C-17 increased the pallet capability from 16 to 20 (a 21-pallet configuration made the loading time longer). However, redesign costs, a heavier floor structure, and higher fuel consumption with the loss of operational capabilities such as ferrying range and 2,400 nautical mile payloads of 164,200 or 160,200, depending on the variant, resulted in a life cycle cost of $1.17 billion for the additional four pallets. Moreover, analysis conducted by the Air Force's Studies and Analysis disclosed limited improvement in force closure times for Southwest Asia and NATO scenarios. The Military Airlift Command recommended modifying the C-17's cargo ramp to accommodate four versus two pallets for a total of 18 pallets and at an estimated life cycle cost of only $98 million. After much study, the Office of the Secretary of Defense adopted the most cost-effective improvement—increasing the pallet capacity from 16 to 18 pallets without changing the external dimensions of the aircraft.[341] As a result, the C-17's cargo compartment width remained a foot less than the C-5's. With hindsight, Colonel Donald M. Dessert Jr., a source selection team member and later the OT&E test director, remarked that widening the C-17 made sense, if it had been done earlier, underscoring the need for the Air Force to have been more involved in the aircraft's specification

*For clarification the C-17's cargo compartment dimensions are a length of 88 feet, width of 18 feet, and height of 12.4 feet while the C-5's are length of 143.9 feet, width of 19 feet, and height of 13.5 feet.

development versus allowing the specifications to simply flow from the mission scenarios. It would also have changed the C-17's pallet loading to the standard mode of straight in versus rotating 90 degrees, which added another step.[342] Although not foreseen at the time, adding two more pallets and putting in the necessary logistics rails on the ramp enabled the dual row airdrop system to come into existence.

The process of estimating program costs proved especially thorny. Moreover at some $38 billion, the program was one of the most expensive programs ever; cost estimates would receive a great amount of attention. During the November 1984 DSARC meeting, the OSD's independent estimate by its Cost Analysis Improvement Group (CAIG) and the Air Force's program costs estimates differed by some $500 million. The CAIG recommended that the Air Force conduct another cost analysis. Completed on 31 January 1985, the Air Force's review resulted in a $401 million reduction from the Air Force's November DSARC estimate of $4,309 million for development—$3,908 million.[343] CAIG Chairman Milton A. Margolis, expressed to Dr. Cooper that "the Air Force now has an understandable baseline in cost and man-hours to manage against as the C-17 enters FSED." Margolis urged the Air Force to undertake a similar cost review for the production phase. He noted that capability and design modifications for electromagnetic pulse protection, defensive avionics, and special operations could "significantly" impact RDT&E and procurement. Lastly, to achieve the "advertised" C-17 reliability and maintainability and life cycle cost goals, the integrated logistics program would need "strong management." Margolis was, however, satisfied, stating "the program now appears executable in cost and content."[344]

With the go ahead for the full-scale engineering development, a rebuilding of the teams at the C-17 System Program Office, Headquarters Military Airlift Command, and McDonnell Douglas followed. The delays had caused a great loss of continuity and expertise. Reestablishing and expanding the teams took months. Anticipating Milestone II approval, the C-17 SPO increased its staff[345] and reorganized, becoming a separate directorate under Major General Harbour. David Ward continued as the deputy director. By December 1985, the C-17 SPO comprised 77 persons. Harbour also sought good working relations with the Military Airlift Command and implemented a quarterly session to surface issues, especially those pertaining to operations and maintenance.[346]

Between February and September 1985, the Air Force and McDonnell Douglas went over the proposed C-17 design with great scrutiny. In all, there were 33 preliminary design reviews for the various systems and subsystems. The review ensured the contractor's design complied with contractual requirements and also enhanced the aircraft's performance, maintainability, and supportability. Military representatives included the Army, Aeronautical Systems Division, Air Force Logistics Command, Military Airlift Command, Air Training Command, and Air Force Operational Test and Evaluation Center. Although nothing was deemed critical to the C-17's progress, the C-17 System Program Office and the Military Airlift Command identified six areas of concern: wing durability, landing gear jack, fuel inerting, deceleration devices, cargo rail activation, and survivability/vulnerability. In June during the program management review, the C-17 SPO asked McDonnell Douglas to present alternatives. As to the wing, Harbour directed McDonnell to use a structural solution versus alleviating the wing load. The Military Airlift Command provided existing jacks for the engineers to evaluate over a new 120-ton jack. The decision on using liquid nitrogen or On-board Inert Gas Generating System (OBIGGS) for fuel inerting required more study and would be made prior to the production decision. More wind tunnel testing was needed before deciding on inflight thrust reversers or control surfaces for deceleration. While McDonnell Douglas proposed a combination system of hydraulic and mechanical for the cargo rail activation, General Harbour requested a look at a pneumatic system. On the last item, data and analysis were still incomplete on the aircraft's survivability and vulnerability. On 30 September McDonnell Douglas hosted the preliminary design review milestone completion. Critical design reviews were to commence in October 1986 and end the following September, but this schedule would slip. In 1986, McDonnell Douglas hosted technical interchange meetings, presenting progress on systems and issues since the preliminary design reviews. As the C-17's design became more firm, refinement of the specifications followed. The items were lumped into a single engineering change proposal, ECP 40.[347]

**Preliminary Design Reviews**

| | |
|---|---|
| Landing Gear Performance | System Safety |
| Structures | Flight Control |
| Hydraulics | Fuel Subsystem |
| Avionics Integration | Fire Protection |
| Lighting | Propulsion |
| Flight Deck/Accommodations | Auxiliary Power |
| Mission Systems | Environmental Control |
| Instruments/Controls | Training Status |
| Emergency Egress | Built-In-Test |
| Electrical | Computer Hardware/Software |
| Flying Qualities | Human Factor |
| Communication/Navigation | Product Assurance |
| EMC & Lightning | Reliability/Maintainability |
| Quality Assurance | Logistics |
| Survivability/Vulnerability | Support Equipment |
| Producibility & Standards | |
| System Test | |

Source: Study (86-1270), Maj Charles L. Johnson II, Air Command and Staff College, *Acquisition of the C-17 Aircraft-An Historical Account*, 1986, p 392.

With the Milestone II concerns addressed, the preliminary design reviews completed, and required second source production certification to Congress fulfilled, the Aeronautical Systems Division awarded McDonnell Douglas a $3.387 billion fixed-price, incentive-firm contract for the full-scale engineering development on 31 December 1985. The contract called for the design development, fabrication, and testing of one flight test aircraft (T-1) and two airframes for static and durability structural testing. Contracts followed for developing C-17 subsystems.[348] The schedule at this time planned for procuring the first two aircraft in fiscal year 1988 with delivery to follow two years later. McDonnell Douglas' master schedule showed the T-1 assembly beginning in December 1987 with a first flight 27 months later in March 1990. Program Management Directive #17, issued in October 1985, established October 1986 for the next milestone event—low rate production decision, Milestone IIIA. The directive gave an IOC date of January 1992, following the delivery of the twelfth production aircraft.[349] This soon changed.

**On Costello's Chopping Block**

Although the C-17 had progressed to the full-scale engineering development phase, support for the program remained an issue. The C-17 "faces a long obstacle course of OSD and Congressional scrutiny," General Cassidy expressed to Defense Secretary Weinberger in the fall of 1985.[350] There was Air Force scrutiny to overcome as well. Air Force budgetary (program objective memorandum, POM) and congressional reductions for fiscal year 1986 slipped the IOC date to the end of 1992. These funding cuts also delayed 14 of the first 36 aircraft and impacted technical data, support equipment, and training efforts. The C-17's production costs had increased from $33.7 to $35.1 billion, primarily because of inflation and the funding reductions, which stretched out the program. Over the life cycle, operation and support cost estimates had also grown from $34.7 to $40.0 billion, as a result of retired pay changes, a higher crew ratio, and utilization rate and fuel consumption increases. More limited funding with more restrictive language would follow.[351]

As Lockheed continued to press for the C-5, General Cassidy sensed a shift in Congress as the fiscal year 1987 budget discussion got underway. Four star to four star, Cassidy appealed to General Bernard W. Rogers, Commander-in-Chief United States European Command.

> Having spent the better part of the past several weeks with many congressional members and staffers alike, it is clear to me that I will need your help and a full solidarity of the unified and specified commanders if the C-17 program is to survive. It no longer appears to be a debate between which airplane we shall have; it is an issue of whether we will carry 1960s technology into the 21st century or invest in an efficient airlifter. It appears to be an issue of funds—a new start at the wrong time. . . . I believe the C-17 program will live or die this year—the first year for long-lead monies.[352]

General Cassidy urged Rogers to write Senator Barry Goldwater and Representative Leslie "Les" Aspin, Chairmen of the Senate and House Armed Services Committees, respectively, and state his need for the C-17. "When you testify before Congress in the next few weeks, please leave them with no doubt about your strong support for the C-17."[353] Gramm-Rudman-Hollings mandated cuts in federal spending, and the Air Force's portion was $1.009 billion. Cassidy found the Air Force leadership willing to protect the C-17 along with the advanced technology bomber at the expense of other programs. Tidal W. McCoy, the Assistant Secretary of the Air Force for Manpower, Reserve Affairs and Installation, openly indicated the C-17 was a "very high priority."[354]

Along with Congress' emphasis on Gramm-Rudman-Hollings reductions was a healthy measure of politics. The manufacture of the C-17's wings became a subject of interest. Per the contract, the Air Force essentially had no say over McDonnell Douglas' decisions on making or buying items, except when it involved going from a domestic source to a foreign source or between foreign sources. Originally, McDonnell Douglas had intended to buy wing components but then decided in 1984 to manufacture them in house. This did not sit well with AVCO Aerostructures of Nashville, Tennessee, builder of wings for the C-5, B-1B, and Gulfstream IV. In 1986, AVCO Aerostructures enlisted congressional influence. A 12 March letter sponsored by Senators James R. Sasser (D-TN) and Albert Gore Jr. (D-TN) and the Tennessee members in the House of Representatives informed Defense Secretary Weinberger that the C-17 program could reduce costs and obtain a quality wing by having AVCO manufacture them.[355]

Congresswoman Marilyn Lloyd (D-TN) followed with a congressional inquiry to Secretary of the Air Force Rourke. Lloyd along with three other members of the House Armed Services Subcommittee on Procurement and Military Nuclear Systems desired to know what provisions the Air Force had for reviewing a contractor's make or buy decisions. The inquiry noted that there were opportunities for sizeable cost savings as well as preserving a national defense asset.[356]

At the end of March, Congressman Joseph Addabbo, chairman of the House Armed Services Defense Subcommittee, asked Secretary Rourke to review the current C-17 production plan for opportunities for subcontractors to bid on major components. In the case of the wings, savings of $100-400 million were possible since the prime contractor would not have to build a new facility.[357] In June, AVCO submitted a C-17 wing proposal to the system program office. Subsequently, the Air Force learned that the House Defense Subcommittee had included language that restricted the release of C-17 RDT&E and procurement funds until the Secretary of the Air Force reported the results of a formal competition. Accordingly, Dr. Thomas Cooper informed William "Bill" V. Chappell Jr., (D-FL) the new Defense Subcommittee chairman, that within the contractual framework the Air Force and McDonnell Douglas would develop a plan for competing the wing.[358] Bill Chappell and all House and Senate Armed Services Committee members also received a letter signed by the service chiefs—Generals John A. Wickham, Larry D. Welch, and Paul X. Kelley, expressing concern that the recent congressional action on the wing competition threatened to delay or possibly end the C-17 program. They were direct: "We strongly urge your support for production of the C-17 now—an aircraft that is critical to our national interests."[359]

McDonnell Douglas prepared a best estimate for in house manufacture and then issued a request for proposal. The C-17 System Program Office oversaw the competition. AVCO Aerostructures, Rockwell International's North American Aircraft Operations, and Lockheed-California Company responded. In May 1987, McDonnell Douglas selected the Lockheed-California Company to manufacture wing components for the first five production options (45 airframes). Moving past the rivalry, McDonnell Douglas made its decision based upon best price. Lockheed shared its work with other companies. Murdock Engineering Company of Texas would fabricate and assemble the engine pylons, Beech Aircraft Corporation of Kansas would do the winglets, and Reynolds Metals of Illinois would machine the wing skins.[360]

The wing flap signaled that building the C-17 was not a monopoly or the exclusive domain of the selected contractor. The Air Force noted the precedence. Congress might force the competition of other components at will. Yet, having the C-17's components built in as many states as possible bolstered congressional support for the program. By July 1987, 14 states shared in some aspect of the C-17 subcontracting pie and their congressional representatives remained sensitive to C-17 funding.[361] The number of states grew to 41 by 1993.[362]

In the end, Congress cut the C-17 program by $129.6 million, approving for fiscal year 1987 $650 million in research and development and $50 million in procurement but restricting the release of the funds until 15 April 1987 to allow a review of the forthcoming General Accounting Office report. This gave Congress the option of canceling the program before a substantial financial outlay. Congress' actions reaffirmed General Cassidy's belief the C-17 would face difficulties in 1987. The President's Budget for fiscal year 1988 contained a request for $1.2 billion for research and development and $723.7 million for procuring two aircraft and spare parts.[363] Journalists predicted delays and deep cuts for the C-17 program. However, a favorable GAO report—*Military Airlift: Air Force Analysis Supports Acquisition of C-17 Aircraft* (March 1987)—did much to ensure funding. The report concluded that the Air Force's plan to build the C-17 was much better than the alternative. Lower life cycle costs made the C-17 $17 billion cheaper than the C-5B option. Direct delivery, throughput, ground maneuverability, and austere airfield operations favored a C-17 as well.[364]

However, there was some turbulence. Representative George Darden (D-GA) secured enough support to propose an amendment to the Defense Bill, deleting all C-17 funding. Darden, who had Lockheed-Georgia located in his district, claimed the $40 billion C-17 program was a fine example of excessive defense spending. Letters to colleagues circulated in late April and early May. Sides became drawn and heated debate on the program ensued once again. But with 321 nay votes, the Darden Amendment failed roundly on the floor of the House of Representatives; C-17 advocates gained a measure of encouragement and optimism.[365]

In the fall of 1987, the program faced the Defense Acquisition Board approval for Lot I (2 aircraft) and the long lead production decision. Among the Army's top leaders and commanding generals, C-17 support remained firm and opportunities were sought to express this to Congress. Secretary of the Army John Marsh speaking before congressional staffers at the service's annual convention stated the Army's number one acquisition program was the C-17.[366] As the year ended, Congress provided \$1,090.5 million in research and development and \$666.2 million in procurement funding for the C-17 program for fiscal year 1988—cuts of \$140.5 million and \$57.5 million, respectively.[367] Congressional backing held throughout 1988.

But at the Office of the Secretary of Defense and Air Force levels support was anything but assured throughout 1988. The newly appointed Under Secretary of Defense for Acquisition, Dr. Robert B. Costello wanted to terminate the C-17 program. In April, Costello's intention became leaked to *Inside the Air Force*, the DC beltway weekly paper. Headlines read: "C-17 Future Is Dim: Costello Eyes Killing Effort In FY90, USAF Slashes Funds." And Dr. David S. C. Chu, OSD Program Analysis and Evaluation, wanted Frank Carlucci to restate the Pentagon's goal for force projection, forcing re-visiting the need for the C-17. For its part, the Air Force was cutting C-17 funding in the five-year budget under development.[368]

Despite the leak, Dr. Costello persisted in wanting to cancel the C-17 program. A civil engineer by profession, Costello had been in charge of General Motor's acquisitions worldwide. In one year alone, he had saved the corporation \$1.5 billion.[369] Tapped for his successes, Costello applied his talents to the Defense Department's acquisition programs. Given the C-17 program's slow start and the predictable consequences, one could easily understand how the C-17 made his hit list. The situation became dire a few weeks before the June 1988 Defense Resources Board meeting. As part of his justification, Costello cited the LCN and ferry range specification changes made by the Military Airlift Command and the aircraft's "deep stall" problem, causing McDonnell Douglas to switch to an electronic flight control system. In his view, this only added more risk to the development portion of the program.

It was obvious OSD staffers, who were against the program, had caught Costello's attention. The Military Airlift Command's weekly status report disclosed:

> It once again shows no matter how hard we (SPO and MAC) try to be absolutely honest in our briefings, some in OSD refuse to listen. Since Dr. Costello is the Defense Acquisition Executive (DAE) and has yet to receive a C-17 program review briefing, Lt Col Johnson recommended to the PEM [program element manager] that we exercise the streamlined acquisition reporting 'chain of command' by having Secretary Welch (ASAF/A) and

> Brig Gen Butchko go directly to the DAE and set the record straight prior to the upcoming FY90 POM OSD issues Defense Resources Board (DRB).[370]

Secretary Welch approved, and he and Brigadier General Michael J. Butchko Jr., C-17 SPO Director, met with Dr. Costello on 9 June. The meeting did not produce the desired outcome. Although Costello conceded design and schedule risks were beginning to turn around, he was still putting the C-17 program on the "chopping block." The C-17 simply cost too much. It was a matter of affordability.[371]

To General Cassidy, Lieutenant Colonel Charles L. Johnson II, C-17 program division at Headquarters Military Airlift Command, astutely described the C-17's dilemma:

> [I] believe the seriousness of this issue ranks at the same level as the 26 Jan 82 (then DepSECDEF Carlucci) decision to buy C-5s and the KC-10s instead of C-17s (and Congress agreed). Once again we are fighting for the C-17's life at the OSD level, but this time we have Congressional support; that is, until we see the outcome of the November elections. Needless to say, we need every warfighting CINC and the Chairman of the JCS to fully support the C-17 at the DRB—no one can blink on this issue. DepSECDEF Taft must witness <u>solid</u>, <u>unified</u> support unlike any other program has ever had at the DRB.[372]

Joint Chief of Staff Chairman William J. Crowe Jr. rose to the occasion. The desired outcome was achieved. Secretary Taft directed a buy profile of 6, 10, 20, 29, 29, and the like, although Air Force Chief of Staff General Larry Welch wanted to cap the program buy at 24 aircraft per year. General Welch was trying to satisfy all of the Air Force's requirements.[373]

**Lot I Approval Secured**

The process of building the first C-17—going from the engineering drawings to actually assembling the components and then to installing the systems—proved a great challenge. Initially, however, the contract award for the full-scale engineering development boosted morale. There was an air of optimism. By the end of 1986, the C-17 had completed a year of full-scale engineering development. The program was progressing and appeared well in hand. Program Management Directive #17 had provided the formal direction to begin the full-scale development with each of the primary organizations—Air Force Systems Command, Air Force Logistics Command, Air Training Command, Military Airlift Command, and Air Force Operational Test and Evaluation Center—receiving specific tasks and guidance. The commands were also to prepare for Headquarters USAF a C-17 system program baseline, the first of many.[374] The objective of the baseline document was to promote program stability and control cost growth. It summarized key parameters, concepts, numbers, and dates as agreed to by the implementing, operating, supporting, and other participating commands. It allowed for managing the program per the agreed upon requirements. Since the program was fluid and the time required for coordination was extensive, the document rarely provided as accurate a snapshot as desired. Later, due to the acquisition reforms, the baseline document became the acquisition program baseline, formalizing and codifying the commitment among the C-17 SPO director, program executive officer, service acquisition executive, and defense acquisition executive.

Reviews of the Department of Defense by the Packard Commission (*Report on Defense Management*) and a Senate Armed Services task force (*Defense Organization: The Need for Change*) brought forth significant changes to the acquisition process. Briefly, Packard recommendations led to creating an under secretary of defense for acquisition, responsible for all research, development, and procurement programs within the Department of Defense. The Air Force followed in January 1987 establishing the Air Force acquisition executive system, which eliminated levels of management, expedited reporting, and simplified decisions. Organizational structures changed as well. Merging the deputy chief of staff for research, development, and acquisition with the assistant secretary of the Air Force for research, development, and logistics, the Air Force created the assistant secretary of the Air Force for acquisition, who served as the Air Force acquisition executive, setting policy, representing the Air Force on the Joint Requirements Review Board and the Defense Acquisition Board, and approving acquisition program baselines. Program executive officers, usually product division commanders, comprised the next level of management. Underneath the program executive officers were the program directors. For a little over a year, until 2 October 1987, Richard P. Godwin served as the first under secretary of defense for acquisition while John J. Welch Jr. was the assistant secretary of the Air Force for acquisition through 1991. Lieutenant General Ronald W. Yates Jr. assumed the principal deputy assistant secretary of the Air Force for acquisition position in January 1989 from Lieutenant General George L. Monahan Jr. Assistant Secretary Welch established the directorate of test and evaluation in January 1988, naming Carroll G. Jones as the director. This directorate paralleled the equally new OSD directorate of operational test and evaluation, headed by John E. Krings. In succeeding months, Jones and Krings spent much time sorting out responsibilities.[375]

Within this climate of change, the C-17 program continued to progress. In January 1987, an acquisition decision memorandum on the November Joint Requirement and Management Board's recommendation approved the Air Force's request to obligate fiscal year 1987 funds for the long lead and initial tooling activities for Lot I, the first two aircraft. The memorandum also requested another program review in the fall of 1987 for approval to obligate fiscal year 1988 funds, the start of production.[376]

Major General Harbour no doubt felt a measure of satisfaction with the long lead funding and tooling approvals for the first two aircraft. He had accomplished much during his tenure as the C-17 System Program Office Director. He had laid the foundation. His successor[377] was Brigadier General (select) Michael J. Butchko Jr. As a former deputy director of the B1-B program and director of the F-15 program, Butchko, like Harbour, was a well-versed acquisition expert. Having been part of the B-1A program at Edwards Air Force Base, Butchko also contributed test management skills, as the C-17 program anticipated initial flight testing in 1990. For almost four years, August 1987-July 1991, Brigadier General Butchko oversaw the C-17 program. Butchko instilled a tremendous amount of energy. Possessing great leadership and motivational skills, he formed a good team as the program went into high gear. Butchko embraced total quality management and was willing to share more information. As an example, he provided the Military Airlift Command his monthly program assessment—the Acquisition Executive Monthly Report—submitted to Secretary Welch. Butchko also sought out what he did not know. Lacking an airlift background, he went to the Military Airlift Command within his first months to get "schooled," flying as part of the crew on tactical and strategic airlift missions. Others followed his lead. Robert Clepper and Ted Lynch, Director of the C-17 SPO Engineering, took an air refueling/airdrop Team Spirit exercise mission to Korea.[378] The C-17 program benefited from Brigadier General Butchko's talents during what would prove a difficult period.

Factions for and against the C-17 existed at the Office of the Secretary of Defense and Air Force levels. In March 1987, Secretary of Defense Weinberger concurred with Secretary of the Air Force Edward C. Aldridge nominating the C-17 program as a Defense Enterprise Program. Originally Richard Godwin had advised Weinberger against including the C-17 as a Defense Enterprise Program, citing "high technical risks."[379] But Aldridge appealed to Weinberger. The Defense Enterprise Program was a recommendation of the Goldwater-Nichols DOD Reorganization Act and the Packard *Report on Defense Management*. The Fiscal Year 1987 Defense Authorization Act had directed the secretary of defense to designate programs to increase the management efficiency of acquisition programs. Although the C-17 program gained streamlined management reporting; Weinberger withheld the multi-year or stabilized funding portion. While the designation conferred upon the C-17 program a certain status, there were also expectations of a funding commitment within the OSD and Air Force staffs and hopes that Congress would be less likely to cut funding.[380] This thinking proved too optimistic.

As the program sought approval in the fall of 1987 for the full release of funds for the first two aircraft (Lot I), more program issues surfaced during the reviews. There were concerns over concurrency, weight growth, defensive systems, electromagnetic pulse protection, software, avionics and flight control systems, life cycle costs, funding, and the program's schedule. Of significance, avionics development and integration had fallen considerably behind schedule. The C-17 was McDonnell Douglas' first effort at developing and integrating complex avionics systems. The company's decision to modify the Sperry hybrid fly-by-wire and hydro-mechanical flight control system to a primary quad-redundant digital flight control system with a hydro-mechanical back-up only complicated the matter at this juncture. Wind tunnel data had disclosed a deep stall characteristic in the C-17 (not uncommon for T-tailed aircraft), which brought about the change from the mechanical to the fly-by-wire flight control system. Nor were the initial assumptions of the 1984 DSARC II that the C-17 was a low-risk program, which paralleled the DC-10 bearing out.[381]

In addition to these concerns, Milton A. Margolis, chairman of the preliminary Cost Analysis Improvement Group reviewing the C-17, also challenged the Air Force's cost estimates for avionics, manufacturing labor, logistics resources, military construction, war reserve material (spares and fuel), and material handling equipment. Expressing the group's reservations in October 1987, Margolis concluded: "there is significant cost uncertainty and risk in this program. These cost risks coupled with overall affordability concerns and the size of the C-17 FY1988 funding ramp justify a delay in further commitments until the more significant of these issues have been resolved."[382] With the OSD program review a few weeks away, Margolis' "surprise" memo proved to be the sticking point. It could take several months to assemble all of the cost data. It also appeared that the requested data was not germane. During the pre-Defense Acquisition Board session, it was agreed that Margolis' concerns should not stop the program review. C-17 SPO Director Colonel Butchko, then just shy of pinning on brigadier general, and Air Force Comptroller Lieutenant General Claudius E. Watts III met with Margolis to work out a compromise—Margolis would have all of the data prior to the Milestone IIIA decision slated for October 1988. While this occasion served as an example of the C-17 SPO director needing the rank of a general officer, General Watts was supportive, as he had spent time as an "airlifter" in the Military Airlift Command and thoroughly understood the command's mission and requirement for the C-17. Through the Vice Chairman of the Joint Chiefs of Staff, Air Force General Robert T. Herres, an invitation had been secured for General Cassidy to attend the Defense Acquisition Board, if necessary. With the establishment of the joint service United States Transportation Command in 1987 and the dual-hatted commander arrangements, the commander of the Military Airlift Command could now tap into the unified command structure for amassing C-17 support. There was also a fortuitous resignation, Secretary Godwin's. General Herres would now chair the Defense Acquisition Board.[383]

On 3 November 1987, the Defense Acquisition Board approved the full release of funds for procuring two aircraft in Lot I and advance or long lead procurement of four aircraft in Lot II as well as the remainder of the RDT&E funds required for tooling. The Milestone IIIA decision (now scheduled for December 1988) would approve the low rate initial production, releasing fiscal years 1989-1992 funds for Lot II, III (six aircraft), IV (10 aircraft), and V (20 aircraft), and advance buy funds for Lot VI (29 aircraft), upon congressional appropriations. Deputy Secretary of Defense William H. Taft IV followed on 10 December, granting the Air Force the requested approval. Taft's memorandum stipulated in the ensuing months the following: another independent estimate of costs (especially avionics and software), criteria to be met for Milestone IIIA/B and IOC, schedules and progress reports, the recommended defensive configuration, manpower estimates, and a formal assessment by the Air Force Operational Test and Evaluation Center on attaining the criteria for Milestone IIIA and initial operational capability. The month delay could be attributed to waiting on OSD coordination. In particular, Dr. David Chu, Assistant Secretary of Defense for Program Analysis and Evaluation, held up the acquisition decision memorandum seeking clarification on the defensive system and associated costs. The DAB members had agreed to defer the defensive system and electromagnetic pulse requirements and funding until the Defense Resources Board fiscal year 1990 program objective memorandum discussions. Milton Margolis desired additional cost data on the program baseline and system operational concept deferred content. Again, the Air Staff, C-17 SPO, and the Military Airlift Command strove to provide the information in a timely manner, fearing a "slow roll" on the acquisition decision memorandum.[384]

At the request of Army Secretary Marsh, Brigadier General Butchko briefed the Army Policy Council on the DAB results in early February 1988. Colonel Charles Andrean followed, presenting the Army's involvement in the development process and the C-17's ability to meet Army requirements. While the briefings were well received, Marsh used the occasion to send a message: the Air Force was guilty of emphasizing intertheater airlift at the expense of intratheater airlift; it was the C-17's ability to do both that increased its value to the Army.[385] At this time the Army had a list of 16 unresolved issues, mostly concerning airdrop (over and outsized), aircraft loads (six mixed helicopters, three Bradleys, or 5 ton trucks side by side), satellite communications, floor strength (no shoring), and the maximum load (167,002 pounds) into small, austere airfields.[386]

**Too Many Pounds**

Excessive weight growth threatened the program's existence and specified performance requirements. At source selection, McDonnell Douglas had specified in its offer an operating weight empty of 259,000 pounds with a maximum gross takeoff weight of 570,000 pounds, allowing a few thousand pounds of "wiggle room." At contract award in July 1982, McDonnell Douglas had stated an operating weight empty weight of 236,633 pounds.[387] Brigadier General Harbour was vigilant about keeping the aircraft's weight down while also achieving needed changes. In January 1985, his "Junk Yard Dog" exercise, as he termed it, enabled the Air Force to gain a four-pallet ramp capability and a beefed up wing by accepting a 3,800-pound reduction in payload. This did not affect the stipulated payload of 172,200 pounds and was in keeping with the C-17 Trades Agreement[388] or Engineering Change Proposal 40, whereby deferred requirements could be added to the existing C-17 contract without increasing the program cost. In exchange, McDonnell Douglas received relief from some of the existing system specifications. The Trade Agreement reflected David Packard's acquisition philosophy.[389]

A several year effort to control weight ensued when the C-17 SPO established in 1986 an integrated SPO, MAC, and McDonnell Douglas weight assessment management organization with the catchy acronym of WAMO. WAMO had the attention of senior managers. At times, the participants were testy with each other, but the job got done. In 1987, the operating empty book weight climbed to 276,489 pounds. By February 1988, as the design matured, the C-17's operating weight empty goal became 268,000 pounds with a maximum takeoff gross weight of 580,000 pounds. The aircraft's structural design did not accommodate much more than that. While McDonnell projected an operating weight empty weight of 265,000 pounds (saving 9,000 pounds), Brigadier General Butchko believed a 7,000-pound reduction more plausible, which ensured the target design weight of 268,000 pounds. By the end of 1989, the book weight stood at 270,894 pounds. A weight reduction of nearly 16,000 pounds had been achieved since WAMO's inception.[390]

Most of the weight reductions came from a more efficient initial design. Engineers reviewed the released drawings, looking for conservative design practices that yielded excess structural margins. This effort identified over 8,300 pounds with over half approved for incorporation. In this vein, McDonnell Douglas engineers proposed weight savings of 250 pounds for the upper wing surface and 1,000 pounds for the lower wing surface skins by chem-milling the wing skins. Because of the wing cracks in the C-5A, Military Airlift Command officials seriously questioned the proposal, but after much discussion and further analysis, the C-17 SPO Director of Engineering, Ted Lynch, accepted the thinner wings as a sound engineering decision.

New technologies and/or redesign provided good results as well, although this tended to pose a dilemma between higher costs versus a decrease in weight. For example switching from aluminum to titanium decreased the operating weight but increased the program's cost. Using composite materials such as carbon fiber, aramid fiber, and fiberglass provided good weight savings while maintaining needed strength. Deleting weight might also affect the aircraft's center of gravity. The WAMO team effort was extensive and exhausting. Items weighing a pound or two even received consideration. Reducing the size of the lavatory mirror saved four pounds, and consolidating the overhead switch panels yielded a pound, for example.[391]

There was a balancing act between saving pounds and ensuring operational requirements. Some of McDonnell Douglas' weight reduction proposals were impractical. Oversight provided a check. Chief Master Sergeant James Lis voiced his wariness over McDonnell Douglas' approaches to the cargo loading stabilizer struts and the aerial delivery rail system, as they threatened operational utility and the single loadmaster concept desired by the Military Airlift Command. As an alternative, McDonnell Douglas proposed using the exterior ramp area as a stowage facility for the lower cylinders. While this reduced the impact of lugging 25-pound cylinders in and out of the aircraft, it resulted in a unique procedural situation, requiring positioning the ramp prior to strut installation. Moreover, the ramp could only be raised after the struts were stowed.[392]

As to the cargo rail system, McDonnell Douglas decided to covert the hydraulic actuation to electric, eliminating over 140 hydraulic actuators and reducing weight. Chief Lis reported: "Our primary concern here is that DAC previously evaluated electric versus hydraulic actuation and went with hydraulic because it was more reliable and lighter. Now they say the opposite is true. We will track this issue closely and address it more formally during the upcoming TIM [technical interchange meeting]."[393] At other times, McDonnell was unwilling to reduce weight without an engineering change proposal or a trade off in range or payload performance criteria, as was the case with incorporating a C-141 type flapper door for toilet servicing.[394] This disagreement highlighted how contentious government-contractors relations were becoming.

Overall, the greatest weight increases occurred in the fuselage, wing, propulsion, and with items weighing less than 100 pounds. The four-pallet ramp decision had added close to 4,000 pounds. And although the switch to the onboard inert gas generating system improved maintainability and eliminated the need to source liquid nitrogen to inert C-17 fuel tanks, it resulted in a weight increase of over 1,000 pounds. Wing damage tolerance considerations amounted to close to some 5,500 pounds, which was offset somewhat by chem-milling the wing skins. To accommodate higher cargo loads, the flooring and supports required beefing up resulting in additional weight. The higher maximum takeoff weight of 580,000 brought forth engines with more thrust, hence more weight. Pratt and Whitney studied shaving off weight from the F-117 engine, but there was no commercial application for doing so.[395]

The Army helped with weight reduction efforts as well, issuing a memorandum in February 1988 that limited the 70-ton Abrams tank to a noncombat transportation mode of 64.5 tons or 129,000 pounds. By doing so, the Army was adhering to what it had specified in the 1981 C-X system operational concept document, although subsequently the Army really desired a combat ready configuration. Purportedly the Army stipulated this limit so the Air Force would not have to redesign the C-17's ramp hinge for higher weights.[396]

Weight growth was also the primary culprit behind the life cycle cost increase. In January 1988, McDonnell Douglas exceeded the life cycle cost baseline by $207 million (1980 dollars). Despite a recovery plan and efforts to find "cheaper pounds" or weight reductions that would not add to maintenance manhours or support costs, life cycle cost surpassed the baseline by $747 million in August 1988. At this time, maintainers specifically expressed dissatisfaction with several design decision notices, such as the OBIGGS storage bottles (any bad lug would now require changing the entire bottle), landing gear weight savings (loss of commonality, increased parts, and maintenance hours), and multiple sizes for hydraulic filter element (original identical filter for 29 elements now three).[397]

Thus, with the C-17 program, the whole weight savings process required a concerted, coordinated effort. Other aircraft acquisition programs had also faced establishing the proper balance between performance and life cycle cost given the natural tendency for weight increases as the design progressed. It was not an easy task. The WAMO structure enabled the contractor and the Air Force to come together and achieve solutions. Later in 1992, out of a need to preserve the C-17's range and payload performance capabilities, the C-17 SPO initiated another extensive weight reduction initiative with a goal of 10,571 pounds, seeking an aircraft operating weight empty weight of 266,000 pounds.[398] When the C-17 first entered operational service, its operating weight was 268,000 pounds but subsequently became 276,500 pounds, mostly due to increasing the maximum takeoff gross weight to 585,000 pounds.[399]

**Head-Up Display And Jacks**

In 1988, there were also design issues that required resolution. One—the head-up display (HUD)—had Air Force Chief of Staff Welch's attention. The C-17 would be the first Air Force aircraft to use the HUD as its primary flight instrument display, although the Navy operated its F-18 and AV-8 with HUDs as the primary. The C-17 required the HUD for routine operations into small, austere airfields; the display would also enhance the accuracy of low altitude parachute extractions. The HUD, which allowed pilots to aim the aircraft as well a receive flight performance data, was a good improvement over the aim only visual approach monitor (VAM) originally proposed by McDonnell Douglas. In March, the Military Airlift Command expressed concern over the placement of the head-up display during a flight deck panel mockup review. At this session, Lieutenant Colonel Thomas Crowley found that he and the other MAC representative were the only ones voting nay. Outvoted, Crowley got the panel chair to approach Brigadier General Butchko on having operations and human factors engineering experts evaluate the command's pilots, similar to the loading demonstration. In its present placement, the HUD obscured buttons and lights, presented a potential hazard to the pilot's face during normal cockpit operations, and prevented some pilots from reaching the fire detector panel. For others, the base of the HUD was just 4.5 to 5 inches from their faces.[400]

With General Cassidy engaging on the issue, Brigadier General Butchko responding, and General Welch observing the HUD during a visit to Douglas facilities, (whereupon he imparted lessons from the F-15's HUD development; namely display clutter, symbology, and lack of pilot involvement), Robert Clepper readily formed an integrated tiger team to come up with alternatives. C-17 SPO and McDonnell Douglas engineers examined the A-10, F-15, and F-16 HUD symbology and operational experiences. The team effort resulted in the wide-field-of-view HUD for the C-17. With birdstrike testing revealing front window deflection coupled with the potential for head strikes, the solution was to move the HUD and seats back three inches. However, these design changes affected other areas such as the center console and throttle where reach and access were crucial. Timely resolution of the HUD facilitated the upcoming critical design review (CDR).[401]

The placement of the HUD, however, was not the only cockpit issue. The C-17 Cockpit Operational Utility Committee, co-chaired by the C-17 SPO and McDonnell Douglas, and its subcommittee the Display Evaluation Group dealt with numerous contentious issues over the next years. The effort was very painstaking at times and compounded by Douglas' reorganization. Two of Douglas' best avionics engineers left the group at this time. Issues arose, for example, over placement and terminology of display symbols, the location of the flotation equipment deployment system handles, the lack of an anti-icing detection failure warning, pilot workload, cockpit lighting, unacceptable throttle configurations, the difficulty in operating the flap/slat control handle, the lack of visual and aural notification when outside of autodrop parameters, mission computer glitches, and windshear detection/pilot procedures. Slow development of the integrated display development station also impacted pilot display evaluations. One delay to upgrade the station ate up a year.[402] This was another example of McDonnell Douglas as well as the Air Force grossly underestimating C-17 software development, and the program paid a heavy price. It also underscored governmental oversight of a contractor and the need for the operating organization to have input.

Another thorny design issue, which had been worked since the preliminary design reviews, was a suitable jack to lift several thousand pounds of C-17 for maintenance repair work on the main landing gear system. "Concur with SPO approach on formation of Tiger Team. We should not go to CDR without more definite and acceptable procedures," Chief Master Sergeant Joseph S. Domingos advised the Military Airlift Command the end of March 1988.[403] Originally, McDonnell Douglas had proposed a jack capable of lifting 150 tons, but this jack would have been nonstandard and a limited inventory item, causing unacceptable mission delays for want of the 150-ton jack. Mechanically, the jack was also unacceptable. Removal of a wheel assembly meant lifting one side of the airplane. The rotation and physical displacement of the C-17 atop the extended jack was simply insurmountable. Other solutions, such as two 65-ton jacks, were less than ideal, mainly because of the increased time required for such frequent maintenance repairs as tire and brake changes.[404] The tiger team drawing upon the assistance of material management technicians and engineers from the San Antonio Air Logistics Center at Kelly Air Force Base, Texas, initially discussed recommendations based upon the C-5. Finally, two SPO engineers, Captains Terry Ryan and Stan Bennett, came up with a very acceptable and somewhat revolutionary solution: a self-contained jacking capability that used one of the landing gear shock struts as a jack. When it was necessary to lift the C-17, pressure from the C-17's hydraulic system would extend the strut of the tire next to the one requiring maintenance. The new jacking system would allow the C-17 to be loaded or unloaded at the same time maintenance personnel removed and installed tires and brakes on the main landing gear. To raise the entire aircraft, maintainers used six 60-ton hydraulic tripod jacks.[405]

The main landing gear jacking issue demonstrated what could be achieved through bringing the concerned parties together and making them work as a team. Brigadier General Butchko was a team builder.

**Critical Design Reviews**

Between May and July 1988, validation of the C-17's final design received much attention, for after completing the critical design review process, the C-17 would progress to the manufacturing phase. It was the last opportunity for smart and cost efficient design changes. An executive program management review held before initiating the CDR set the tone: "Believe we got Douglas' attention that all is not on schedule and 'promises' were not acceptable as fixes. Detailed achievable schedules and better planning with contingency work arounds was the theme hammered home to Douglas."[406] Centering on such major areas as airframe, electrical and lighting, structures, power plant, avionics, systems integration, crew and mission systems, flight technology, and product assurance, the critical design reviews went better than expected. Generally, McDonnell Douglas officials proposed acceptable corrective actions as issues surfaced and had fulfilled most of the CDR requirements by the milestone date of 29 July 1988.

McDonnell Douglas, however, did have problems meeting the CDR schedule in the areas of procuring "off the shelf" components and avionics design and integration. The slow development of the mission computer hardware and software design was the greatest concern. A month before the start of the critical design reviews, Brigadier General Butchko advised Assistant Secretary Welch that DELCO only had onboard 15 percent of the software personnel needed for developing the mission computer. The outstanding avionics items threatened to delay the Milestone IIIA decision. Butchko underscored the Air Force's concern by withholding approximately 10 percent of the milestone payment. A joint McDonnell Douglas-SPO "Red Team" ensured the issues progressed to resolution. Finally, by the end of November, new schedules for developing the DELCO mission computer and the Honeywell electronic flight control system were in hand.[407] Mission computer and software development, however, continued to seriously plague the program, so much so that DELCO-McDonnell Douglas indicated some six months later in May 1989 that they could not deliver a fully functioning mission computer for the first operational aircraft, but perhaps do so by P-20.[408] More setbacks followed in succeeding years.

**T-1 Takes Form**

There was cause for celebrating in 1988. Assembly of the first C-17 (T-1) began on 24 August 1988 with the mating of parts to form a cargo floor channel rail. Douglas workers Steve Ybarra and Ernest O'Campo secured a place in aviation history by installing the first fasteners in the rail. The floor rail was the first of

227,000 pieces in the assembly process. Douglas' C-17 production and support personnel numbered over 6,500 at this time. McDonnell Douglas showcased the event at its Douglas Aircraft Company facility, Long Beach, California.[409]

The C-17's power plant was also progressing. On 9 May 1988, Pratt & Whitney delivered the first two F117-PW-100 engines, test articles, five months ahead of schedule. Reflecting the program's commitment to procuring commercial "off-the shelf" equipment where possible, the F117-PW-100 engine was the military version of the commercial PW2000 series turbofan engine, a proven third generation engine. As a result, the government got a mature engine and logistics system without having to fund any engine development. Originally, McDonnell Douglas had selected the PW2037 engine, which Delta Air Lines inaugurated in December 1984, and then switched to the PW2040 variant when it became available in 1987. The PW2037 had set the industry standard for most fuel efficient turbofan, as well as one of the most reliable. The PW2040/F117 engine provided 41,700 pounds of thrust, an increase of 4,100. Along with other performance enhancements, the more powerful engine helped to offset airframe weight increases through greater lifting capabilities. Ground testing the engine installed in a C-17 nacelle was the next major event.[410]

Although McDonnell Douglas' management remained optimistic and maintained T-1's delivery would occur as planned in January 1990 with the first flight following in August 1990, Brigadier General Butchko indicated during the 2 November 1988 pre DAB program review a slippage of two months for mating T-1's wings to the fuselage. He expressed a 50/50 chance of making the first flight by December 1990. McDonnell Douglas was also behind on its commercial line and on the T-45 modifications. To alleviate saturating its manufacturing capacity, McDonnell Douglas changed the make/buy plan and leased space at Air Force Plant 85 in Columbus, Ohio. However, Plant 85, scheduled for the out years, would do little for T-1 and the early production aircraft.[411]

**Milestone IIIA-Low Rate Initial Production**

Assessments of the C-17 program by the Office of the Secretary of Defense staff occurred in the fall of 1988 when the Conventional Systems Committee held a program review before the low rate initial production decision, Milestone IIIA. As each office reported, a consensus emerged on the state of the program. Overall, the program was viable; concerns expressed centered on the manufacturing and assembly of the first aircraft and meeting the subsequent schedules for first flight, testing, and initial operational capability. The OSD staff comments were especially insightful and foreshadowed future developments.

The Assistant Secretary of Defense for Production and Logistics, Jack Katzen, advised "The C-17 Program has incurred a high schedule and cost risk because of development and production overlap, a concentrated weight reduction effort, and late release of engineering drawings. This late release of engineering drawings, alone, has led to a tool design/fabrication backlog of 720,000 hours."[412] Of this total, some 200,000 hours had not been forecasted and had as a result a potential impact on cost. The late drawing releases also held up subcontractor procurements, causing schedule slips, which could not be recovered. Consequently, McDonnell Douglas had to restructure the assembly process and took steps to prevent further slippage. "However, it is felt that existing schedules for T-1 and early production aircraft deliveries will slip."[413] The software schedule for the mission computer and the electronics flight control system software had also gotten behind. Although the slippage might place the first flight at risk, Katzen rated software develop as a medium program risk at this juncture.[414]

John Krings, the OSD Director for Operational Test and Evaluation, noted that the required Air Force Operational Test and Evaluation Center's early operational assessment "concluded that attainment of the Milestone IIIA criteria, readiness for IOT&E, and the progress of requirements/test criteria development are on track."[415] Krings was particularly opposed to making production decisions without adequate testing. He believed a concurrent program had the potential to field an aircraft in a developmental state, especially if program delays occurred. Krings labeled developing the mission computer a major risk.[416]

Charles E. Adolph, the Deputy Under Secretary of Defense Research and Engineering (Test and Evaluation), informed the committee that most areas of the C-17 program were making satisfactory progress towards initiating flight test activities, scheduled for August 1990. However, Adolph noted four items that poised medium to high risks for the program's schedule and cost.

> The scope and progress of the Avionics and Electronic Flight Control System and the mission computer software development may cause a delay in the first flight. The test program flying schedule is optimistic, based on historical data on comparable aircraft. The Live Fire Test plan has been reviewed but not yet approved by OSD. The defensive system avionics test program scope, content and schedule is not clearly defined and integrated into the C-17 program baseline.
>
> With the exception of the above areas, there has been satisfactory progress to warrant favorable consideration for low rate initial production (LRIP).[417]

At the last Defense Acquisition Board review in October 1987, Adolph's staff had raised a number of issues: the structural response of the C-17 airframe to the high sink landing required for short takeoff and landing operations; timeliness of avionics hardware, software development and integration; recurring questions over the required operational capabilities that caused the test planning and execution to be in a state of flux; and design weight of the aircraft exceeding the threshold. In their view, satisfactory progress had now been made, except for avionics.[418]

Almost every electro-mechanical system on the C-17 was controlled by software. With software coding in excess of 500k lines, the C-17 was a software intensive weapon system. Subcontracting, McDonnell Douglas served as the integrator of all C-17 software and hardware. But McDonnell had little experience on software intensive programs and, as a result, brought in at the senior management level an experienced avionics engineer to oversee implementing and administrating the software configuration control process. Because of the unrecoverable slippage in the electronic flight control and mission computer, Adolph assessed the first flight date of August 1990 as posing a high risk—a five percent possibility of occurring—with the alternate date of December 1990 as medium risk—a fifty percent probability.[419]

As to the flight test schedule being optimistic or "success oriented," historical data and simple math proved this point. Dividing the 2,300 hours scheduled for flight testing by the historical data of 25.5 hours per month from the YC-14, YC-15, and C-5A programs yielded a requirement of 90 test months. Thus, the baseline of 64 test months plus a reserve of an additional 20 months yielded a shortage of 6 test months. Accordingly, the test program could not be completed by the scheduled Milestone IIIB date, delaying the declaration of initial operational capability. Besides this issue was a concern that insufficient funding might make the test program hard to execute.[420] Nevertheless, overall, the C-17 program was still regarded as achievable.

Following the Air Force Systems Acquisition Review Council review, the DAB met on 5 December 1988. Brigadier General Butchko presented the status of the C-17 program. He was upbeat. All of the Milestone IIIA prerequisites had been completed—program documentation, critical design reviews, production readiness review, independent logistics assessment, independent cost analysis, T-1 assembly initiated, and early operational assessment. The C-17 had achieved all technical performance requirements for payload, range, takeoff/landing, mach, and backing up. The C-17 had either met or exceeded all reliability, maintainability, and availability requirements. This was not the situation for four of the ten major avionics subsystems though. DELCO with the mission computer and electronic display system, Honeywell with the electronic flight control system, and Teledyne with the warning and caution system had marginal statuses. General Butchko highlighted management initiatives undertaken by the C-17 System Program Office and McDonnell Douglas. There were cost controls, a weight management program, measurements, second sourcing, T-1's rephrased schedule, increased emphasis on the industrial modernization incentives program, and the implementation of total quality management. At this time, the schedule planned for first flights of T-1 and P-1 in October 1990 and an initial operational capability in fiscal year 1992. The estimated total acquisition cost now stood at $36.1 billion (then year) with a potential savings of $.8 billion if the Air Force, Department of Defense, and Congress approved multi-year contracting. General Butchko informed the board the challenge was in the tight schedule, but the C-17 was ready for the low rate initial production decision.[421]

John Krings, however, refused to sign off on the acquisition decision memorandum, delaying approval for over a month due to an assessment of McDonnell's T-45 program. A Navy review of the T-45 questioned if the aircraft would be operationally acceptable, and the program manager voiced no confidence in McDonnell Douglas' ability to build a military aircraft. These events led Krings to have doubts about McDonnell Douglas' manufacturing capability. Krings convinced Dr. Costello to hold a DAB executive session to discuss building only one or two test aircraft. The door was open once more for those desiring to cancel the program. Initially, John J. Welch Jr., Assistant Secretary of the Air Force for Acquisition, was unable to turn off reconvening the DAB. McDonnell Douglas executives Robert L. Clepper and Thomas M. Ryan Jr. came forward with a briefing explaining the differences between the two programs. Essentially, the T-45A program was a derivative of the British Aerospace Hawk trainer aircraft with a very austere development phase. Welch and Butchko followed McDonnell Douglas' presentation, briefing Krings in early January. If this had not worked, there was talk of bypassing the OSD staff and going directly to the Vice Chairman of the Joint Chiefs of Staff, Air Force General Herres, with General Cassidy making a personal appeal to Deputy Secretary of Defense William H. Taft IV.[422] Once again, the C-17 benefited from the establishment of the joint service United States Transportation Command.

On 18 January 1989, based upon the conventional systems committee's recommendation, Deputy Secretary Taft only granted approval for low rate initial production procurement for fiscal years 1989-90 (Lots II and III, 10 aircraft) and advance procurement in fiscal year 1990 for 1991 (Lot IV, 10 aircraft). Approval of the rest of the Air Force's request hinged upon a satisfactory Defense Acquisition Board review following attainment of the baseline milestone for the Lot IV award—the event-based contract award, T-1 and P-1 first flights, scheduled for October 1990. An extensive list of taskings concerning the defensive systems, live fire testing, system maturity matrix, flight test schedule, simulator, operational readiness evaluation, operating weight empty, electro magnetic pulse hardening, integrated logistics support, procurement costs, operating and support costs, low rate initial production, and documentation for Milestone IIIB followed from the Under Secretary of Defense for Acquisition, Dr. Costello.[423]

Thus, ten years from its inception, the C-17 acquisition program had finally gained approval for the production phase. As the next presidential administration came into power and more difficulties plagued the C-17, the program's course remained uncertain and under fire as ever. But for the moment, there were celebrations.

# IV

## DEFINITELY IFFY-The Crisis And Beyond
## 1989-2001

The Berlin Wall—the Iron Curtain that symbolized the division between democracy and communism—was breached on the night of 9 November 1989 as East Germans freely crossed into West Berlin. Over the next years, the world community observed the break up of the Soviet Union into independent states and the decline of its communist and military influence globally. The Cold War was over, and its attendant Soviet-oriented strategy was now defunct. Slowly a reordering—a reassessment—of the United States' national security requirements followed. The familiar and predictable nature of Cold War politics ceased, and for a time, the United States grappled with what the new environment entailed.

Instability gave way to open conflict, and the United States found itself intervening in Panama and then in a major war in Southwest Asia, facing Iraq's Saddam Hussein. In the aftermath, there was more reassessment, more reordering. After the Gulf War, the United States settled on a strategy of preparing for two near simultaneous major regional conflicts but soon faced smaller-scale contingencies as well as such asymmetric threats as terrorism.

In January 1989, Vice President George H. W. Bush assumed the office of the presidency. A Navy pilot during World War II, President Bush nominated Donald B. Rice as his Secretary of the Air Force, Army General Colin Powell as Chairman of the Joint Chiefs of Staff, and subsequently General Merrill A. McPeak as Chief of Staff of the Air Force (October 1990). Holding a doctorate in economics, Donald Rice at the time of his appointment had spent the last seventeen years as the president and chief executive officer of the RAND Corporation.[424]

President Bush chose Representative Richard B. "Dick" Cheney (R-WY) as his secretary of defense after the Senate rejected his first choice—former Senator John G. Tower of Texas. Quiet, smart, a man of respect, Cheney knew Congress and got along with the House and Senate defense committees, avoiding the difficulties that Secretary Weinberger had faced. Following the end of the Cold War, Defense Secretary Cheney, a realist, wanted the North Atlantic Treaty Organization to remain as the security organization for Europe and called for the alliance to lend more assistance to the emerging democracies in Eastern Europe. He was less optimistic than other administration officials on the peaceful evolution of the former Soviet states. Nevertheless, with the old order changed, the American people expected a peace dividend. Congress would provide it, if the administration could not. Accordingly Cheney cut military forces and programs along the lines suggested by General Powell. Overall the plan called for reducing the military by 25 percent, and from 1992-1995 defense spending declined by 22 percent.[425] Acquisition programs faced reductions as well. The C-17 was not exempt, albeit the airlift requirement was well accepted. The reductions in force structure, however, resulted in readjusting airlift's million-ton-miles per day figure which in turn raise debate over how many C-17s, if any, were needed.

Air Force Chief of Staff, General Merrill McPeak had a distinguished career as a fighter pilot. He was receptive to change and believed in the need for a new Air Force culture.[426] Consistent with Secretary Cheney and General Powell's efforts to restructure the military forces in the post-Cold War era, Secretary Rice and General McPeak, announced a major restructuring of the Air Force in September 1991. It was the most extensive reorganization since the Air Force's inception in 1947. To this end, the Tactical Air Command, Strategic Air Command, and Military Airlift Command were disestablished. Two new organizations were activated in their places: the Air Combat Command got all of the "shooters," the fighters, bombers and missiles, while the Air Mobility Command got almost all of the airlift and air refueling resources. Additionally, the Air Force Systems Command merged in July 1992 with the Air Force Logistics Command to form the Air Force Materiel Command. Overseas, commanders now commanded all assets they needed to make air power unified within a theater. These actions addressed the limits of organizing Air Force commands along purely functional lines and the blurring that had occurred between the tactical and strategic missions over the years, further confirmed during the Gulf War.[427]

As the 1990s progressed, despite the absence of a global Soviet threat, the world remained an unstable place. On 9 December 1992, the eve before William Jefferson Clinton became president, US troops arrived in Somalia. A month after Clinton's inauguration a terrorist bomb exploded in a parking garage beneath the World Trade Center in New York City. President Bush's decision to end the ground war when he did also left Clinton to deal with a recalcitrant Saddam Hussein very much in power in Iraq. North Korea demanded some attention as well. Then there was Bosnia, Haiti, Rwanda, and Serbia. President Clinton found he could not ignore these regional conflicts while staying the course of additional defense reductions. The C-17 was vulnerable as costs and production delays mounted.

**Shaky**

In January 1989, Congress began its scrutiny of the fiscal year 1990 President's Budget. Testifying before the House Appropriations Committee's Subcommittee on Defense, General Duane Cassidy pitched his airlift programs:

> The C-17 is a modern, low risk airlifter . . . the additional lift capability it will produce allows us to reach the goal of 66 MTM/D . . . the C-17 is under production. We completed Critical Design Review in July, 1988, and assembly of the first aircraft began in August . . . it will be capable of

moving large quantities of munitions, fuel, and outsize cargo needed by the Army's highly mobile ground and aviation forces directly to the fighting in forward areas. More importantly, the C-17 will lower the manpower requirement and decrease the operation and support costs. It will minimize the life-cycle costs and provide the most affordable solution to the nation's airlift shortfall.[428]

Although General Cassidy's statements were well-received, Headquarters United States Air Force and Office of the Secretary of Defense staffers debated continuing the program following President George Bush's remarks to Congress on 9 February. Bush told Congress that he would trim the 1990-94 budget proposed by Reagan, allowing just enough growth to offset the rate of inflation. For 1990, this translated into a \$6.3 billion cut from the proposed \$305.6 billion budget and left staffers looking for ways to accommodate President Bush's decision.[429]

Under General Cassidy's guidance, the Military Airlift Command continued its pro-active role. Lieutenant Colonel Charles L. Johnson II, Chief C-17 Program Division, traveled to Washington, DC. His presence at the Air Force-level discussions enabled the Military Airlift Command to comment ahead of time on proposed C-17 cuts instead of having to try and reverse a decision afterwards. During the four-star commanders' conference in mid-February, General Cassidy was successful in securing what was most critical; the generals of the major air commands supported a reduced buy profile for fiscal years 1990-1994, preserving the critical ramp up to 24 aircraft by 1994 for multi-year savings. However, when the buy profile was briefed to General Larry D. Welch, Air Force Chief of Staff, another 5 aircraft had been cut in addition to the 19 previously with the resulting loss of multi-year savings. The situation was unacceptable to General Cassidy, and he counseled that if the Air Force did not adhere to a buy profile of 24 aircraft by 1994, the program would lose the projected multi-year savings and raise a larger issue—the C-17's affordability. This erosion came to the attention of John J. Welch Jr., Assistant Secretary of the Air Force for Acquisition, as he and his principal deputy prepared for congressional testimony before the Senate Appropriations Committee. This prompted Air Force acquisition and programs and resources staffs to remedy the discrepancy, and the buy profile submitted to the OSD on 24 February for inclusion in the amended Air Force budget was for 76 aircraft, a cut of 20 aircraft, but containing 24 for both 1993 and 1994.[430] The next weeks were critical.

General Larry Welch signaled during his congressional testimony in March that he was prepared to accept large cuts in the C-17 program (as well as the B-2, F-15 and F-16 programs).[431] At this time, Lieutenant Colonel Johnson discovered some members of the Air Staff suggesting the transfer of strategic airlift to the Department of Transportation, rationalizing the Air Force was sacrificing its total obligation authority for airlift to support the Army instead of buying "combat" force structure for itself. The mere suggestion was "blood boiling" to Johnson. It "highlights the mentality I am up against every time I go to the Air Staff to fight for the C-17."[432]

Excerpts from the issue paper entitled "Reorganization of Military Airlift Command" revealed the deep divide. "It is the responsibility of the military to fight and win, it is the responsibility of the nation to provide the means by which the military carries out its mission. The military should concentrate its limited resources on the business of fighting, not exhaust these resources on strategic transportation." The Air Force should return to the "Fly and Fight" philosophy by removing the "'airline' Air Force from 'combat Air Force.'" Strategic airlift could be transferred from the Air Force, as it was a "pay as you go" industrial fund. Its management overhead cut into the Air Force's manpower ceiling. Placing airlift in the Department of Transportation allowed for utilizing older and mixed military-civilian aircrews, thereby freeing up military personnel as well. Specific to the C-17, "We should not sacrifice combat capability to preserve [the] C-17." The "C-17 does very little AF resupply." "One C-17 carries one tank—dumb. One C-17 equals 9 F-16s in cost. Surely 9 F-16s are more effective than one tank." Moreover, the "Army wants [the] C-17 to operate unrealistically close to FEBA" [forward edge of the battlefield], resulting in more cost expenditures for defensive systems and structural changes to enable unprepared airfield landings.[433] The author or authors obviously came from the fighter world, thought only in terms of immediate self-preservation, and ignored the unmanned fighters and cargo vehicles of the future.

Such sentiments also existed at the DOD level. An unnamed senior official characterized the C-17 as "irrelevant" in *Aviation Week & Space Technology*. He explained, the C-17 was "conceived by the airlift Mafia in the Pentagon as a way to move two divisions to the Zagros Mountains [Iran] when we were worried about the Russians and the Ayatollah." Portraying, that situation as "gone," the C-17 still remained. The official indicated that increased warning times as well as the changing European environment had created other alternatives to the C-17.[434]

Nor did the C-17 program have the support of the DOD's acquisition czar. Under Secretary of Defense for Acquisition Robert Costello still believed the C-17 too costly and claimed it had been added to the budget without thoroughly examining sealift options. In Costello's court was the Committee for National Security, comprised of former military and government officials to include Lawrence J. Korb, Director of the Brookings Institution but formerly the assistant secretary of defense for force management and personnel. As the press disclosed in January, the influential body recommended scrapping the C-17 on grounds of cost, technical problems, and unproven operating concepts, such as the small, austere paved/unpaved runways. Korb indicated a C-5 cost half as much and favored fast sealift alternatives. The timing and content of the announcement challenged a response from General Cassidy, and heated editorials were exchanged.[435]

In comparing costs, Korb seemed to have forgotten the C-5's tremendous overruns as well as factoring in operations and maintenance life cycle costs. That Korb chided Cassidy as commander of the United States Transportation Command for not weighing the trade-offs between the C-17 and fast sealift indicated the growing pains of the new unified command and that the Navy as well as the fighter generals in the Air Force regarded the C-17 as taking away procurement dollars. Although Cassidy had the track record of the AMST YC-15 flight test program, the C-17 was literally just being pieced together. Rising unit costs and the contractor's poor performance would continue to bolster those who were advocating their own programs or were just plain against the C-17.

During the April Defense Resources Board session, which ironed out the Defense Department's priorities on the amended budget, the C-17 was among the major weapon programs debated. The new Secretary of Defense, Richard Cheney, chaired the session, requesting according to his style "just the facts." Cheney's directive gave the Military Airlift Command (via the United States Transportation Command) its "day in court" with command officials explaining the military's requirement for the C-17 directly to the secretary. Although the Air Force had recommended substantial cuts to the C-17 program, Cheney opted for a less damaging funding profile. The Military Airlift Command's ability to use its joint service command channel had come in handy again. Thus, the amended budget submitted to Congress favored a purchase of 94 C-17s with a yearly buy profile of 6, 10, 20, 29, and 29 aircraft over fiscal years 1990-1994.[436]

After clearing this hurdle, the program encountered difficulties in Congress. Initially, the House Armed Services Committee, chaired by Les Aspin (D-WI), authorized full funding while the Senate Armed Services Committee, under the chairmanship of Sam Nunn (D-GA) sought to reduce procurement and research and development, although the committee did preserve the request for six aircraft in fiscal year 1990. By April, Congress knew the program faced delays and cost increases. McDonnell Douglas publicly acknowledged that the C-17 program was over budget by some $400-500 million. Cost overruns of $150 million could be attributed to difficulties in developing the mission computer and the electronic flight control system. Both systems had sizeable software requirements[437] to grapple with. These problems would postpone the first flight for months. Moreover, the actual manufacture of the first C-17 was three to four months behind the scheduled August 1990 first flight. McDonnell Douglas' massive restructuring and implementing of total quality management ("Time to Quit and Move to Seattle") were also proving quite disruptive[438] to the C-17 program. The GAO highlighted the difficulties in *Military Airlift: C-17 Faces Schedule, Cost, and Performance Challenges* (August 1989). As a result, the Senate Armed Services Committee further directed that Secretary Cheney report on the progress in achieving milestones, the schedule delays, and major design changes. Due to the slipped schedule, both the House and Senate Appropriations Committee made funding cuts. During the September conference, these marks held, and the Senate and House agreed on reducing the number of C-17s procured in 1990 to four aircraft, providing $1,110.1 million for aircraft procurement, $99.7 million for long-lead funding, and $885.2 million for the RDT&E effort. These reductions equated to 27.15, 40.51, and .03 percent, respectively. Consequently, the program's cost increased by a $1.16 billion. Based upon the continuing delays, the Air Force advised that the first flight would probably not occur until June 1991, a ten-month slip from the new baseline. As an aftereffect, the IOC slipped to June 1993.[439] The November 1989 Defense Acquisition Decision Memorandum attempted to reorder the program by approving a procurement profile of 12 aircraft for 1992, 24 for 1993, and 29 for 1994.[440] Succeeding events, however, would disrupt this.

**Cheney's Major Aircraft Review-120 C-17s**

In the fall of 1989, with the Berlin Wall breached and communism crumbling in Eastern Europe, Defense Secretary Cheney directed a top-level review of major aircraft programs, namely: the B-2 bomber, advanced tactical fighter, A-12 advanced tactical aircraft, and the C-17 transport. The four weapon systems exceeded $200 billion. The recent events had invalidated the United States' Soviet threat assessments once again, as prior to the breakup, intelligence assessments had indicated the strategic warning time for an impending Soviet attack had increased considerably.[441] In effect, Cheney was stepping out ahead of congressional action.

With regard to the C-17, the OSD staff studied the feasibility of canceling the program and undertaking a C-141 service life extension program (SLEP) to 60,000 flying hours, thereby offsetting the loss of the C-17. But the C-141 was aging at a faster rate than forecasted in the *US Air Force Airlift Master Plan*. Along with increasing the cargo carrying capacity, an air refueling capability had been added during the "stretch" modification of the fleet into the C-141B in the early 1980s. Fatigue cracks were fixed at this time, but more cracks appeared in subsequent years, requiring further repairs. In recent years, there had been increased demands to perform heavy weight air refuelings and low level flying. Air Force Logistics Command engineers had warned that these new missions would add to airframe fatigue. Mid-year 1989, the Warner Robins Air Logistics Center advised of premature wing structural damage, forcing the Military Airlift Command to consider C-141 service life issues. In a January 1990 message, General Hansford T. Johnson informed General Welch and the major command commanders that the Military Airlift Command had grounded twenty C-141s for wing cracks, imposed fleet-wide flight restrictions, and reduced the severity of combat training flying to preserve as much structural life as possible. Wing crack repairs were expected to take two years.[442] It was not a ploy, as the announcement came when the command was still involved with Operation Just Cause in Panama, then the largest American combat operation since Vietnam. Every airframe was needed.

When the OSD's SLEP request came, the Military Airlift Command was seeking advice from Warner Robins and Lockheed for formulating a sound approach to the latest cracks. The command asserted that risks coupled with negligible benefits did not make a refurbished C-141 a viable solution to future airlift requirements. Originally the airframe was designed for a service life of 30,000 flying hours; the stretch modification extended the service life to 45,000 hours. With the C-141 under its 45,000 hours and already experiencing accelerated wear, it was premature to consider extending to 60,000 hours without an in-depth analysis of the C-141's structural integrity, so the thinking went. At the minimum, General Johnson recommended thoroughly examining the C-141's wing, similar to what was done on the C-5A's and the KC-135's wings. Such a review would take months and cost millions of dollars. The April 1988 Aloha Airlines accident where a Boeing 737-200 lost the top half of the forward passenger section inflight also influenced thinking on structural integrity. Besides the wings, could the fuselage, empennage, and vertical and horizontal stabilizers be safely or economically extended?[443] "It would be unsafe and irresponsible to advocate an extension of the service life of the C-141, to double its design limit with these uncertainties, and still expect that it be capable of carrying out a wartime mission," counseled one staff officer.[444] From a cost standpoint, the SLEP was prohibitive, estimated at $13.2 billion. Additionally, costs associated with terminating the C-17 contract amounted to just under $1 billion with $5.2 billion already sunk into the program. The Air Force and the OSD staff were won over: the C-141 SLEP proposal was unsound from cost as well as airworthiness considerations.[445]

The major aircraft review concluded the end of March, coinciding with the military services' submissions of their program objective memorandums. Maintaining the new world order would require the military to rapidly respond with reinforcements from the United States. But the transport fleet was getting old. Consequently, Defense Secretary Cheney announced before the House and Senate Armed Services Committees on 26 April 1990 that the C-17 acquisition program would continue, although scaled back. Cheney recommended procuring 120 versus 210 aircraft. He came to his decision reasoning changes in the European security environment no longer justified the long-held 66 MTM/D. Rather, a new airlift goal of 48 MTM/D seemed appropriate. At the same time, Cheney realized that in five to ten years it might be prudent to buy more C-17s. The net effect of Cheney's decision on the C-17 reduced the military's wartime strategic airlift capability by 11.8 MTM/D and its non-mobilized capability by 6.3 MTM/D. Theater airlift—due to the C-17's direct delivery—decreased by 3,700 tons per day. Later in the year with the passage of the Defense Bill, Congress asked for another mobility study, what became the *Mobility Requirements Study*. Senators John Glenn (D-OH), Trett Lott (R-MS) and Alan Dixon (D-IL) had especially questioned Cheney on reducing the number of C-17s. Senator Pete Wilson (R-CA) had asked for his rationale.[446]

After the decision, the Air Force revised the fiscal year 1991 President's Budget from an aircraft buy of 6 to 2 aircraft, and the production peaks from 29 to 24 aircraft. Over the summer, C-141 retirement plans became an issue. The OSD staff sought to retire the C-141s on a capability basis: 2.3 C-141s retired for every C-17 acquired. Recognizing the demand for airlift aircraft during simultaneous contingencies with multiple operating locations would require airframes as well as capacity, the Air Force and the Military Airlift Command desired approximately a one for one trade out, retiring 106 C-141s. The OSD position advocated by Assistant Secretary David S. C. Chu maintained Cheney had set a goal of 48 MTM/D in his April congressional statements. General Colin Powell broke the impasse, indicating it was best to keep the 66 MTM/D and the options open, pending the new study results. Henceforth, C-17s replaced the retiring strategic C-141s on a one-for-one basis. Replacing tactical C-130s with C-17s, as stipulated in the *US Air Force Airlift Master Plan*, became overcome by Cheney's action. Although Congress maintained the Air Force's buy profile, it essentially halved the funding requests, causing the program additional turmoil.[447]

Secretary Cheney's reduction resulted in a C-17 unit cost increase in excess of 25 percent from the baseline Selected Acquisition Report of 31 December 1988. Accordingly, Under Secretary of Defense for Acquisition, John A. Betti, and Secretary of the Air Force, Donald B. Rice, had to certify the program acquisition unit cost (PAUC) to Congress before mid-December 1990 as required by the 1982 Nunn-McCurdy unit cost guidelines amendment. Failure to do so would temporarily suspend funding obligations, jeopardizing the Lot III award (4 aircraft). Complying with this congressional directive, Secretary Rice certified the PAUC was estimated at $278.9 million, working forward from the out-of-cycle September figures. However, when the Aeronautical Systems Division issued the 31 December 1990 Selected Acquisition Report, the PAUC had increased to $293.95 million for a program acquisition cost of 35.27 billion for 120 aircraft. Thus, the C-17 had become a 300-million dollar airplane as a result of Cheney's major aircraft review and congressional cuts to the C-17 in the fiscal year 1991 Defense Bill.[448] Accordingly, the initial operational capability changed to September 1994, as P-11 and subsequent aircraft assembly starts became delayed by several months.[449] Additionally, it had become clear McDonnell had production problems.

**Selected Acquisition Report**

| | Dec 87 | Dec 88 | Dec 89 | Sep 90 | Dec 90 |
|---|---|---|---|---|---|
| Cost (TY$)* | 35695.1 | 37454.6 | 41811.9 | 31266.2 | 35274.4 |
| Quantity | 211** | 210 | 210 | 120 | 120 |
| Unit Cost* | 169.172 | 178.355 | 199.104 | 260.55 | 293.95 |

*millions
**includes T-1

Source: Reports, HQ ASD/C-17 SPO, C-17 "Selected Acquisition Report," 31 December 1989, 30 September 1990, 31 December 1990.

**MAR Buy Profile**

| FY88 | FY89 | FY90 | FY91 | FY92 | FY93 | FY94 | FY95 | FY96 | FY97 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 4 | 4 | 2 | 6 | 12 | 18 | 24 | 24 | 24 | 120 |

Source: Point Paper, HQ MAC/XRSC, "Status of C-17 Assembly and Funding," 21 December 1990.

## Elusive Schedule And Rolling Boil

Although analysis of the Gulf War airlift flow showed the C-17 could have made a significant contribution, increasing throughput by some 28-50 percent in the first 45 days,[450] program difficulties persisted, clouding the relevance of this statistic. The first flight date was elusive; production work on the next aircraft remained behind. In May 1990, the Air Force had cited McDonnell Douglas for various problems in managing the C-17 program, and in July, the Air Force had withheld progress payments.[451] The next months were no better.

In January 1991, Defense Secretary Cheney's abrupt cancellation of the Navy's A-12 program, after learning somewhat "overnight" that the program was a billion dollars overbudget, 8,000 pounds overweight, and 18 months behind schedule, prompted the Office of the Secretary of Defense to undertake a C-17 Review, immediately.[452] Donald J. Yockey, Undersecretary of Defense for Acquisition, declared: "No Lot III [4 aircraft in FY 1990] releases until satisfactory completion of C-17 review."[453] Alarmed, Secretary of the Army Michael P. W. Stone expressed to Donald J. Atwood Jr., Deputy Secretary of Defense:

> Although this is an Air Force program, any decision to delay or eliminate it will have a grave impact on the Army. Operation Desert Storm offers considerable evidence that a dangerous shortfall exists in strategic airlift. . . . I am aware that serious problems exist with this program. However, these problems do not diminish the importance of the aircraft to the nation's defense and should not make the aircraft the target of our action. Therefore, I offer that efforts to mend this program be directed at the way it is managed. We should make every effort to ensure that the C-17 is delivered in full and on time.[454]

Visits to McDonnell Douglas disclosed little oversight by top management and the lack of effective risk management. Defense officials also criticized the corporation's manufacturing procedures. There was insufficient manpower to maintain the schedule. Furthermore, a lack of integration and coordination resulted in redundant work and increased costs. Defense analysts estimated that McDonnell Douglas could sustain up to a billion dollars in cost overruns. Although there were many concerns, the C-17 program was not viewed as a repeat of the A-12; there were no technological development problems. Alternatives, however, were considered: extending the C-141 service life and procuring 136 C-130s or retiring the C-141 and obtaining 136 C-130s and 120 C-5s. Concluding the review process, Dr. David Chu, the Assistant Secretary of Defense for Program Analysis and Evaluation, believed that the C-17 was still cost-effective and the best option. And Rear Admiral Dave Robinson, who chaired the Joint Requirements Oversight Council, stated that nothing had changed since the April 1990 major aircraft review that would alter the need for the C-17. Donald Yockey did not recommend terminating the C-17 either. General Colin Powell and Donald Atwood desired the C-17 as well.[455] While support from the OSD and joint staff remained, there was a question of how strong. Critics, such as Jeffrey Record, were pointing out the C-5 as the better choice.[456]

As one of the primary contractors on the A-12 program, McDonnell Douglas heeded C-17 criticisms. To improve production, McDonnell formed a Production Review Team with C-17 SPO and Defense Contract Management Command representatives. The team came up with 23 recommendations with out-of-position work a major focus. Consensus existed that until the latter was corrected, there could be no predictable schedule.[457]

Lessons from the B-2 program were employed. Brigadier General Butchko established a small "SPO West" staff at McDonnell Douglas' Long Beach facilities in April 1991. Patterned after the B-2 program and discussions Butchko had with the B-2 program director, its charter was to "take all necessary actions to facilitate the earliest possible first flight date."[458] Witnessing testing, improving configuration control procedures, expediting government paperwork, and providing McDonnell Douglas with an on-the-site team, SPO West became regarded as a good thing.[459] However, the first flight and follow-on production remained behind.

At the end of April 1991, Brigadier General Butchko informed Major General Edward P. Barry and Assistant Secretary Welch that a first flight date of late July was more realistic. Avionics and flight control integration in the flight hardware simulator, final assembly and ramp testing, and component airworthiness verification were the culprits resulting in the delay.[460] McDonnell Douglas remained the perpetual optimist and, in fact, briefed Secretary of the Air Force Rice at the end of May on a 30 June first flight (In January, McDonnell Douglas had placed the first flight in March).[461] By mid-June McDonnell Douglas only projected a schedule slippage of less than two weeks, specifically to 11 July, while the C-17 System Program Office had moved its first flight assessment to late July and August, medium and low risk, respectively.[462] Reports from SPO West supported the later appraisal. Lieutenant Colonel Walter J. Evans advised that even if the latest schedule held, "we could be hung-up on 31 Jul doing paperwork-DD-250 items and validating test results."[463] But there were also troublesome leaks, which were impacting the workflow. With some humor, Evans noted: "It will be like 'ducks on a June bug or people on T-1' when the tanks are closed and everyone wants time on the aircraft."[464]

Patience at this point was running thin. Following Secretary Rice's visit to Long Beach, Rice had tasked Generals Barry and Butchko for a coordinated position on the date of the first flight, an estimated "at completion cost" for the whole program, and the benefits or impacts to a production moratorium, shifting the emphasis away from fixating on the first flight to ensure a viable and quality-focused aircraft delivery schedule.[465] As a result, Major General Barry announced 31 August as the revised first flight date. On 21 June, McDonnell Douglas Aircraft executives Robert Hood and David Swain traveled to Washington D.C., meeting with Welch and his director of airlift programs, Major General Stephen B. Croker. Assistant Secretary Welch was direct stating no one accepted McDonnell Douglas' estimates of the completion cost and aircraft schedule. Despite promises to the contrary, he had seen no improvement these past six months. Even the 31 August date looked shaky. Welch voiced his desire for an integrated plan. Swain expressed McDonnell's frustration, stating the Air Force was constantly saying the at completion cost estimate and the aircraft delivery schedule were wrong. How could his company motivate its workforce when the Air Force was so negative?[466]

McDonnell Douglas had sought to achieve more than expected by setting highly optimistic schedules as challenges to its managers. Unfortunately, Douglas had not foreseen the backlash and the total loss of credibility when they failed to meet any schedule dates.[467] Additionally, "nobody really knew when a thing should be expected. It was really weird to watch," William Casey, McDonnell Douglas' C-17 chief test pilot, recalled.[468] The C-17 SPO reiterated its position: it desired a realistic, achievable schedule. At this time, McDonnell implemented several managerial changes, bringing in James F. Berry from the Northrop Corporation as vice president and general manager responsible for C-17 production. Berry brought McDonnell Douglas his B-2 manufacturing expertise.[469]

Nevertheless, a string of glitches continued to delay T-1's first flight. Assistant Secretary Welch received weekly briefings. There were fuel leaks. Hydraulic fluid fires during engine testing at Quartzsite, Arizona, in November and December 1990 meant changes to the engine pylons to strengthen hydraulic lines. The APU—auxiliary power unit—gave them fits. The slats, flaps, and spoilers took longer to rig. Installing new software versions required more time and more integration work. There were numerous minor write-ups of anomalies, for example, in the warning and caution, electrical and lighting, and radio and avionics systems that necessitated attention. In one week, the first flight date was changed four times.[470]

P-1 was also critical to the first flight. Revisions in 1988-89 provided for concurrent testing, enabling P-1 to take up the airloads calibration and movable flight controls testing from T-1, reducing first flight, in theory, by two to three months. McDonnell Douglas indicated P-1 was ready for testing in March 1991. Contrary to assertions, however, over 700 open items or discrepancies existed when the C-17 System Program Office insisted on reviewing all P-1 open items. Two months later with the diversion of 180 workers on two ten-hour shifts, P-1 was really ready for airloads calibration testing.[471]

There was always something that kept the first flight date beyond reach. The situation was exasperating, but the new C-17 System Program Director, Brigadier General Kenneth G. Miller, remained undaunted. Finally on 23 August, T-1 began the low speed taxiing tests, but the first flight crew aborted the test when excessive pressure (200 pounds) on the brake pedals was required to stop the airplane during the initial brakes checks. Maintenance personnel adjusted the brakes, and the first low speed test continued the next day. On the final high speed taxi, 12 September, T-1 reached 100 knots and slightly rotated—lifting the nose wheel off the runway and then coming back down. Everything checked out, and McDonnell Douglas projected a first flight on 14 September. But this too slipped by a day due to low ceilings.[472]

The C-17 Globemaster III flew for the first time on 15 September 1991. Fittingly, overcast skies along the route delayed the flight until later in the afternoon. With just fourteen minutes remaining in the takeoff window, T-1's crew received word all alternate landing sites were in the clear. Already pre-positioned, the huge plane began its roll down the runway at Douglas' Long Beach facilities, lifted off with a certain gracefulness despite its size, and headed out over the Pacific Ocean, making its way at last to Edwards Air Force Base. Sharing in the honor of taking T-1 on the first C-17 flight were William Casey, pilot, Lieutenant Colonel George London, co-pilot and Air Force test pilot, Theodore Venturini, Douglas loadmaster, and Henry Van de Graaf, Douglas flight test engineer.[473]

The first flight repudiated the criticism over expected performance. The C-17 took off using some 4,000 feet of runway with a gross weight of 410,000[474] pounds, flew up to a ceiling of 20,000 feet, and achieved a maximum speed of 250 knots. Test points undertaken during the flight centered on the functional performances of the aircraft, such as taking off and landing, handling characteristics, electronic flight control system, engine performance, instrumentation, automatic flight control system, and speed braking. Touching down at Edwards 2 hours and 23 minutes later, the plane had performed well in all areas. The delayed departure, the need to fly under visual flight conditions, and the requisite landing one hour before sunset had cut short the planned three-hour maiden flight. Upon arrival at Edwards, control of the aircraft passed from the contractor to the Air Force with C-17 SPO Director Brigadier General Miller accepting the plane.[475] Miller expressed, "We're looking forward to an equally successful flight test program."[476]

Years later, test pilots Casey and London described the flight as very conventional and somewhat anticlimactic. They had rehearsed the flight so many times in the simulator and flown it in the C-135 and C-141 that it was almost like being in the simulator one more time. Besides the nose gear delay, which was eventually solved by going back to two actuators, there had only been a slight problem with the flight control computer system's computers dropping off line, but the system was quad-redundant. The plane had met their expectations. Casey, who also had the distinction of flying the YC-15, rated the C-17's first flight handling qualities as "superior" to its legacy. The fly-by-wire flight control system and automatic features made it fly more like a fighter. There was a lot of satisfaction that the first flight had gone fine. It was a real team effort, and Casey and London had just done their part in getting the C-17 airborne at last.[477] September 15, 1991 was a good day for the many that had shared in the trials and tribulations of the program since its inception.

The inaugural flight and official Air Force acceptance celebration was really a low-key affair. The numerous delays had made planning for anything more elaborate unwise. Besides the invited media, David Swain, C-17 Executive Vice President, C-17 SPO Director Brigadier General Kenneth Miller, and Air Force Flight Test Commander Brigadier General Roy D. Bridges watched as the C-17 departed Long

Beach and then marked its landing at Edwards. With the first flight date in such a state of flux and so long overdue, high-ranking Defense Department, Air Force, and Military Airlift Command officials were not able to participate. As scripted the press conference showcased the first flight aircrew members; the VIPs' roles were merely congratulatory.[478]

Originally, in February 1985 at the full-scale engineering production decision, the target date for the first flight was the first quarter of fiscal year 1990. By September 1988, it had changed to August 1990.[479] Thus, depending on the reference point, the C-17's first flight was a year to two years behind schedule. There was never any breathing room, in part due to the Air Force's concurrent engineering approach and McDonnell Douglas' compressed aircraft production schedule, which proved too ambitious. Additionally, the C-17's design was actually never baselined—frozen. "As a result, many systems, features, characteristics, etc were redesigned over and over and over because new personnel assigned to the program (contractor and customer alike) wanted something different, keeping the design in a rolling boil up to and beyond first flight," Casey recalled.[480] The push was to make the earliest possible date, and in hindsight, continually missing target dates further eroded confidence in the program, especially as it increasingly faced questions over costs. Delays, however, remained in manufacturing and assembling the first C-17s. As a matter of record, it was not until June 1994, with the delivery of P-13, that McDonnell Douglas consistently began delivering C-17s ahead of schedule.[481]

As T-1 underwent developmental test and evaluation testing in the fall of 1991, separate hearings by Representatives John D. Dingell (D-MI) and John H. Conyers (D-MI) delved into McDonnell Douglas' technical and financial difficulties in managing the C-17. Dingell wanted to know how the $900 million cost overrun had occurred? Was McDonnell Douglas honest? Conyers asked if McDonnell was too big and important to let it fail? Much of the Conyers hearings dealt with claims by two former McDonnell Douglas employees that the riveting process for manufacturing the wings was defective, which was later disproved but not without a lot of sensationalism. Eleanor R. Spector, the Director of Defense Procurement, testified that McDonnell Douglas could absorb its $700 million cost overrun; there was no need for the government to bail them out for claims exceeding the fixed-price full-scale engineering development contract. Afterwards, Conyers informed Defense Secretary Cheney that he intended to investigate further the quality of the C-17 wings, allegations of a cover-up by McDonnell Douglas, and inappropriate influence by senior Air Force officials.[482] A flyable C-17 provided no assurance of congressional funding either.

The President's 1992-1993 Budget had sought funding for six aircraft in fiscal year 1992 and 12 aircraft the next year. Citing the program's developmental and production delays, Congress provided for four and eight aircraft, respectively.[483] Concerned about the C-17 program, Congress enacted restrictive measures—downright "hold-the-DOD's feet-to the fire." The National Defense Authorization Act for FY 1992 and 1993 limited the obligations of fiscal year 1992 procurement funds to no more than $400 million until the secretary of defense submitted a report that described the total cost to finish the full-scale development contract, provided how potential cost overruns would affect subsequent production contract prices, certified the completion of the first flights for the development and production aircraft, provided the details of all performance specification reductions, and included a certification from the chairman of the joint chiefs of staff that the C-17 met unified and specified commanders' requirements and was still cost effective. Deputy Secretary of Defense Donald Atwood gave these assurances several months later.[484] Congressional staffers made it perfectly clear to Air Force liaison officers that while no one disputed the mobility requirement, McDonnell Douglas simply needed to get the program in order over the next year or else face the consequences.[485] Staffers also made a point of remarking: "It would have been easier for us to fight the fight [for the C-17] if your Chief [General Merrill McPeak] and Secretary [Donald B. Rice] had been more vocal."[486] Their silence had made a negative impression. Congress only wanted to hear from those who could fix the program.

Despite efforts in 1991 to get McDonnell Douglas going, the C-17 schedule was way behind. Fuel leaks were posing a problem and secured a lot of media attention. In April 1992, Major General Charles E. Franklin, Air Force Program Executive Officer, gave his assessment and course of action:

> We are now behind the 13 month schedule on all ships except P-2 and P-5. Collectively, we are not doing an acceptable job of anticipating problems or implementing effective corrective action. The past several months have been filled with opportunity and while there has been some progress, I believe if one applied a cold, hard, objective yardstick measure to what was done versus what should/could have been done, we have failed. At this point I am unsure if the 13 month schedule is salvageable; however, I remain convinced it was doable when it was developed. If we fail to achieve the 13 month schedule, responsibility must be shared among this office, the SPO and DAC. A different level of activity and focus is required from these same players to arrest this malaise of inaction—I will personally see to it that this occurs.[487]

In June, Secretary of the Air Force Rice communicated to John F. McDonnell the need for demonstrating sustained improvements in the C-17's production performance. The Air Force knew the program could no longer continue as it had been; it required extraordinary management effort. There was also the realization that the Air Force had to ensure congressional funding of adequate production rates in order for McDonnell Douglas to be able to improve.[488] The Air Force was not successful in this effort, as more troubles plagued the program by late summer.

In September, range and payload performance deficiencies surfaced during P-2's performance testing, becoming a major issue with much publicity. "This is not a good month for the C-17 program," wrote Major General Franklin. "We thought we would be 51nm or 2145lb short of our 2400nm/160,000lb range/payload requirement; test results revealed the shortfall to be 155nm or 6,692lb."[489] McDonnell Douglas officials indicated their primary solution was to seek relief from what had been specified for the C-17. While some relief might be warranted, Franklin made it known he wanted a concerted and aggressive effort by McDonnell Douglas and the C-17 System Program Office to reduce weight and drag.

And on the first of October, the C-17's wings failed at 128 percent of their load limit during static article testing. Normally wings were rated sound after reaching 150 percent. Although not a massive wing failure and quite fixable, it was unsettling and remain so until the wings passed testing in September 1993.[490]

Pointing to the range/payload performance, wing failure, and delivery and test schedules delays, Congress cut funds and aircraft profiles from $2.5 billion for eight aircraft to $1.9 billion for six aircraft in fiscal year 1993 and reduced advance procurement from 12 to eight aircraft for fiscal year 1994. The reductions added three more years to the production run, increased program costs by approximately $210 million, and threatened the IOC date. Additionally, Congress restricted the obligation of funds until:

- the secretary of defense submitted the certification report required by the 1992 National Defense Authorization Act
- the Air Force accepted delivery of the fifth production aircraft
- the secretary of the air force convened the Scientific Advisory Board to investigate the feasibility of a C-141 service life extension, limiting retirement until a decision
- the secretary of defense certified the progress of production aircraft P-9 and P-14
- the secretary of defense convened a special Defense Acquisition Board to assess the requirements, costs, operational effectiveness, and contractor performance.[491]

Despite the program's ills, the requirement for a C-17-type airframe remained.

**Revised Airlift Requirement**

After a two-year effort, the congressionally requested *Mobility Requirements Study* (MRS) was completed in 1992, documenting a need for 120 C-17s and a new fiscally constrained goal of 57 MTM/D in strategic airlift capability. This represented a middle course. Another study would address intratheater. Originally, Congress had directed the review following the ending of the Cold War, and then it became necessary to incorporate the Gulf War lessons. The most demanding scenario required delivering four and two-thirds Army divisions, 15 fighter squadrons, and 1 Marine expeditionary force to the Persian Gulf area (8,700 nautical miles) in six-eight weeks, assuming "moderate" risk. This became the new benchmark.

Reinforcing Europe no longer dominated thinking; getting to the Middle East did. Although the MRS substantiated 120 C-17s, disconnect remained. Congressional language in 1990 had stipulated that the MRS be based upon fiscal year 1999 force structures which then projected available resources of 80 C-17 primary aircraft authorized—now, at this juncture totally unrealistic with the delays. There would be just 48 C-17s, representing a reduction of nearly 5 MTM/D. The study also recognized C-141 retirements would further erode MTM/D capability in the first decade of 2000 with the Department of Defense needing to consider additional C-17 purchases or other alternatives.[492] General Hansford Johnson worked to minimize the gap between airlift resources on hand and those required during wartime. He also had another concern.

As Commander-in-Chief of the United States Transportation Command and Commander of the Air Mobility Command, General Johnson had overseen the movement of .5 million passengers, 3.7 million tons of cargo,[493] and 6.1 million tons of petroleum products to the Middle East during the Gulf War. In more organizational terms, these statistics translated to a task of deploying and sustaining 2 Army corps, 2 Marine Corps expeditionary forces, and 28 Air Force tactical fighter squadrons. While General Johnson was quite satisfied with the study's recommendations, when asked specifically on the strengths and weaknesses of the airlift portion, he stated: "it was decided that because of resource constraints the study would not allow the C-17 requirement to float. The final draft, in essence, traded off the C-17 for prepositioning."[494] The study did not recognize that there was still a sizeable amount of airlift needed to close a unit on prepositioned ships. "To close 16,000 Marines in a squadron of four or five Maritime Prepositioning Ships takes about 250 C-141 equivalents. During Desert Shield, it took 264 aircraft the first time we moved that large of a force. I asked how many of those 250 C-141 loads could have been moved on commercial passenger aircraft, and the answer was 34. The reason for so low a number is that you don't preposition afloat high-value equipment items such as helicopters, some weapons, and so forth."[495] Thus, there was definitely a need for more airlift than the *Mobility Requirements Study* disclosed. The year 1993 would be decisive for the C-17 program.

**Lines In The Sand-NDAA Option**

"Do we need C-17? Yes, numbers say so. Do I need it bad enough to compromise my integrity? No," General Ronald R. Fogleman expressed to his senior officers during a December 1992 meeting at Headquarters Air Mobility Command.[496] By now the adjective "troubled" preceded most references to the program. General Fogleman, a fighter pilot by background, had just assumed command of the new airlift and air refueling organization in late August 1992. He was familiar with the C-17 program from serving as the deputy director and then director of programs and evaluations at Headquarters United States Air Force (1986-1990), where in the former position he chaired the Programs Review Committee, the latter the Air Staff

Board. He had just made a visit to Edwards and flown on the C-17 in October 1992. General Fogleman had also been involved with the initial operational capability of the F-15 and F-16 in the 1970s and early 1980s. Thus, he understood what it took to make the C-17 operational.[497]

General Fogleman elaborated further, saying he was not going to be "stampeded" into deciding on the C-17. "As a programmer I was going to have to be convinced of the value of the airplane and then the likelihood that the airplane would live up to its reputation, etc. I had not a predisposition that it would not; on the other hand, I had no reason to believe that it would."[498] He knew the Air Force had suffered a lack of credibility with Congress by becoming zealots about their procurement programs, blinded to other choices. It was for these reasons, General Fogleman considered alternatives—as the C-17 became more and more a very troubled program. In a close-hold fashion, General Fogleman directed his Director of Plans, Major General Phillip J. Ford, to look into options. The tasking passed to Majors Gwen Linde and Kenneth Wavering with analysis assistance from Lieutenant Colonel David Merrill. The trio considered new commercial aircraft, used DC-10s, Russian cargo planes, C-5s, and a C-141 SLEP. They briefed General Fogleman that none truly met the military's requirements and that the C-17 remained the best answer. Of the alternatives, however, Boeing's 747-400 appeared the most cost effective.[499]

The President's Budget submission for fiscal year 1994 reflected an IOC slip from September 1994 to January 1995. Both Cheney and McPeak were very concerned about the program's progress. General McPeak had told his staff to put money back in the budget for C-141s in the outyears to ensure enough airlift capacity due to the slippage and continued uncertainty. The Air Mobility Command was doing good to get 7 or 8 MTM/D into Mogadishu for Somalian operations and still support remaining commitments with the fleet it had.[500] General Fogleman was hard over on the C-17's slippage, telling his staff, "I will not testify to Congress that I agreed to a slip, and if asked, I will say I am disappointed. I will not defend a slip. If IOC slip is the only solution to the current problems—that is an acquisition issue and I am hurt as the user."[501]

Over the next months, there was no good news story to report. "Sir, I'm not an expert on RDT&E, but this program looks hard broke (or very close to it). It will soon spill over into our command," Vice Commander Lieutenant General Walter Kross informed General Fogleman the beginning of February.[502] Program delays were bumping up against initial squadron operations and threatening the Milestone IIIB decision. The results would be a loss in million-ton-miles per day capability. If the Air Mobility Command continued to accept production slips, successfully executing national security objectives would be at risk.[503] Major General Ford advised General Fogleman to get on the "high ground." It was up to McDonnell Douglas to perform. Alternatives were available.[504] A March session with Acting Secretary of the Air Force Michael B. Donely and the new Under Secretary of Defense for Acquisition, Dr. John M. Deutch, convinced Fogleman that the program was facing political reality. Deutch was ready to cancel.[505] When General McPeak, during budget cut drills, tasked his staff to examine changing the C-17's buy profile from 16 to 6, 8, 10, or 12 aircraft per year offset by "buying back" retiring C-141s, General Fogleman countered with "We might want to suggest a smarter option would be to combine smaller buys of C-17 with commercial buys (767, 747, MD-11). Plant the seed."[506]

Early in 1993, General Fogleman was publicly stating his interest in alternatives, if C-17 production problems continued. Considering the program's state, concerns voiced by OSD and Air Force senior leaders, the congressional pressure, and a new presidential administration with its emphasis on cutting costs, Fogleman regarded it as his responsibility to plan an alternative course to preclude the command from losing its funding for airlift modernization—modernization that was so critical for wartime requirements.[507]

In congressional testimony, General Fogleman revealed, when pressed by Senator John McCain (R-AZ), that he had drawn "some lines in the sand" and stated he expected the operational delivery of the C-17 on 14 June 1993 and intended to hold McDonnell to IOC requirements. Senator McCain did not mince words. If McDonnell did not make these "bench marks," it was time to say, "Enough."[508]

Fogleman's statements renewed interest in previous options, namely the Boeing 747 and the Lockheed C-5D as Non-Developmental Airlift Aircraft (NDAA). The NDAA concept progressed rapidly. Internally, the AMC staff worked with the Air Staff and OSD to ensure General McPeak and Dr. Deutch were ready to discuss alternatives during their congressional testimony. Additional C-141 fleet restrictions in May also heightened the necessity of finding suitable aircraft, if the C-17 did not prove itself. The Air Force Scientific Advisory Board had found more extensive evidence of wing cracks (weep holes) during its structural analysis of the C-141 for a service life extension. As a result of the board's recommendation, General Fogleman restricted the C-141 fleet from carrying full payloads, and air refuelings were limited to training missions. In August, per the advice of Lockheed and the Warner Robins Air Logistics Center, the fleet underwent weep hole cracking inspections. The Air Force Scientific Advisory Board had concluded that it was economically impractical to extend the service life beyond 45,000 hours. Based upon congressional direction in the Fiscal Year 1994 National Defense Authorization Act, the board reiterated its position. This effectively ended further consideration of SLEPing the C-141. The Air Force subsequently announced retirement of the last C-141s by 2006. [509]

Airline carriers in the Civil Reserve Air Fleet program voiced strong objections to the NDAA concept. The carriers along with their powerful associations saw the commercial NDAA as breaching the National Airlift Policy. In the 1950s, the commercial airline industry and the then Military Air Transport Service engaged in a bitter dispute, played out in Congress, over the role each would play in national defense. The National Airlift Policy directive, first issued in 1960 and again promulgated by President Ronald Reagan in 1987, acknowledged the importance and need for both civil and military aircraft. Essentially, the military would transport military-unique cargo and passengers while the remainder of the government's peacetime business went to the commercial carriers who pledged aircraft through the CRAF program for wartime needs.[510]

That the Air Mobility Command proposed acquiring commercial aircraft versus securing only military-unique aircraft disturbed the hard-won pact. "We cannot understand how DOD can consider spending a reported $5 billion to purchase commercial aircraft, a proposal that would undermine the relationship between CRAF and the DOD that has existed for over 30 years and is more valid today than at its inception, as recently proven in the Gulf crisis," Edward J. Driscoll, president of the National Air Carrier Association, advised Defense Secretary Les Aspin. "Civil carriers can and do provide the air transportation services needed by DOD at the least cost to the taxpayer. If CRAF is not used to the maximum extent in peacetime, it will not be available in times of emergency or war." Evoking the National Airlift Policy, "we would hope to receive your assurances that the military would limit its purchases to aircraft uniquely suited to military purposes."[511]

Described as tenacious, Ed Driscoll had by-passed General Fogleman and the Air Mobility Command, going directly to Secretary Aspin. Driscoll also secured congressional support for the association's position. Individual carriers provided proposals. Southern Air Transport wanted the government to contract with civil carriers for leasing or procuring the cheaper, more readily available B-747s-100s/200s. Arrow Air proposed that CRAF carriers provide "on demand" airlift. The association came up with a Stage 0 CRAF. To assure the carriers that all options were being considered, the Air Mobility Command hosted meetings in July and August 1993, briefing the carriers on the current state of mobility forces and inviting them to give more detailed offers. However, suggestions of using civilian capability through an enlarged CRAF, lease-back arrangements, expanded commercial contracts, or Defense Production Act take over of commercial aircraft for military use all fell short. If the Air Mobility Command depended too much on an expanded civil airlift to replace its organic military capability, then the command would degrade its ability to support as well as respond rapidly to contingencies and operations in threat environments, as demonstrated in Somalia, Bosnia, Liberia, and India.[512]

Besides the carriers, aircraft manufacturers and other interested persons had their own proposals. The NDAA alternative was interesting given the employment situation that three retired four-star general officers had. Alfred Hansen worked for Lockheed while Thomas Ryan was with McDonnell Douglas. Robert Huyser had a close association with Boeing. In early February, Boeing briefed the Air Mobility Command on the capabilities of the 767-300 and 747-400 as an option to a C-141 SLEP, after receiving assurances via retired General Huyser that the interest was genuine. The commercial freighters could complement the C-17s by moving palletized cargo. While Boeing was restating its position of a decade ago, it was now more effective, as the majority of the cargo moved during the Gulf War and Somalia was on pallets. The several month build up for the former operation meant a greater use of sealift with its tremendous outsize capability. McDonnell Douglas was prepared to offer used DC-10-30s as tankers-transports and new MD-11s as passenger, freighter, convertible freighter, or tanker variants to augment the C-17s. Converted DC-10s would essentially be adding the same capability as the command's KC-10 fleet. Lockheed officials were also quick to respond. More assertive, Lockheed briefed an updated C-5B (C-5D) to the House and Senate Armed Services Committee staffers early in April and came to Scott Air Force Base to meet with General Fogleman a few days later. Unlike the others, Lockheed intended for the C-5B to supplant the C-17. The NDAA was very controversial and much debated. Congress supported all interests—the civil carriers as well as those for the C-5, C-17, and B-747.[513]

As the NDAA option progressed, General Fogleman was accused of using the 747 as a "stalking horse." In later years that question was asked to many and the answer was: No. In an interview in 2000, Fogleman explained:

> So, getting alternatives was not necessarily difficult, but then the issue became how do you do a great and honest evaluation. Interestingly enough, one of the alternatives was, of course, to look at the 747 widebody. A lot of people have accused me of using it as a stalking horse, that I was never really serious about the 747. I was willing to be as serious about the 747 as its capability demanded. Put another way, I knew that the 747 wasn't going to be able to do the austere airfield kinds of things that the C-17 was. But there may have been another way to skin that cat, so that we didn't need the C-17. So, we started looking at how useful would the 747 be in main operating base to main operating base, etc. As we got into it, I went so far as to have some analysis of how many reservists did we have who were flying 747s and these kinds of things, because we looked at a lot of different ways of doing it. So, anyway, as we got into the analysis, I became convinced that the real value of the C-17 wasn't in its total gross weight capability; its real value was the utility it gave us in austere airfields and things like that. So, at a point in that analysis, I became convinced that, one, the C-17 did have the kinds of characteristics that we needed if it met specs [specifications] and that it would be far more valuable in the force than some additional number of 747s and some combination of C-17s.[514]

Well read on National Airlift Policy documents, Fogleman did not regard the B-747 discussions as necessarily undermining the Civil Reserve Air Fleet program.[515] After all, pressed by Congress in the 1960s, the Military Air Transport Service had operated as military transport aircraft the C-135, commercially the Boeing 707, in the interim until the C-141 became available. Such was the shortfall in military airlift back then.[516]

## Airplanegate

Allegations of misconduct against Air Force and McDonnell Douglas officials almost derailed the program completely at the beginning of 1993. The DOD's Deputy Inspector General, Derek J. Vander Schaaf, had initiated an inquiry at the request of Congressman John H. Conyers, Chairman of the House Legislation and National Security Subcommittee, Government Operations. Issued in January 1993, the report, *Government Actions Concerning McDonnell Douglas Corporation Financial Condition During 1990*, alleged that Air Force officials had deliberately planned to provide McDonnell Douglas financial assistance the latter half of 1990 to ensure the corporation's continued performance on the C-17. The officials also failed to have McDonnell disclose its financial difficulties as required by acquisition regulations for advance and/or unusual payments. The report concluded such actions improperly channeled $442.1 million to McDonnell Douglas and reduced the corporation's financial risk, which created a false impression of success thereby enabling the contractor to obtain additional financing (to include the issuance of debt securities) and the Air Force to receive more funding from Congress. Among the officials cited for improper conduct were: John J. Welch, Major General Edward P. Barry, Brigadier General John M. Nauseef, Darleen A. Druyun, Brigadier General Michael J. Butchko, and Albert A. Hixenbaugh.[517]

The report hit the Air Force like a bombshell. The Air Force had not been consulted. Secretary of the Air Force Rice responded by stating the report was resurfacing outdated issues, most of which had already been discussed in November 1991 during subcommittee hearings. At that time, the DOD's Director of Defense Procurement, Eleanor Spector, acknowledged the government's leniency. The Air Force indicated that it would conduct its own independent review before taking any recommended disciplinary actions. McDonnell Douglas spokespersons expressed the corporation had done no wrong and was only paid for work performed. For Conyers, this was the wrong approach, and he set in motion a series of congressional hearings. The Air Force dug in more and initially refused to allow the named generals to testify, as they were under an inquiry, but would make current officials available. John McDonnell likewise balked at appearing. Conyers countered with threats of subpoenas. Conyers also went to the Securities and Exchange Commission, and an investigation was initiated.[518]

At the same time, Robert C. Duncan, OSD Director of Operational Test and Evaluation, provided Congress, as directed, a report on the C-17's first fifty hours of flight testing (*Early Operational Assessment Of The C-17 Aircraft*, December 1992). The release could not have been more untimely. "If the deficiencies identified in this report were left uncorrected, a number of requirements listed in the requirements correlation matrix of the C-17 System Operational Requirements Document would not be met."[519] The report showed the infant C-17 with some bugs in the areas of operational effectiveness due to avionics immaturity, weight growth, wing structural weakness, and flap and slat temperature limitations, all of which furnished Conyers more fuel for his criticisms. Conyers chose to ignore that the five test aircraft had amassed 974 flying hours on 278 test missions by 1 February 1993. Additionally, aircraft manufacturing had improved. P-1 had taken 776 days to complete while P-5 took 491 days (although P-5 was still delivered 132 days late). However in February, both T-1 and P-1 experienced cracked or broken forward main landing gear trunnion collars. The C-17 SPO astutely arranged for P-5 to stop at Andrews Air Force Base for congressional viewing before proceeding to electromagnetic and lightning testing at Patuxent River, Maryland.[520]

During congressional hearings on the C-17 program, Major General Charles Franklin, Air Force Program Executive Officer, candidly stated that he found the program with many management problems upon assumption of his position (August 1991). "The other thing that was going on that is going on now is, there was no real corporate oversight of the program, which I found to be absolutely amazing given the financial situation and giving [sic] the problems that we were having with the schedule and other problems."[521] When asked who was to blame, Franklin stated "it is everybody's responsibility" in the acquisition system. "If it is everybody's responsibility," Representative Gene Taylor (D-MS) retorted, then "how come nobody raised a red flag." Franklin could only reply that since he was not there, he did not know.[522] Franklin's candor only seemed to provoke distrust. Retired Colonel Kenneth Tollefson, the Air Force's and later the DOD's contracts manager at the Long Beach facility from 1987-1992, caste doubt on the Air Force's previous congressional testimony. Tollefson gave many examples of the Air Force and McDonnell Douglas ignoring or taking a more optimistic view of the situation. Among those singled out were the C-17 system program manager, the undersecretary of the Air Force for acquisition, John McDonnell, and Jerry Johnston.[523] William E. Jenne, a former McDonnell Douglas employee and subsequent financial consultant to McDonnell testified that the corporation had not been honest in its financial reporting. Russell Murray II, a backer of the C-5, was also invited to appear. He provided a critical tutorial of the many decisions the Air Force had made concerning airlift and the C-17 program. Members of Congress compared past congressional testimony by senior Defense, Air Force, and McDonnell Douglas officials with the statements made by Franklin, Tollefson, Jenne, Murray, and others having direct program knowledge.[524] Beyond the C-17, the Air Force had a major credibility problem.

In April 1993, Air Force Chief of Staff General Merrill McPeak was placed on the hot seat by lawmakers during House Armed Services Committee hearings. Congressman David K. McCurdy (D-OK), a C-17 proponent for 13 years, told General McPeak that he was "embarrassed, however, by the lack of management and the shoddy performance by the contractor up to this point."[525] Norman Sisisky (D-VA), another C-17 supporter, was blunt:

> I am very disturbed. We joined with the Acquisition Subcommittee and the Oversight and Investigations Subcommittee in looking at this problem, and

> I think it is a problem for the Air Force. Because for someone like me, and I am sure other people on the committee, it is just lack of faith in your acquisition program. For over 6 years the warning flags were there. We had witnesses that showed every element of that plane—every element, not one was right, and nobody, nobody, both in the Department of Defense acquisition group, whether they got it or not, but particularly in the Air Force management, paid any attention. Let's forget the cultural aspect—if we report it, then somebody is going to try to kill the program.
>
> It was this Congress, not the Department of Defense or the Air Force, that tried to put fences around it. We assumed that something was wrong, but somewhere in the culture of the Pentagon the thing failed. Even Secretary [Les] Aspin said he never realized until he got there how bad is the acquisition system.[526]

Sisisky pointedly told McPeak that he would be in trouble if Congress lost confidence in other Air Force programs. McPeak acknowledged that the C-17 program had not been well managed but appeared over the "hump" and was now executable. General McPeak gave a little in the exchange, indicating that Congress' funding cuts had also played a role. (Major General Franklin had tried to do the same in his testimony.) While Sisisky acknowledged Congress did share some responsibility, he left no doubt about the congressional mood.[527]

> I am telling you, General, I am warning you. This thing is not out of the woods and we are going to have to come up with options, and if we do other things, what it is [sic or emphasized] going to cost us? I don't want a fiasco like the A-12. That may have been a good political decision, but for $2 billion more we could have saved $18 billion, believe it or not. I don't want that to happen.
>
> So I think we have got to be very careful both with this committee, the Air Force, Department of Defense, to be sure—and the manufacturer, to be sure that this program is right. Because if it isn't, the forces may not be on this committee that want to kill it, but there are forces in this Congress, I promise you, that want to kill this program.[528]

Representative John Murtha (D-PA), Chairman of the House Defense Appropriations Subcommittee, asked General McPeak for frankness and candor from service officers as the subcommittee debated whether to recommend funding for either 0 or 12 aircraft, in effect to cancel or proceed.[529]

Congressional support for the C-17 had nose-dived. As the matter dragged on, there was nothing to be gained. Secretary of Defense Aspin was astute. Aspin agreed with the Air Force's review that no criminal conduct had occurred but disagreed that “some management actions, while questionable, were within a range of normal management discretion.”[530] Aspin counseled:

> The defense acquisition system operates on the principle of centralized policymaking and decentralized execution. At the heart of the system is the need for accountability at all levels. If the system is to work, then those charged with the responsibility for the management of billion dollar systems must perform to the highest standard.
>
> The story of the C-17 program reflects an unwillingness on the part of some high-ranking acquisition professionals to acknowledge program difficulties and to take decisive action. Without questioning the motivation of Air Force personnel, I must insist that program leaders understand their responsibilities to identify, early and forthrightly, significant program difficulties. Clearly, this was not done in the case of the C-17.[531]

Defense Secretary Aspin relieved Major General Butchko as commander of the Air Force Development Test Center based upon his accountability as the C-17 SPO director. Aspin also directed that three others no longer work in acquisition management: Lieutenant General Barry, formerly the C-17 Program Executive Officer and currently Commander of Space and Missile System Center; Brigadier General Nauseef, Deputy Chief of Staff for Financial Management and Comptroller at Air Force Materiel Command; and A. Allen Hixenbaugh, formerly the C-17 System Program Office Deputy Director for Contracting.[532] Aspin’s actions ended the service careers of three general officers**.** Despite this closure, “Airplanegate,”[533] as one editorial described the affair, pushed Aspin and the OSD staff to deal firmly with McDonnell.

### On Probation

“McDonnell Douglas must take immediate aggressive action to ensure that the company will meet contractual requirements. Unless there is a strong resolve on the part of McDonnell Douglas corporate management to meet contract requirements, particularly schedule, specifications, and testing requirements, the C-17 program cannot be continued,” Under Secretary of Defense Deutch advised John F. McDonnell. Deutch had just replaced Donald Yockey as the DOD’s acquisition czar and would equally show his mettle over the succeeding months.[534] It mattered little that the first C-17 was entering operational service within a few weeks. A Defense Department’s whiz kid of the 1960s, Deutch[535] would have tremendous influence on the course decided for the C-17. Some regarded him as one of the persons “most responsible” for the program’s successful turnaround. He certainly played a big role. His credentials included professor of chemistry, dean and provost at Massachusetts Institute of Technology, and director of energy research and assistant secretary for energy technology at the US Department of Energy. Sharing an MIT background with the newly appointed Secretary of the Air Force, Sheila Widnall, the two would have a good working relationship at a most critical time.[536]

Deutch further informed John McDonnell that he would be undertaking an extensive C-17 review, culminating in a Defense Acquisition Board session in August. Deutch requested that McDonnell Douglas, the Air Force, and the Defense Plant Representative Office (DPRO) take immediate corrective actions with regard to the program's operation and financial management. He further authorized a cost and operational effectiveness analysis (COEA) to study alternatives, directed the DPRO to assess the ability of McDonnell Douglas to complete the program, and established a Defense Science Board task force of government officials and outside experts to examine the C-17 program and make recommendations. Major General James A. Fain Jr., Aeronautical Systems Center Commander, and Robert Fuhrman, private consultant and formerly with the Lockheed Corporation, co-chaired the top-to-bottom review task force. Paul Kaminski chaired the Defense Science Board.[537] Deutch took this course unhappy with what he had heard from the Air Force at the 30 April DAB session. Namely, the Air Force had stated that there had been improvement in the development program and that the major technical and schedule problems were over. Deutch had disagreed, citing the late aircraft deliveries and lengthened test schedule.[538]

As part of the "get well or else effort," General Fogleman and Major General Franklin also met in May with John McDonnell and corporate officials, reviewing aircraft deliveries, the IOC date, and McDonnell's plan to meet program requirements. Fogleman made it clear that modernization was the priority. Fogleman indicated he wanted to have what was the best, the optimum for airlift requirements. But that was not going to happen unless John McDonnell and the Air Force came together to work out their differences.[539]

During his May and June testimony before the House and Senate, Deutch provided actions taken, gave the current assessment, and laid out the strategy for what he referenced as a "very troubled" program. He could not report the C-17 had "turned the corner." Its cost and schedule he characterized as "highly uncertain." Deutch stated the C-17's troubles resulted from McDonnell Douglas' failure to devote the necessary financial, management, and technical resources; the "ill-advised" use of a fixed-price development contract, which forced McDonnell Douglas to file claims for over contract expenses; and the program's instability in the areas of schedule, quantity, and funding. When asked if there was a "cultural problem" in the procurement community, Deutch spoke of the need for mutual trust, a willingness to take initiative to better manage programs, which meant allowances for risks, and the necessity for candor in disclosing problems as they occur. Deutch told Congress he would make a recommendation on whether to cancel or salvage the program. Since the C-17 might still be the best solution, he suggested that Congress "fence" the fiscal year 1994 funding until a decision was made. Whatever the outcome, the airlift requirement was real.[540] Articles abounded on the C-17's demise.[541]

Within a month, John McDonnell wrote Deutch explaining what he was doing to turn the program around and included a copy of *C-17 Program Plan For Strengthened Management*. To ensure the right focus, John McDonnell reassigned to the program Kenneth Francis, Hank Lange, and Randy Mizer, proven and effective managers. One hundred additional engineers and 50 information technology personnel would be either added from other programs or hired in to facilitate the production and testing efforts. Besides personnel changes, McDonnell formed an Advisory Council of current and former McDonnell Douglas senior executives to review the program. In conjunction with the C-17 SPO agreement, McDonnell would implement an Integrated Product Development management concept. By mid July an Integrated Management Information System would be on-line and a new Program Integration office would be fully staffed with responsibilities for program requirements management, risk management, change management, system affordability, test integration, and other special integration efforts. Besides the over $400 million McDonnell had invested in the program, McDonnell would spend another $200 million over the next five years improving quality, decreasing unit cost, and upgrading processes and systems. John McDonnell noted the corporation had made many improvements over the last eighteen months. "Further, I am totally committed to doing whatever else is required toward achieving success on the C-17 Program and continuing our strong partnership with the Department of Defense."[542]

In early July, "CEO" meetings were established bringing together the top Air Force and McDonnell Douglas leadership[543] to oversee the progress on the 11 May memoranda items detailed by Dr. Deutch. At the first sessions, some basic principles were adopted. Although relationships were badly strained, probably at their lowest and bitterest, the contractor and the government would become a team. These senior executives would do what it took to instill team building. Major General Franklin stated the C-17 program had a long history of not meeting its commitments, and as a result they faced no confidence in the program. All parties agreed they would regain program credibility by accomplishing all tasks on time and as stated. The delivery of each Lot III aircraft on or ahead of schedule would receive great emphasis. There were discussions on the acceptable delivery configuration. James Berry, McDonnell Douglas C-17 Program Manager, informed the assembled that McDonnell Douglas had already added 100 engineers as planned and would evaluate if this was sufficient.[544]

By late summer, the Fain-Fuhrman task force[545] of aerospace experts indicated the C-17 was a salvageable program. "One major finding is that the C-17 is basically a sound design and will be capable of meeting most of the realistic operational requirements of the Department of Defense. However, another major finding relates to the extremely negative management environment between the contractor and the U.S. Government which has created gridlock and has seriously impeded progress. The program cannot move forward successfully in this environment."[546] Essentially there was no reason why the C-17 could not be produced, and once produced, it should perform as designed. David Swain and Brigadier General Kenneth Miller had made some efforts at improving relationships but acknowledged they were still unacceptable. McDonnell Douglas' filing for financial compensation virtually made it impossible for the Air Force and McDonnell to agree on fixes for not meeting performance specifications. The task force also disclosed several other findings. The flight test schedule was behind. The C-17 did not meet all of the contracted range and payload specifications stipulated by McDonnell Douglas. System engineering processes were inadequate given the C-17 was a concurrent program. The amount of redesign and retrofit work indicated the C-17 was still quite immature. Part shortages, changes, out-of-station work, more modern techniques and tooling, and work force turnovers had affected the transition to production and manufacturing. Program management systems failed to provide adequate oversight for cost, schedule, and performance. Logistics support, however, was rated adequate. As a result, the task force suggested that McDonnell and the C-17 SPO adopt an integrated product team organizational structure. To get beyond the differences and resolve the outstanding legal claims, the task force recommended a comprehensive "omnibus" settlement between the two parties.[547]

Besides the Defense Science Board Task Force, the Institute for Defense Analyses (IDA) completed its *Cost and Operational Effectiveness Analysis of the C-17 Program* (December 1993). Originally, Congress had requested the study, and it subsequently became part of Deutch's review. The IDA's analysis concluded the C-17 was the "preferred military airlifter" based upon its throughput, utilization rate, and cost-effectiveness. If an all-C-17 force were not possible, then the most attractive alternative was C-17s and wide-body commercial aircraft. The next best alternative was a mix fleet of C-17s and C-5s.[548]

From August until November 1993, a Defense Acquisition Board considered the C-17 program. The complexities of the issues required more than just the planned August session. Beginning on 27 August, the DAB met, discussing the IDA COEA; the Joint Requirements Oversight Council requirements; the OSD affordability assessment; the reports from the Air Force, Defense Contract Management Command, and Defense Science Board Task Force; and program options. Based upon the extensive reviews, Deutch announced in December 1993 that 40 C-17s would be built and that the program would be halted if McDonnell Douglas did not improve the program within two years.[549] To John McDonnell, Deutch wrote on 3 January 1994:

> As a result of our communications over the past several weeks I believe that I must restate my offer for settlement of C-17 issues. This letter supersedes all prior letters.
>
> Over the past five months we have performed an intensive review of the C-17 program. Based on this review, I have concluded that the current C-17 program is not viable without substantial change and that three elements of change are required for a successful strategic airlift program:

1. A provisional 2-year program for C-17 production at a rate of 6 aircraft per year. During this period McDonnell Douglas must (a) introduce major management and manufacturing process changes, (b) demonstrate an ability to deliver aircraft on schedule and at cost, (c) successfully complete the flight test program and (d) satisfy all other contract specifications including Reliability, Maintainability, and Availability (RM&A) requirements.

2. Execution of a comprehensive settlement between the United States Government and McDonnell Douglas on outstanding C-17 business and management issues. This prospective settlement and the management and manufacturing production changes mentioned above are the subject of this letter.

3. Consideration of a mix of commercial wide-body aircraft or new C-5B production to meet the requirements for military airlift in the future.

These three elements will require consideration and action by Congress and my support of this course of action depends upon Congressional commitment to the entire package. The business settlement in this letter cannot stand alone because by itself it does not accomplish the goal of assuring the nation's strategic airlift military requirement will be met.[550]

John McDonnell penned his signature to the agreement on 6 January.

Deutch's letter and the acquisition decision memorandum that followed placed the C-17 and McDonnell Douglas on "probation" and provided for the start of the non-developmental airlift aircraft program. A Defense Acquisition Board review in November 1995 would rule if the C-17 program would continue or to proceed with the NDAA.[551]

The omnibus agreement between the government and McDonnell Douglas stipulated that McDonnell would obtain $348 million in new outlays, of which $111 million was for more flight testing, in exchange for dropping claims of approximately $1.25 billion. McDonnell agreed to invest an additional $456 million improving flight testing and addressing inefficiencies in systems engineering as well as the production and manufacturing process. Deutch's legal experts had advised him that it was pointless to go to court, as precedent showed that even when a contractor's case was weak, they recovered a part of their claim. McDonnell Douglas was asserting that the government was responsible for some of the cost growth. Therefore, Deutch proposed the settlement, and John McDonnell was sagacious enough to agree. The DOD extended the flight test program into 1995 and revised range and payload and other specifications that would not impair operational capability, although some disputed this. Thus, for a range of 2,400 nautical miles, a 157,000-pound payload replaced 160,000 pounds, and 169,000 pounds became the new maximum payload instead of 172,200 pounds. The C-17's cruise speed slowed a fraction to .74 Mach. The new small, austere airfield takeoff distance increased 200 feet to 3,000 feet.[552] As the storm clouds hovered over the C-17 program, 1993 was the year the Air Mobility Command prepared to receive its first C-17 and commence operational flying.

**Operational At Last**

On the morning of 14 June 1993, C-17 P-6, the *Spirit of Charleston*, flew into Charleston Air Force Base and became assigned to the 437th Airlift Wing, Brigadier General Thomas R. Mikolajcik commanding. As a major, Mikolajcik had been one of a select few serving on the C-X Task Force that inaugurated the C-17 program, just a paper concept then. Now, some thirteen years later, he and General Fogleman stood on the red carpet looking at the future as General Merrill McPeak and General James H. B. Peay, III, Vice Chief of Staff of the Army, alighted from the *Spirit of Charleston*. The arrival was more than a DV flight. Out the rear cargo doors came two Army M-270 multiple launch rocket systems, two HMMWVs,* and a dozen XVIII Airborne Corps troops, some 120,000 pounds of cargo. Able to haul twice the payload of the C-141, the C-17 was revealing its true capabilities.[553]

"This aircraft shows America's commitment to Global Reach. The bottom line is the C-17 enhances a wonderful American characteristic, our flexibility. The new cornerstone of this nation's mobility fleet is the Globemaster III,"** General McPeak stated in his prepared remarks.[554] General Peay, noting it was the Army's 218th birthday, thanked McPeak for the present and then more seriously stated the C-17 was critical to the Army's warfighting doctrine of rapid power projection, making fort to foxhole delivery a reality. General Fogleman expressed his confidence in the C-17. It was the plane that could do the job required.[555] Among the assembled crowd was a list of who's who. Politicians, state officials, Department of Defense civilians, senior military officers, and retired general officers rounded out the attendees. Absent, however, were Aspin, Perry, Deutch, and Donely as well as several key congressmen, indicating the program's troubled state.[556]

P-6, however, arrived at Charleston limited in what flying it could do. "You'll eventually have to make a decision to deliver a C-17 to KCHS [Charleston] that is less than fully capable (P-6, 7, 8, or 9)," Lieutenant General Kross had advised General Fogleman in mid-February 1993.[557] Brigadier General Mikolajcik was pressing for an early date, as "the initial concentration is on non-flying activities and the slow build in student training supports a 'walk before you run' concept. To support crew training, the aircraft is only required to fly one sortie per week in the first two months."[558] Major General Frank E. Willis, AMC Director of Requirements, did not agree. "The best use of a partially finished aircraft may well be to keep it at the plant to accomplish deferred work, or possibly, the test community may use the extra airframe to accelerate the delayed test program."[559] The matter ended when

*High Mobility Multipurpose Wheeled Vehicle

**Early in February 1993, the C-17 received its name, Globemaster III, following the legacies of the Douglas C-74 Globemaster and C-124 Globemaster II.

General Fogleman penned, "Walt, In my view sooner is much better than later. Press for a May 93 delivery."[560]

With much of the initial squadron training focused on non-flying tasks, Brigadier General Mikolajcik astutely sought to jump start training with an early delivery. Major General Willis looked at the issue believing aircrew training was the critical factor and also sought to avoid the criticism the B-1 program had received. When briefed by Willis, General Fogleman agreed to a 4 June delivery date, prompting the C-17 System Program Office to immediately review its production, flight test, and deferred work schedules. Subsequently, SPO Director Brigadier General Miller met with Major General Franklin and then with General Fogleman on 3 May. Miller's assessment of the first C-17's configuration upon delivery was sobering. Besides the flying limitations, the crew door would not open properly. Compromising, yet firm, General Fogleman agreed to a 14 June delivery date for P-6.[561]

The problem was the imposed concurrent developmental flight testing and production decision, with delays in both areas exacerbating the situation. Thus, C-17s were entering the operational inventory while the testing program was still underway. The DOD, Air Force, and Congress had agreed on such an approach largely due to the belief that building the C-17 was a matter of integrating proven technology. Additionally, to develop, test, and fix problems before beginning full production was simply too costly and inefficient. Necessary modifications would be retrofitted on the aircraft already delivered as well as worked into the production line as groups or blocks. Unlike fighter aircraft, which deployed as a unit, all C-17s needed to have the same configuration, as any aircrew flew the aircraft throughout the worldwide system. Concurrency made sense. Yet, the C-17's flight testing delays laid bare its weaknesses. As a result, Charleston's first C-17s were less than fully capable. P-6 essentially could only fly "around the flagpole"—fly local patterns under visual flight rules (VFR). Colonel Donald M. Dessert Jr. and Lieutenant Colonel Terry. E. Tomeny, C-17 Operational Test and Evaluation Test Director and Combined Test Force Director, respectively, had briefed General Fogleman on the situation and worked out a process that was without precedence. After the Combined Test Force (CTF) had tested and signed off on test points, the C-17 SPO incrementally provided capability releases to conduct operational flying. The Air Mobility Command had prioritized a list of capabilities required for aircrew training, eventually grouping them in sixteen major blocks. The procedure added a significant workload to the CTF. At this time, the test program was about 60 percent complete. Willis also pressed Miller on ensuring that the capabilities of the delivered aircraft matched the capability releases granted. This would remain an issue and impeded training. By October, Charleston commenced flying one C-17 for two sorties per day. P-7 had joined P-6 at the end of August, and P-8 was due at the end of October. The plan was to use one aircraft for flying, one for ground training, and one for technical order and flight manual verifications. The late aircraft deliveries, DV static tours, and modification and retrofit work all added to the already tight schedule for meeting initial operational capability.[562] As of 6 December, the three C-17s had flown 55 sorties and 177.8 hours. Also by this date, Charleston had qualified 8 pilots, 24 copilots, and 13 loadmasters. Thirty-four enlisted maintainers had graduated from the engine course while 174 were receiving on-the-job training. Twelve operational aircraft and 48 aircrews were needed for IOC.[563] Training aircrews and maintainers remained in the foreground for several years.

Although the C-17 garnered much praise, the first aircraft had their share of problems and limitations. "Expect numerous nuisance cautions and warnings," Colonel Dessert and Lieutenant Colonel Tomeny had advised. The two provided the Air Mobility Command a thorough briefing on what to anticipate with the C-17. The list of restrictions was a long one. Yet, in over 1,500 flight test hours, no test aircraft had experienced a malfunction that required immediate landing.[564] In the information exchanges, the C-17 CTF representatives related that the top inherent failures were: the main landing gear tires, communications control, forward wing tip light, mission computer, landing gear indicator, latch assembly, retracting rod, nose landing gear tire, intercommunications, incandesce lamp, multi-function display, and head-up display.[565]

Moreover, the first C-17s "were a real mess. Beyond anything in my prior experience," Bill Casey expressed.[566] The workmanship was poor in part because they were literally almost built by hand and done under great pressure with the program so far behind schedule. The fit and finish were simply lacking; seam lines did not line up right. The paint job[567] was bad. When opened, the crew entrance door rested on wooden chocks, it was so poorly designed, a butt of joking. For a time, things, such as the fairing panels or bolts, fell off the aircraft while in flight. The airflow would work them loose. How McDonnell Douglas, with decades of aircraft manufacturing experience, had fallen down with the first C-17s was partly due to the low buy rates, which did not allow for much automation and quality improvement. It was hardly viable for subcontractors to manufacture a few parts. Additionally, the break in funding meant, persons or crews that had manufactured some of the first aircraft were gone, requiring a rebuilding of the experience levels and more "hand-built" C-17s in the meantime. Likewise, McDonnell's changeover to total quality management was initially disruptive to production. Subsequent cost cutting efforts due to the corporation's poor financial performance and the industry's downturn also resulted in employees with more seniority bumping C-17 workers, causing additional turmoil. However, the contributing factors of funding and low aircraft buy rates belonged on the doorsteps of the Congress, the DOD, and the Air Force.[568] Although Secretary Deutch had limited the program to 40 C-17s, the ensuing 1994 omnibus settlement with its stipulated production rates provided McDonnell Douglas stability so it could turn out a better product. Despite the initial poor quality, the C-17 did what it was designed to do.

Aircrews remarked favorably upon the C-17. The aircraft was easy to fly. It handled well on the ground and in the air. Pilots and loadmasters expressed confidence in the C-17's ability. From their past experiences with the C-5 and C-141 in Grenada, Panama, the Gulf War, and Somalia, they readily saw the advantages the C-17 offered in improving air flow, ground congestion, loading, and unloading. Pilots gave a lot of praise to the fly-by-wire flight control system and state-of-the-art avionics. They looked forward to practicing takeoff and landings on short airfields in 1994, as the head-up display would show them exactly where to touch down on the runway. Loadmasters were especially pleased with the backend. Early in the program, a McDonnell Douglas design engineer had experienced a loadmaster's workload aboard a C-141 making a trip to the Far East. From this trip came the automated stabilizer struts and the loadmaster's workstation. Other welcomed features were the in-floor loading rollers and special lighting. Light fixtures just above the floor helped to ensure tie down chains would be properly attached to vehicles. Unlike the loadmasters on other military transports, the C-17 loadmaster, aided by a computer, could figure out weight and balance loading in minutes and was also hooked up to the aircraft's air-to-ground radio, providing better aircrew and ground communications.[569] Perhaps, loadmaster Master Sergeant Bill Ellis summed it up best: "They have incorporated everything that is good from the C-130, the C-141, and the C-5 on this plane."[570]

Two independent reviews of the C-17's flying characteristics by trade journalist pilots from *Aviation Week & Space Technology* and *Flight International* also gave the aircraft high marks. Former Navy pilot David North expressed after flying P-4 at Edwards with a McDonnell Douglas test pilot: "The C-17 delivered to the Charleston AFB this year will be able to do the Air Force mission and do it well."[571] Equally, Harry Hopkins conferred his thumbs up: "To have wheeled a 200t-plus aircraft about with such agility had been truly impressive. To have thundered it so confidently onto the ground at a precise point was a remarkable experience."[572] However, there were things to work out, and the capability restrictions did slow aircrew training as well as what operational missions the C-17s could perform in its first year. For example, with the completion of tropical weather testing, the C-17 could fly in heavy rain (instrument meteorological conditions) as fall weather approached.[573]

"What is #1 operational problem in launching this aircraft," General Fogleman asked in November 1993. The reply came: "Charleston maintenance is currently performing a lengthy Flight Control Computer (FCC) test prior to launching a C-17. The test requires two hydraulic mules and originally ran about 4 hours, however it has been reduced to just over 2 hours."[574] The lengthy check was necessary, as the aircraft's immature software did not permit the aircrew to initiate this self-test. Having the maintainers perform the test ahead of time, eliminating as many problems as possible, increased the chances of a successful training sortie. Initially operating the mission computer was also frustrating. Frequently it would not self-test, and the aircraft would be written up for maintenance only to have the mission computer work on the next try. The display[575] would also go blank for seconds at a time. The software glitches and stray voltages were most annoying and hard to isolate. Software upgrades for the mission computer and electronic flight control system were planned well into 1994. Releases for day/night en route (CONUS and overseas), forward operating base ground operations, day/night air refueling (single ship), day/night VFR single ship low level, and formation (essentially Blocks 4A-10A) followed in March 1994.[576] Flight restrictions required the aircraft to fly with 29,000 pounds of ballast to maintain aircraft center of gravity limits until May 1994. The C-17 was tail heavy. Much time was wasted repositioning the ballast. Problems with the On-Board Inert Gas Generating System (OBIGGS) system curtailed the number of passengers to twenty. Restrictions on backing, star turns, and pivot turns ended in 1994 with the change over to the new slats and an improved intercom. Smoothing out the landings and eliminating sharp turns curbed the excessive wear on tires, although the problem would remain, for the main landing gear did not caster. Fill value anomalies required caution in fuel planning to avoid fuel transfer imbalances until the aircraft received new fuel fill valve controllers. Largely due to the number of nuisance cautions and false warnings, the C-17 flew with three pilots and a loadmaster for much of 1994.[577]

Depending on their retrofit and modification work status, not all of the C-17s could fly the releases when made available. Additionally, as new capabilities were released, aircrews had to then train or retrain in these specific areas. Thus, fewer releases would have been better, but the situation dictated otherwise. By the end of 1994, the dozen C-17s had a good amount of capability; the C-17 as a weapon system had undergone considerable maturing.

The active, reserve, contractor, C-17 System Program Office, and Operational Test & Evaluation personnel at Charleston forged a team and worked through the difficulties of fielding a new aircraft. Tapping into a ready pool of talent and military expertise, McDonnell Douglas hired retired Major General James Kellim as site manager for its operations at Charleston. From 1987-1990, Kellim had served as the deputy chief of staff for operations at Headquarters Military Airlift Command. He was later joined by retired Lieutenant General Gary H. Mears, formerly deputy chief of staff for logistics at the Military Airlift Command. Lieutenant Colonels Ronald R. Ladnier and Thomas P. Toole, commander of the 17th Airlift Squadron and deputy for the 437th Logistics Group, respectively, deserve recognition for their tremendous efforts, at times digging in as needed.[578]

With the operational fielding of the C-17, the C-17 System Program Office and the Air Mobility Command, via the Requirements and Planning Council sessions, also focused on identifying and prioritizing baseline improvements to the C-17 fleet. The council integrated the improvements with the necessary funding strategies and retrofit schedules. For example, among the first desired enhancements were a 40-container delivery system, self-sufficiency, upgrading the cargo compartment heating, and defensive systems.[579] Despite the operational fielding, the C-17 was still a very troubled program, as flight testing and aircraft production remained behind.

**Turning Around**

"Those three—Kadish, Deutch, and Kozlowski—were the first-tier heroes of saving the airplane. Let's face it; this airplane was dead. The only thing holding it out of the grave was maybe a winglet somewhere. The quality was poor; the costs were out of control. There was really bitterness on all sides—from the government side to the company to Congress. There were people on the Hill who didn't just want to cancel; they wanted to punish McDonnell Douglas," Lieutenant General Walter S. Hogle Jr. remarked in 1999, reflecting on the program's saga.[580] Between November 1992 and January 2000, as the Air Force's director of public affairs, the 437th Airlift Wing commander, AMC director of plans, and AMC vice commander, he had a front row seat.[581] Lieutenant General Charles Johnson from his vantage as the C-17 SPO director (1996-1999) echoed these sentiments, adding Paul G. Kaminski to the list.[582] Others could be included as well. What they were alluding to was the positive attitude that the new personalities brought to the C-17 program as it began its recovery. The Fain-Fuhrman task force had highlighted the bitter relations and the need to move beyond. The omnibus agreement and the personnel changes together provided the mechanism for the C-17 program to begin anew.

Accordingly, at the Air Force level, Brigadier General James S. Childress took over as the program executive officer from Lieutenant General Franklin. Brigadier General Ronald T. Kadish replaced Brigadier General Miller as the director of the C-17 System Program Office. McDonnell Douglas named Donald Kozlowski to head the C-17 program titled as senior vice-president-C-17, replacing David Swain. Paul Kaminski would step into the under secretary of defense for acquisition and technology position when Deutch became the deputy secretary for defense in March 1994. General Childress brought to the table acquisition expertise, as his last position was the F-15 program director at Warner Robins Air Logistics Center. Early on he sought "buy-in" from the key players for a plan to get to November 1995. He continued the CEO meetings and started the Milestone III Steering Committee, chaired by Rudy de Leon.[583] Kadish knew airlift, acquisition, and program management. Early in his career, he had piloted the C-130E and subsequently found himself assigned to the F-16 SPO at Wright-Patterson. Prior to becoming the C-17 SPO director, Kadish was the SPO director for the F-15 and F-16 programs, 1990-1993. Kozlowski, likewise, had extensive experience, managing five major programs—Advanced Tactical Fighter, YF-23, A-12, F/A-18, and High Speed Civil Transport—in his 31-year career at McDonnell Douglas. Both Kadish and Kozlowski came in fully supported by their respective organizations. They continued efforts at team building and integrated product teams established by their predecessors. They were energized and charged to move the program forward. When Congress approved the settlement, the past was left behind. They could work from a clean slate. As a further motivation, the NDAA option drove them to make the C-17 right. These personnel actions over the late summer and early fall 1993 reset the program's foundation.[584]

Other key personnel changes had also occurred earlier in 1993 cementing a good team effort all around. Among them were Rudy de Leon, Darleen Druyun, and Sheila Widnall. Rudy de Leon, formerly a staff director of the House Armed Services Committee, was first a special assistant to Defense Secretary Aspin and

Deputy Secretary Perry and then served as the undersecretary of the Air Force in May 1994. In February, Darleen Druyun[585] became the principal deputy assistant secretary of the Air Force for acquisition and management. Druyun's association with the C-17 program had begun in the 1980s. In later years, she referred to herself as the C-17's "godmother." At the beginning of August, Sheila Widnall assumed the Secretary of the Air Force position. Her technical mind saw the C-17 for what it was, a good airplane. She remained proactive in working in her words the "window of opportunity" that the program had been given by Dr. Deutch. The "team" was bolstered again in October 1994 when General Fogleman was selected as the Air Force Chief of Staff and Lieutenant General Fain became the Assistant Vice Chief of Staff of the Air Force.[586]

During the CEO sessions, the plan became to focus on meeting three specific objectives: the initial operational capability (January 1995); the reliability, maintainability, and availability evaluation (RM&AE, July-August 1995); and the Milestone IIIB decision (November 1995). To this end, the C-17 System Program Office, McDonnell Douglas, Combined Test Force, Defense Plant Representative Office (subsequently Defense Contract Management Command), and Air Mobility Command representatives got together developing an integrated master plan, detailing what was required to ensure success in each objective area. General Fogleman stated he needed to manage to a January 1995 IOC date to get Charleston up and running. He was not interested in a slippage. He would, however, accept two different C-17 configurations at IOC, provided all 12 aircraft had the wing, slats, and flaps retrofit work completed. Brigadier General Kadish acknowledged the identification, implementation, and retrofitting of RM&AE fixes into the 12 aircraft by IOC remained the program's biggest technical risk. At one time there were 1,600 fixes. By March 1994, there were indications that the list had stabilized and was no longer growing. To facilitate the retrofit work effort, McDonnell secured an American Airlines' facility at Tulsa, running three shifts six days a week. On-time deliveries and reductions in unit costs supported a successful Milestone IIIB decision. Donald Kozlowski advised he had implemented a quality first, schedule second mindset. In effect, harnessing an employee's pride in the quality of his/her work to drive meeting deadlines. That Kozlowski was a people person and got out on the factory floor had already helped boost sagging morale. At the time, McDonnell's commercial aircraft sector was experiencing a slow down, resulting in skilled C-17 personnel facing bumping again. But the bumping was kept to a minimum and did not prove as disruptive as in the past.[587]

Although the government and the contractor had come up with an agreement, congressional approval was required; obtaining it took some convincing. Dr. Deutch seized the initiative, explaining the approach. He related to Congress that he had been tempted to cancel the program. But there was an undisputed need for more airlift. The C-17 met the military airlift requirements. Deutch was candid: "The C-17 program is broken; it's worth trying to fix it. I am not here today to tell you that we have 'turned the corner.' Instead, I am here today to tell you where the road ends. The road ends in two years when either MDC will have demonstrated the ability to build C-17s successfully, or we shall move to an alternative airplane." Under Secretary Deutch also assured Congress that actions had been taken on the restrictive language stipulated in the fiscal year Defense Authorization and Appropriation Act, namely meeting the specified milestones before additional C-17 purchases, establishing a concurrent NDAA program with the $100 million appropriated, and updating the *Mobility Requirements Study*.[588]

In his March 1994 congressional testimony, General McPeak stated the C-17 was the Air Force's No.3 procurement priority, behind the F-22 and precision-guided munitions for the B-1 and B-2. McPeak asked that the program continue, so the Army could deploy when requested by the President.[589] In April, General Fogleman went before Congress, providing testimony on the programs of the United States Transportation Command/Air Mobility Command. With regard to the C-17 program, Fogleman spoke of the C-17 filling the role as the next "core" airlifter. During questioning, however, Representative Charles Wilson (D-TX) specifically asked Fogleman to declare how many C-17s were required. To this, he replied:

> So today, all of our war plans are built on C-141 equivalent loads. That's our core airlift. Now the plan was to replace 240 some C-141s, there are 120 C-17s. And that 120 C-17s because it was a wider body, because we anticipate greater reliability, maintainability, gave us equal capability, in fact a little bit of increased capability or half the airplane. But as we drop below 120 C-17s, and we start to look at others, for instance, I can tell you 40 is not enough, but there is probably some number between 40 and 120 where there is a break in the curve, where if that's all I got, I would at least have a military use for the number. And I will tell you that I will take great criticism for this, but that number is somewhere in terms of total aircraft, between 70 and 80, so that I need at least 60-65 airplanes on the ramp to have a true core airlift. And the rest of that capability I could make up with some kind of commercially [available aircraft]. Now what that means, sir, is that I have just given you a back of the envelope answer before all the analysis is done on the bottom-up review, MRS, all this . . ..[590]

Many regarded Fogleman's statement as damaging. His remarks were based on the Joint Chiefs of Staff J-8 C-17 Assessment and IDA analysis. It required General Fogleman to reiterate the command's position as 120 versus the 70-80 aircraft. The latter figures would not support the airlift requirements for two major regional contingencies nor would they be sufficient if only C-17s were used to meet the Joint Chiefs of Staff directed strategic brigade airdrop requirement. Clarifications followed.[591] It further indicated just how tentative the situation was with the C-17. If the Air Mobility Command had to, what could it live with was uppermost in General Fogleman's mind.

Also at this time, the House Armed Services Committee had derailed the settlement agreement by cutting the annual number of planes purchased from six to four with the savings used to procure commercial aircraft. The "team" scrambled to counter the recommendation. Rudy de Leon, ex-congressional staff director for this very committee, played a prominent role, unleashing a "full court press."[592]

Meanwhile, John McDonnell acted in "good faith" and continued to proceed as if Congress would approve the settlement. Negotiations with the Air Force had already taken many months, now McDonnell Douglas was left waiting on Congress. John McDonnell personally conveyed his commitment to Senator Nunn.[593] Once more, John McDonnell showed he was a big man, although some would say he really had little choice. Nevertheless how McDonnell proceeded was another example of the extra ordinary efforts taken to get the program and his corporation on the right track. In September 1994, John McDonnell stepped aside, appointing Harry C. Stonecipher as chief executive.[594]

In the ensuing weeks, Defense, Air Force, Air Mobility Command, and McDonnell Douglas officials impressed upon Congress the need for approving the omnibus agreement. It was another uphill battle made all the more difficult by faultfinding reports.

The General Accounting Office was especially critical of the IDA's COEA, the omnibus settlement, and C-17's small, austere airfield advantages, and intended use. The GAO advised Congress in *Airlift Requirements: Commercial Freighters Can Help Meet Requirements At Greatly Reduced Cost* that the COEA favored the C-17 in its assumptions on airfield availability, utilization rates, and intratheater role, which greatly reduced the cost-effectiveness of alternatives. "Adjusting for these three questionable assumptions would result in the C-17 fleet being less capable and a mixed fleet more capable and more cost-effective than IDA's conclusions indicate." "Therefore, Congress should not consider the COEA as a basis for authorizing 120 C-17s. The minimum number of C-17s needed to fulfill military requirements has yet to be determined."[595]

In *Military Airlift: C-17 Settlement Is Not A Good Deal*, the GAO cited several reasons for its conclusion. The settlement placed little or no economic burden upon McDonnell Douglas. Claims had not been subjected to a full legal or price analysis. The settlement proposed lowering payload and range specifications a second time. Most of the management and productivity improvements called for would not be realized until 1996, well past the Milestone IIIB decision. Lastly, the DOD had not specified criteria for evaluating McDonnell Douglas' post-settlement performance. "Congress is being asked to approve a settlement based on faith in McDonnell Douglas' ability to improve cost, schedule, and performance while fundamental questions remain unanswered regarding the contractor's ability to produce the aircraft efficiently." The report also recommended that the secretary of defense determine the minimum number of C-17s needed for military-unique requirements.[596]

Unfortunately, DOD and Air Force officials were caught in a waiting game—waiting for McDonnell Douglas to visibly show improvements, waiting for the conclusion of the flight test program, waiting for an updated mobility study in order to determine optimum airlift forces, waiting for what modifications were needed for commercial aircraft to efficiently carry oversize cargo, and lastly waiting to assess McDonnell Douglas' performance at the end of the two-year probationary period.

GAO criticism continued. *Military Airlift: Comparison of C-5 and C-141 Airfield Availability* reported the C-17's advantage to the C-5 decreased from 6,400 to 900 airfields when wartime requirements were applied, challenging the Air Force's long-standing assertion that the C-17 would land on more airfields and enhancing the C-5 as a NDAA suitable option. The Air Force-Air Mobility Command countered that when all factors—runway width and strength, obstructions, towing requirements, backing capability, and so forth—were taken into consideration the C-17 still retained nearly a two-to-one advantage. For example, the C-5 needed 144 feet to turn 180 degrees while the C-17 required just 90 feet, performing a star turn.[597]

Lastly, in *C-17 Aircraft: Cost and Performance Issues*, the GAO asserted that the "capabilities, on which the aircraft was originally justified, are not likely to be used as originally intended." Coupled with the program's cost increases, the report concluded: "a 120-aircraft C-17 program is not the most cost-effective way to meet airlift requirements." In large part, Cheney's decision to reduce the program affected the C-17's employment as an intratheater and direct delivery asset. However, it did not help that the Army had recently changed its need for the 60,000-pound low-altitude parachute extraction system (LAPES) drop, which was C-17 unique, and had not incorporated the direct delivery concept into its doctrine and war plans. Air Force adjustments in 1993 had de-emphasized the direct delivery role as well. Moreover, the C-17 had yet to fully satisfy airdrop requirements. These GAO reports were part of the Fiscal Year 1994 DOD Authorization Act, which had requested an examination of various program aspects.[598]

Nor was a Rand study supportive. *Finding the Right Mix of Military and Civil Airlift, Issues, and Implications* concluded that the "best estimate of the right mix was one that has civil-style transports to provide needed replacements for two-thirds of the C-141 fleet then designated for retirement. Substitution of a modified 747-400F for the C-17 to replace two-thirds of the C-141 would lower costs considerably." Rand calculated the cost of the 747s to be $25 billion less over a twenty-five year period than a fleet of 120 C-17s. Rand assumed, based upon Desert Shield/Storm cargo movements for the first thirty days, that bulk cargo was the primary requirements. The DOD and Air Force replied that Rand in drawing its conclusions was ignoring operational realities as well as the need for core military aircraft. The preliminaries from the revised *Mobility Requirements Study* disclosed that within the first 29 days, 65-75 percent of the cargo requirements were oversize and outsize movements, largely vehicles, and not bulk cargo.[599] The Deutch-directed *Strategic Airlift Force Mix Analysis* (SAFMA) study was in the process of grappling with the optimum force mix of C-17s and NDAAs.

In his congressional appearances and meetings, Deutch stressed why the settlement and the six-aircraft buy were so critical. He went so far as to state during his House Armed Services Committee testimony that "If we do not have common understanding about where we are trying to go and why, we should as well turn to something else."[600] Subsequently meeting with the House Armed Services Chair Ronald V. Dellums (D-CA) and staffers, Deutch let Dellums know that if the administration could not get six aircraft, Congress might as well cancel the program.[601] To clarify its position and rebut the reports, the OSD issued a white paper entitled *Department of Defense Airlift Acquisition Strategy*. "Approval of the settlement and six C-17 aircraft in fiscal year 1995 are essential elements of the Department's airlift strategy. Without both, we lose the ability to hold McDonnell Douglas strictly accountable for its performance, and we forgo the benefits we are already beginning to realize." Namely, in good faith, McDonnell had proposed making investments of $35 million to lower production costs and would put in another $65 million. Moreover, the C-17 offered unique military requirements. Commercial wide-body aircraft could not carry outsize cargo. While other aircraft could transport more, the C-17 provided greater throughput, delivering more cargo in a shorter time and in a constrained environment. The C-17 had more versatility in its configurations, hauling vehicles, bulk cargo, and passengers; performing aeromedical movements; and airdropping containers, paratroopers, and equipment. Its short, austere airfield capabilities eliminated transloading cargo, enabling the direct delivery of cargo and troops as combat conditions warranted. It could perform combat offloads. No commercial aircraft had this capability. Nor could commercial aircraft fulfill airdrop and the strategic brigade airdrop requirements. With low-level flying capabilities, an on-board inert gas generating system to suppress wing fires and an integrated defensive system to ward off missile attacks, the C-17 could operate in hostile environments. Commercial NDAA alternatives fell short in these areas as well.[602]

The "full court press" campaign included letters of support from the defense secretary, joint chiefs chairman, service chiefs, Defense Science Board chairman, and even Inspector General Derek Vander Schaaf.[603] Vander Schaaf and seven from his staff had been part of the Defense Science Board review. "While we found no basis to withdraw any of our previous criticism . . . we were encouraged by the candid assessments of problems and the diligence with which corrective actions were sought and pursued." "Failure to approve the settlement agreement will leave the program with a management environment that is not working and the prospect of wasting millions of dollars in litigation. I see the settlement agreement as a sensible business arrangement," Vander Schaaf advised Senator Kennedy.[604] President Bill Clinton also weighed in with a letter to Speaker of the House Thomas S. Foley (D-WA), and on 24 May the House overruled the Armed Services Committee, restoring funding for the two aircraft. In the Senate, Charles E. Grassley (R-IA), William V. Roth Jr. (R-DE), and Alphonse M. D'Amato (R-NY) attempted to rally support to defeat the settlement but were unsuccessful.[605]

In the end, thanks in good measure to Rudy de Leon, enough congressional support was secured, and the fiscal year 1995 Defense Bill formally approved the claims settlement. But the legislation also stipulated that no production funds other than advance procurement would be available until Secretary of the Air Force Widnall reviewed airlift requirements. The year prior, Congress restricted advance procurement to $100 million until the secretary of defense reported on fixes to the wings, flaps, slats, and landing gear to include identifying the cost of retrofitting the first 10 production aircraft.[606]

The delivery of P-13[607] on 29 June 1994 one day early marked another turn in the get-well effort. It was also the most complete aircraft to date. By this time, McDonnell Douglas had more than halved the hours spent on reworking completed aircraft. Secretary Widnall officiated at the acceptance ceremony and subsequently flew on the airplane to Charleston. The flight afforded her an opportunity to see how well her "troubled" airplane was performing. On 20 August, McDonnell Douglas delivered P-14 eleven days early and with only 96 waivers, then the fewest. Aircraft deliveries were very visible, and either McDonnell Douglas made the date or it did not. The corporation faced tremendous pressure. Donald Kozlowski had set a personal commitment of quality first, schedule second, and cost third. It produced results. All subsequent C-17s were delivered early and the discrepancies continued to decline as well. It was a clear indication that McDonnell Douglas' production and manufacturing processes had turned around. Moreover on 22 December, Charleston received P-17 forty days early. It was the twelfth and final aircraft needed for declaring the initial operational capability. By 28 December, McDonnell had the last of the twelve aircraft out of the Tulsa retrofit program, setting the stage for meeting the IOC date. Other good omens were the durability test article surpassing the contractual required 1.5 lifetimes (45,000 hours) in November and the completion of developmental testing in December 1994.[608]

Meanwhile, the airdrop portion of the test program had stalled due to parachute contacts (grazing) with the fuselage. "We looked at the C-130s, 141s, and guess what we discovered? Chutes hit the fuselage on all of these airplanes. And so we had gone through all of the analysis, and we had done everything that we could possibly do, but yet the Army test community wasn't going to jump because they thought there was a danger," General Fogleman recalled.[609] Thus, as dawn broke on 9 July 1994, General Fogleman and XVIIIth Airborne Corps Commander Lieutenant General Henry H. Shelton led a group of forty paratroopers on a 1,250-foot jump over Edwards Air Force Base. First Fogleman and then Shelton exited the C-17. No publicity stunt, the jump was a tremendous statement. General Fogleman, a rated parachutist, was dedicated to meeting the Army's operational requirements. He had great confidence in the C-17. And so Fogleman suggested the jump to move the test program forward. They were leaders—senior officers-instilling confidence to accomplish the mission. As chance came into play, the only two chutes that grazed the fuselage that day were the generals' chutes. Besides its motivational impact, the jump also gave General Shelton an opportunity to talk with the test team, and he allayed some of their concerns. For one, tears in the parachutes were occurring at Fort Bragg as well, and they stemmed from a change in manufacturers.[610] Engineers from the CTF, SPO, and McDonnell Douglas also believed that chute damage was occurring on the drop zone after landing during the chute roll-up.

Painting the aft and lower fuselage sections of the aircraft with blue chalk verified that most of the chute damage did not come from grazing. Minor changes to the static line, deck angle, airspeed, flap settings, and landing gear position mitigated the grazing, especially key was tweaking the deck angle. Subsequently, three sorties of 40 paratroopers jumped at Edwards in July 1994 with no parachutes grazing.[611] Army safety concerns had been resolved, and airdrop testing continued.

However, problems persisted. Upon initiating simultaneous dual door jump testing, it was discovered that the airflow around the aircraft could potentially result in paratrooper contact with the deployment bag (D-bag) and paratrooper chute entanglements (from paratroopers trailing or centerlining behind the aircraft). In addition, wake vortices off of the wings prevented the C-17 from achieving heavy equipment and personnel formation airdrops time requirements for the Army's strategic brigade airdrop mission. The entanglement issue had surfaced as the C-17 was ending its developmental flight testing. The Air Force had approved commencing dedicated initial operational test and evaluation (DIOT&E) and now desired to proceed. At the December 1994 Army General Officer session, Major General Richard W. Tragemann, Commanding General of US Army Test and Evaluation Command, stated he would not provide a safety release for dual door jumps until the entanglement issue was resolved. Major General Robert B. Rosenkranz, Commanding General of US Army Operational Test and Evaluation Command, exercising his authorities, indicated he would not recommend evaluating C-17 paratroop operations during the DIOT&E until a solution was found. The Air Mobility Command needed to have the dual door capability by the July-August 1995 reliability, maintainability, and availability evaluation—the pass/fail test of the C-17. The Air Mobility Command also took the position that the C-17 must demonstrate the operational requirements document threshold and key performance parameter of 102 paratroopers. In reality the command had no choice; failure of a key performance parameter opened the program up for cancellation per the new acquisition policy. With DIOT&E scheduled for completion in June 1995 (after already incurring several delays), the Air Mobility Command felt pressed and had proposed that Major General Rosenkranz and the Air Force Operational Test and Evaluation Center consider evaluating single door operations during DIOT&E to support an interim capability release.[612]

General Fogleman in his new assignment as the chief of staff of the Air Force remained engaged and conferred with his Army counterpart, General Gordon R. Sullivan. General Robert L. Rutherford, the AMC Commander, advised General Fogleman: "I do not believe we should be in the business of telling the Army what platform to jump from. However, I believe they will have to be reasonable if we are to progress through DIOT&E."[613] Without resolution of the paratroop entanglement issue, the C-17 program was at risk, facing the November 1995 Defense Acquisition Board decision. But the capability release was not forthcoming until May 1995 after jumpers successfully demonstrated the 102-paratrooper-mass exit, dual door airdrop based upon employing new aircraft and paratrooper drop configurations and increasing the static line lengths from 15 to 20 feet.[614] In June, at the request of the OSD, six C-17s provided a "representational slice" of what the Air Mobility Command might be tasked to airdrop for the strategic brigade airdrop mission. Among the heavy equipment items airdropped were a M-551 Sheridan tank, 155mm howitzers, and HMMWVs while 204 paratroopers jumped from a two-ship formation.[615] Formation spacing for safe exits and time intervals to ensure the element of surprise had yet to be finalized, however.

Besides resolving airdrop issues, the C-17's unit cost had to come down as well. Rudy de Leon led a major cost cutting review to be competitive in the upcoming Milestone IIIB decision. With probation holding the number of C-17s to 40, the publicly published cost documents in September 1994 placed the unit cost at $553 million, subjecting the program to unwanted criticism. Simple arithmetic told de Leon that even if there were a program decision for a fleet of 60 or 80 C-17s, the unit cost would still be too high, and Congress would balk. Derek Vander Schaaf had actually raised the issue. Differing from previous cost cutting efforts, which identified potential savings, the "should cost" review focused on implementing savings through greater efficiencies in production, design changes, and possibly downscoping based upon testing and operational results. Complementing de Leon on the Air Force side was Darleen Druyun. Again Don Kozlowski focused McDonnell's best talents on the effort, zeroing in on the high payback items as well as tracking down every cost account to include those below $100,000 for savings. The goal was to get the unit cost well under $200 million. With C-17 SPO support, McDonnell seriously studied a lower cost engine nacelle by removing the core thrust reverser but found General Rutherford unwilling to support the initiative because it would degrade the C-17's ground maneuvering and engine-running offload capability. McDonnell did improve upon its scrap, rework, and repair rate of 25 percent as well as its production line efficiency of 15 percent, getting the rates more in line with industry standards. Another positive turn was the government and the contractor agreeing to a single cost model. As a result of these efforts by the end of 1995, the projected unit cost had dropped to $172 million (multi-year rate for 80 aircraft), making it competitive with the price of a B-747-400, one of the main NDAA contenders.[616]

The CEO meetings also focused on the reliability, maintainability and availability evaluation scheduled for July 1995. Although operationally representative missions would be flown, Brigadier General Kadish stressed the RM&AE was a contract verification evaluation and the primary focus would remain so. Because of the differing purposes, changing ground rules, and resulting confusion, the CEOs concluded that OSD and Congress needed to agree in principle on what the evaluation would accomplish. One thorny issue revolved around determining what would constitute passing the utilization rate requirement. Tangling with OSD, General Fogleman held his ground on conducting a two-day "illustration" of the C-17's wartime surge capability. Besides providing the required data, Fogleman believed the two-day event would serve to defuse C-17 criticism, similar to the range and payload demonstration flight[617] of January 1993. Kadish briefed that current maintenance trends were good for the upcoming evaluation. Mainly, minor components were failing, resulting in easy fixes. Practice RM&AEs would do much to prepare the 437th Airlift Wing for the real event. It was generally felt that no matter what, criticism of the evaluation would be forthcoming.[618] The assessment proved accurate.

Also in 1994, General Fogleman got the airplane into the public's view in addition to performing its military mission. With the existence of an alternative, the C-17 had to compete against it. From Charleston's crews, a team was formed to demonstrate the aircraft's features. The C-17 was flown to the nation's capital and put on display for members of Congress to see the airplane up front, against a C-5. In May, the Air Force showed off the C-17 at Britain's Air Fete '94, one of the largest military air shows. The C-17 (P-11) set an endurance record on its return trip (Mildenhall-McGuire AFB), flying 9.6 hours without air refueling. Making another overseas trip in early June, the C-17 transport joined US Air Force F-16s fighters and a B-1 bomber flying in formation over the Colleville American Military Cemetery in France, commemorating the Fiftieth Anniversary of D-landings during World War II. By June, the C-17 had set 21 world records in payload-to-altitude and time-to-climb. Impressively, on 3 June, the C-17 broke a STOL record when it carried 44,088 pounds to an altitude of 6,562 feet; it did so taking off in 1,369 feet and landing in 1,356 feet. The C-17 performed aerial demonstrations at Rodeo '94, the international airlift and air refueling competition hosted by the United States Transportation and Air Mobility Commands. In September, the C-17 made its Pacific debut, enhancing aircrew experience levels and providing en route personnel an opportunity for training as well. Before the initial operational declaration, the C-17 was executing operational missions. In October 1994, aided by air refuelings, two C-17s flew fifteen-hours nonstop to Dhahran, Saudi Arabia, delivering troops and equipment, totaling some 160,000 pounds. These operational missions were part of the United States's response to Iraqi troop movements. In December 1994, the C-17 completed a humanitarian relief operation to the hurricane-struck Caribbean, airlifting 384,000 pounds of cargo on three missions.[619] There was historical precedence, the C-141 entered the operational force in April 1965 prior to completing the Category II test program and began flying regular missions to Southeast Asia that August.[620]

General Fogleman had considered flying the C-17 into Uganda for Rwanda humanitarian relief and into Haiti as part of the contingency and peacekeeping efforts but held off in light of the plane's newness and the immaturity of the C-17's en route support system.[621] For his risk taking, Fogleman took some criticism, even from his own staff. Conviction drove him: "You had to take some risks with this program, otherwise it was going to die." "Airshows. People would get wrapped up and tell me, 'Well, it's meaningless. You fly this thing in, and you stop it in 500 feet, back it up, and turn it around on the runway. It's meaningless. We probably won't operate that way.'" They missed the point. It was done to impress that no other big airplane could do that. "'This really is a unique kind of airplane.' So, you had to have the publicity along with a solid program."[622] Remarkably all of this was done with just a handful of C-17s. Over the course of 1994, the 437th Airlift Wing received 8 C-17s, possessing just 13 C-17s by December 1994.[623]

**Reaching IOC And Passing RM&AE**

On 17 January 1995, General Rutherford declared the C-17 had reached initial operational capability. The Air Mobility Command had twelve operational aircraft (one backup**),** indicating a certain level of readiness to perform airlift operations**.**[624] At the program's inception what constituted IOC was quite open. Revisions in 1987 and 1988 sought to define IOC in more meaningful terms: "a point in time following delivery of sufficient assets to perform a given mission and following an evaluation to the satisfaction of the commander in the operational environment."[625] It was pegged to the number of aircraft delivered, trained personnel, support system, and a trial period of performance—a capability demonstration. The refinement by Headquarters Air Force Systems Command was a direct result of the bad publicity the B-1B received during initial squadron operations.[626] Headquarters Military Airlift Command grappled with making it specific to the C-17 program. With an early C-17 program management directive defining IOC as the "delivery of [the] 12th production aircraft" and with both the specification and system operational concept documents using different crew and utilization rates, General Cassidy elected to go with a "capability represented by a 12 aircraft C-17 squadron established and trained to conduct operational mission profiles" listed in the C-17 System Specification document and flying at a rate used for the reliability, maintainability, and availability parameters.[627] This philosophy was carried forward in the subsequent IOC revisions codified in the C-17 operational requirements documents. Thus, with 12 aircraft, 48 qualified crews, 65 percent of the maintainers trained in 100 percent of the tasks, the aircraft capable of performing 24 of the 25 mission profiles,[628] sufficient spare parts, and an en route support capability, C-17 SPO Director Brigadier General Kadish and 437th Airlift Wing Commander Brigadier General Hogle advised General Rutherford at the end of December 1994 that IOC requirements had been met.[629]

Billed for years as a milestone event, IOC was really anti-climatic. General Rutherford had wanted it that way, as "no news is good news." Secretary Widnall had agreed, stating the often-used phrase of "troubled" program might end up the focus of the media's coverage, detracting from the event.[630] Their concerns proved well founded. At this time, articles appeared on efforts by Representative Elizabeth Furse (D-OR) and Senators Paul Simon (D-IL) and Dale Bumpers (D-AR) to introduce legislation to cease funding the C-17 program, as the NDAA alternatives were more cost-effective.[631]

After declaring initial operational capability, the Air Force and McDonnell Douglas then gave full attention to the required reliability, maintainability, and availability evaluation. Originally, this "operational readiness evaluation" was to occur 30 days after IOC and was not as extensive as it became. Operational missions were to have been conducted under simulated conditions with all missions originating and ending at Charleston Air Force Base. The main purpose was to verify if the C-17 met or exceeded contractual warranty requirements.[632] As an incentive, the Air Force had offered McDonnell Douglas a maximum of $12 million. "Our intent," as Lieutenant General Johnson recalled from his early days on General Harbour's staff, "was to make everybody be serious about RM&A when we designed the jet. Don't just focus on range and payload and those kinds of things. RM&A was just as important."[633] With the incentive award, McDonnell Douglas engineers would design components for more reliability and maintainability.[634]

Subsequent changes made the evaluation into much more. The 18 January 1989 acquisition decision memorandum stipulated the RM&AE as a key event to the Milestone IIIB, full-rate production decision. In February 1992, Donald Yockey required the Air Force Operational Test and Evaluation Center to incorporate the RM&AE surge phase data into the initial operational test and evaluation final report on the C-17's suitability and effectiveness, submitted to the Office of the Secretary of Defense and Congress. The August 1993 Defense Acquisition Board sessions, led by John Deutch, made the RMA&E into a pass or fail capability evaluation, adding, at this time, a multi-base requirement and making the utilization (UTE) rate part of the evaluation. On the former, McDonnell Douglas took issue on how the various systems would be scored in a multi-location environment and raised reservations on the plan. The Air Mobility Command, General Fogleman, agreed to revise the objective surge UTE rate to 15.15 as a result of better modeling. In January 1994, as part of the Air Force's settlement with McDonnell Douglas, the RM&AE was to be "more operationally realistic," locking in the multi-base. The agreement also uncoupled the RM&AE from the IOC date. It had become obvious that there was not enough time to complete retrofit work so that the RM&AE had 12 like-configured aircraft.[635] Thus, the RM&AE became a critical test (with failure building the case for canceling the program) when the original intent had simply been to ensure the C-17 was as reliable and dependable as the C-141 it was replacing.[636]

As a result, the RM&AE plan needed revision. General Fogleman instructed the Air Mobility Command staff to "plan for success," namely a higher utilization rate. The command would not be cautious or conservative; the evaluation would be as open and honest as it possibly could. He specifically requested that the C-17s demonstrate a wartime surge UTE in excess of 15.2, addressing Dr. Milton Minneman's concerns that the Milestone III cost and operational effectiveness analysis (COEA) UTE rate of 15.2 over 45 days mesh with the RM&AE's rate. Since the RM&AE plan called for achieving a 15.2 surge UTE rate over 48 hours versus the COEA's 45 days, Brigadier General Kadish agreed that OSD would develop an analytical method to project the UTE rate, thus ending the impasse. At issue was the case for the C-17. The Institute for Defense Analyses had published the COEA, stating the C-17 was the most cost-effective based on a 15.2 UTE rate.[637]

In February 1994, Dr. Deutch had used the COEA data to convince the House Subcommittee on Military Acquisition to support the C-17. "The COEA shows that if the same [wartime] UTE rate is assumed for the C-17 as the other aircraft (12.5 hours/day), then the C-17 loses to the C-5B much of its relative advantage in delivering outsize cargo. So, with respect to outsize cargo, high C-17 UTE rates (if achieved) favor the C-17, but low C-17 UTE rates make the C-5B aircraft more attractive."[638]

A tiger team, with members coming from Headquarters Air Mobility Command, C-17 SPO, McDonnell Douglas, and the 437th Airlift Wing, developed a new RM&AE plan that was more operationally representative, namely flying *Mobility Requirements Study Bottom-Up Review Update* scenario missions, which meant longer flights. Cargo loads included 12 Abrams and 14 Sheridan tanks and 12 Bradley fighting vehicles. In 1994 after a series of briefings, Air Force and Defense officials approved the approach. Common data reporting, missions, the mix of missions, and other ground rules were agreed upon. The main sticking points were: Dr. Minneman's desire to have more wartime and fewer peacetime sorties (reasoning the Air Force was buying the aircraft for wartime use) and to actually surge and sustain wartime operations over more days but at a lower rate (14.5) (as analysis would determine all UTE rates). AMC was "gaming" the evaluation in scheduling higher UTE rates, in effect trying to get a mature rate of 15.15 out of an immature aircraft (The fleet would reach maturity after 100,000 flying hours; the RM&AE hours comprised 2 percent). General Fogleman disagreed and insisted upon an evaluation that allowed the C-17 to demonstrate the UTE rates stipulated in the COEA. Darleen Druyun agreed with Fogleman. The OSD staff would also develop a methodology for comparing RM&AE parameters to the mature rate. At the end of May 1994, R. Noel Longuemare, the Principal Deputy Under Secretary of Defense for Acquisition and Technology, expressed his agreement with the Air Mobility Command plan. RM&AE planning had to face certain realities, however. The C-17 was an immature weapon system. McDonnell Douglas' Donald Kozlowski reminded all that it would be best to schedule the wartime segment at the end, as the wartime flying rates may consume too many spares, which were limited at this time.[639] With these issues out of the way, the Air Mobility Command got down to business.

Executing RM&AE fell to the men and women of the 437th and 315th Airlift Wings at Charleston Air Force Base with the Army's participation coming from the XVIII Airborne Corps. The 437th's Commander, Brigadier General Walter Hogle, expressed some years later that initially upon arriving at Charleston he had had strong doubts about the C-17 passing the evaluation, on the order of "No way in hell."[640] There were just too many things that had to be done to the aircraft. But then there was a miraculous turn around; McDonnell Douglas put forth an incredible effort. The corporation was under enormous pressure to ensure the C-17s were ready. The requirement was for the twelve aircraft and one backup to be nearly identical. The first four production aircraft had been test airplanes and required extensive work to standardize them. At one time, there was a list of around sixteen, seventeen hundred items or fixes that had to be accomplished before declaring IOC. The RM&AE would clearly make or break the C-17 program, and people were standing by ready to cancel the program.[641]

General Hogle saw the RM&AE as a good thing, as it introduced competition back into the process. The contractor really had to perform—fix the airplane, make it right. The settlement had just occurred and "McDonnell Douglas and the government had religion. There was no more fingerpointing, backbiting. I was very impressed with the team that we had at Charleston to get the airplane fielded right and to have a successful RM&AE."[642] The C-17 had to pass on its own merits, and General Hogle was clear in his guidance: "our objective was to create an environment in which the airplane could succeed or fail. We didn't want to get in the way. In other words, we wanted to have our maintenance technicians trained so that if a part broke prior to takeoff that they knew how to fix it and knew how to fix it well and were very proficient. So that meant we had to expend a lot of effort to do that." [643] For the crewmembers, it was the same. They needed to be proficient. "Plus you've got a thousand, two thousand, people at Charleston who have committed themselves to this too, and they want the airplane to pass; they want it to succeed. So you're trying to hold them back and keep them impartial."[644] Charleston's enthusiasm for the C-17 came across too well in a few pre-RM&AE news interviews, despite Hogle's counsel.

"RM&AE-are we ready?" asked General Rutherford in October 1994. "No, not today," replied his staff.[645] But preparations were on track for July 1995. McDonnell Douglas had reduced the maintenance discrepancies. The C-17 was performing well. En route system personnel and crews were undergoing training. Besides training for the RM&AE, six issues—the retrofit schedule, spares, software development, jumper entanglement, Army certification of airdrop procedures, and exhaust gas temperature margin—could seriously impact the evaluation, and the Air Mobility Command staff kept a "close watch."[646]

As a prelude to the RM&AE, the Air Mobility Command conducted three readiness reviews: 3-16 November 1994, 13-19 March 1995, and 1-3 May 1995. McDonnell Douglas had wanted a "mini-RM&AE" at least 6 months prior in order to correct what deficiencies might arise. The first readiness review also enabled the commander of the Air Mobility Command to assess whether aircrews and the support structure were ready for declaring initial operational capability. In November, seven C-17s simulated 10.5 days of peacetime and 3.5 days of wartime operations. In the March review, a highlight was the first-ever engine running offload of a M1A1 tank (120,000 pounds) in a simulated forward operating base in the Mojave Desert. P-14 made the landing in 2,650 feet. In May in over three days of wartime operations, twelve C-17s flew 85 sorties logging over 521 hours, achieving a wartime UTE rate of 14.48 hours and two wartime surges of 16.17 and 16.62.[647] The C-17 was ready for its final exam.

Dropping 16,000 feet[648] per minute, Pilot Red Millander and Copilot Kyle Fields had the 418,000-pound C-17 in a tactical descent. The desert terrain loomed larger. At 4,000 feet, Millander slowed the plane and aimed for the Barstow-Daggett airstrip in the middle of the Mojave Desert. Touchdown! Millander stood on the brakes. The plane's thrust reversers took hold. Millander and Fields achieved the shortest landing that week, 1,900 feet, as the C-17 was put through its paces during the reliability, maintainability, and availability evaluation.[649]

Conducted between 7 July and 5 August 1995, the evaluation compared the actual performance of the C-17 against design requirements in both peacetime and wartime scenarios, 23 and 7 days, respectively. It also provided additional data to support the initial operational test and evaluation, demonstrated potential surge rates, and yielded data for computing a mature C-17 fleet UTE rate. Twelve primary and one back-up aircraft participated, flying airdrop; airland; small, austere airfield operations; air refueling; formation; and low-level missions. LAPES was not tested, as the Army no longer required it. C-17s operated from seven locations, including RAF Mildenhall, United Kingdom.[650]

"I believe there is little doubt that the C-17 has passed the test," remarked General Rutherford at the conclusion.[651] When the evaluation ended on 5 August, the Globemaster IIIs had flown 513 sorties and logged 2,259 flying hours, exceeding UTE rates and achieving departure reliability and full mission capable rates of 99.2 and 85.1 percent, respectively. The C-17 airlanded a total of 5,015.7 tons and 2,791 personnel, airdropped 345.8 tons and 3,243 paratroopers. The RM&AE proved a resounding success with the C-17 passing all but one of eleven test categories. As expected, false indicators from the built-in test (BIT) system were unacceptable. Additionally, since the Air Force and McDonnell acknowledged that the onboard inert gas generating system was not a mature system, it was excluded from evaluation. Based upon the results, the McDonnell Douglas Corporation received an incentive award of $5.91 million versus the maximum possible amount of $12 million.[652]

***RM&AE Results***

| *Parameter* | *Required* | *Actual* |
|---|---|---|
| Overall Launch Reliability | NA | 99.2 |
| *Reliability* | | |
| Mean Time Between Maintenance Corrective | 0.62hr | 1.56hr |
| Mean Time Between Maintenance Inherent | 1.29hr | 3.42hr |
| Mean Time Between Removal | 2.22hr | 7.45hr |
| Mission Completion Success Probability | 85.7% | 97.8% |
| *Maintainability* | | |
| Mean Manhours to Repair | 8.2hr | 2.7hr |
| Mean Manhours per Flight Hour | 28.4hr | 4.26hr |
| Built-in Test Fault Detection | 95% | 98.6% |
| Built-in Test Fault Isolation | 90% | 95.2% |
| Built-in Test False Indication | 5% | 59.9% |
| *Availability* | | |
| Full Mission Capable | 72.9% | 85.1% |
| Mission Capable | 80.7% | 90.6% |

| | | |
|---|---|---|
| *Utilization Rate* | | |
| Peacetime | 4.07hr* | 4.32hr |
| Wartime Sustained | 12.25hr* | 12.71hr |
| Wartime Surge (Day 1, 2) | 15.2hr* | 16.6/17.1hr |

*These were the planned; the required were 3.2, 10.0, and 12.5/12.5, respectively.

Source: Briefing, HQ AMC/XPQC, "C-17 Reliability, Maintainability and Availability Evaluation (RM&AE)," 11 August 1995; Letters w/atch, Gen Ronald R. Fogleman and Sheila E. Widnall to Ted Stevens and Strom Thurmond, [RM&AE Results], 10 August 1995.

Not everyone was pleased. The General Accounting Office criticized. "The RM&A evaluation was less demanding than originally called for in the contract specifications and the 1992 draft RM&A plan." "The revised mission profiles in the final RM&A plan increased the total number of flying hours, number of aircraft sorties, and average wartime sortie duration, . . .. The impact of these changes was longer duration wartime sorties and a reduced ratio of sorties to flying hours, resulting in less stress on the RM&A aircraft than originally planned." The evaluation "did not demonstrate what a mature C-17 fleet would do during 45 days of wartime surge operations. The evaluation simply demonstrated that high utilization rates could be achieved over a 48-hour period." "In awarding the $5.91-million fee, the Air Force gave the contractor credit for meeting the full mission capable goal. In our opinion, none of the aircraft should have been considered full mission capable during the evaluation. First, the Air Force, based on the results of developmental testing, had restricted the aircraft from executing the formation personnel airdrop mission under operational conditions for safety reasons. . . . Second, the aircraft were not considered effective for the aeromedical evacuation mission, which was not completely tested during the RM&A evaluation."[653] The GAO report asserted that McDonnell should receive $750,000 less due to the performances in formation personnel airdrop and aeromedical evacuation.

In 1994 at the request of Representative Norman D. Dicks (D-WA), the GAO had gotten very involved in the RM&AE reviewing the planning effort and monitoring execution. General Rutherford had even invited them to "assist with the evaluation and look over our shoulder."[654] But the GAO had not availed the opportunity. The Air Mobility Command found the GAO's criticism after the fact unwarranted. Colonel Evans, who was Headquarters AMC's representative at Charleston during the preparation for the RM&AE, recalled:

> The biggest problem with the RM&AE, not from our perspective, but from the critic's perspective was that it was characterized as a "stacked deck." From the AMC perspective, it was fair. [RM&AE], It's a very important thing. It's not something you're going to do lightly. It makes sense to

> prepare. It even makes sense to practice once or twice, which is what we did. When we finally got to this thing, we did it well. Well, from the GAO's perspective, it was we practiced and greased every possible skid.[655]

From Brigadier General Hogle's viewpoint: "We prepared for it to get the best airplane we possible could. I was absolutely floored at the effort that the company put in to fix things that were wrong—and the dedication of our people to get it right." "The proof is in the airplane we have today, and it's a marvelous airplane. And it keeps getting better, so I'll take the criticism."[656] Had General Hogle not trained his wing as he did, McDonnell Douglas could have legally claimed any failure was due to the Air Force's lack of support. Moreover, was the evaluation not akin to an Inspector General's operational readiness inspection that wings had prepared for in the past? Maintainers, logisticians, planners, aircrews, and the en route system all had to train up to a high level of proficiency so that the C-17 could succeed or fail on its merits. Any blame should not come back to 437th and 315th personnel. The RM&AE certainly made the C-17 mission capable quicker. And the fixes that McDonnell made were enduring improvements to the airplane.[657] Subsequently, the C-17's performance during Bosnia (Operation Joint Endeavor) confirmed the results of the RM&AE, taking the sting out of the GAO's criticisms. And Representative Dicks was more inclined to support the C-17 as Boeing* and McDonnell Douglas discussed merging.

The whole RM&AE experience also raised questions of how future aircraft acquisition programs should conduct evaluations. The C-17's evaluation represented a first. The GAO criticisms and claims that it was not valid for determining wartime utilization rates had some merit. Most would agree with Lieutenant Colonel James Allen:

> If you want to realistically test out an airplane, surge it for a week or so under wartime conditions and find out how it will really perform under those conditions.
>
> There is a fiscally responsible side to it, too, that you have to consider. Stretching it out is not necessarily the right answer, but we do have to design a RM&AE that at the same time will show the surge capability of the aircraft and perhaps the routine day-to day-operability of the aircraft. Maybe two parallel RM&AEs rather than one that combines both.[658]

The C-17's RM&AE was one of the most intensive service evaluations ever for a new Air Force aircraft.

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*In 1997 McDonnell Douglas merged with The Boeing Company.

## Milestone IIIB-DAB Decides

In addition to the C-17's operational performance and program improvements, the findings of the revised *Mobility Requirements Study* and the *Strategic Airlift Force Mix Analysis* suggested a favorable outcome for the C-17 program when it faced the fall Defense Acquisition Board Milestone IIIB session. In 1995, the Joint Staff released an update (U) of the 1992 *Mobility Requirements Study* (MRS), which incorporated the Clinton administration's "bottom-up" review (BUR) of national defense, called MRS BURU. Using a fiscal year 2001 force structure,[659] MRS BURU reviewed airlift, sealift, and prepositioning requirements against four specific scenarios, analyzing the cost and risk aspects of each.[660]

With regard to the Air Mobility Command's strategic airlift responsibilities, MRS BURU recommended a range of 49.4 to 51.8 million-ton-miles per day to support two nearly simultaneous major regional contingencies (MRC), the most demanding scenario. This scenario assumed a moderate risk. The Air Mobility Command was projected to attain the goal of 49.4 MTM/D in fiscal year 2006 with some 31 MTM/D coming from the fully mobilized military airlift fleet and the remainder from activating the Civil Reserve Air Fleet. According to MRS BURU, this equated to a need for 120-140[661] C-17 equivalent aircraft. Since the C-5 was not the equivalent but an alternative to the C-17, this study seemed to portend a C-17 decision. MRS BURU also recommended increases in the CRAF.[662] MRS BURU was deliberately optimistic in its assumptions with regard to the warning time, decision to deploy, call-up of the air reserve component and CRAF Stages I and II, use of CRAF III, and the time available to position mobility assets. This was done to identify the minimum number of resources required in a fiscally constrained environment. Late in March 1995, Secretary of Defense William J. Perry signed the MRS BURU document, forwarding it to Congress. MRS BURU fed into the *Strategic Airlift Force Mix Analysis* effort. While MRS BURU figured out the total airlift requirement, the latter advised on the mix of C-17s and NDAAs. A subsequent examination of MRS BURU by the Joint Warfighting Capability Assessment (JWCA), which periodically reviewed and adjusted mobility requirements, resulted in JCS Chairman General John M. Shalikashvili recommending in March 1996 a "point solution" of 49.7 MTM/D.[663] Fifteen years earlier, at the C-17 program's inception, the *Congressionally Mandated Mobility Study* had settled on a fiscally constrained airlift requirement of 66 MTM/D.

Requested by Dr. Deutch in the 1994 acquisition decision memorandum, the *Strategic Airlift Force Mix Analysis* evaluated the operational effectiveness and costs of the various nondevelopmental airlift aircraft and served as the "tailored cost and operational effectiveness analysis" (COEA) for the November Milestone IIIB decision. SAFMA results determined the type, configuration, and number of NDAAs that would complement the final number of C-17s selected. It was one of many factors that Dr. Deutch considered for the DAB decision.

The Air Mobility Command's Analysis Flight was responsible for conducting the SAFMA. As a starting point, an analyst team headed by David Merrill, used the cargo and passenger requirements stated in MRS BURU. All of the threat and scenario assumptions also came from MRS BURU. Using the Mobility Analysis Support System for modeling and conducting thousands of computer simulations, the study centered its analysis on the halting phase of the most exacting scenario, namely Northeast Asia with its limited infrastructure, in a two-major regional contingency scenario. The most demanding category of cargo in this scenario proved to be outsize. The SAFMA measured the amount of outsize, oversize, and total cargo moved in the halting phase and compared force mixes[664] against each other and not specifically C-17s against NDAAs.[665]

As directed, the SAFMA also examined such constraints as maximum [number of aircraft] on the ground (MOG) and utilization rates. Unlike the Institute for Defense Analyses' COEA, SAFMA assigned higher UTE rates, longer ranges, and shorter ground times to the NDAA-type aircraft. Because of the outsize requirement, which the commercial NDAA did not possess, the analysis determined that the military needed to have, at a minimum, 86 C-17s along with 104 C-5A/Bs to meet or exceed the outsize requirements of the MRS BURU and the two MRC scenario. To reach the MRS BURU requirement of 120 C-17 equivalents, the SAFMA found satisfactory mixes of 86 C-17s and 30 C-33s (B-747-400), 100 C-17s and 18 C-33s, or 120 C-17s and no C-33s. To attain the 140 C-17 equivalents, the SAFMA disclosed mixes of 100 C-17s and 44 C-33s, 120 C-17s and 24 C-33s, 132 C-17s and 18 C-33s, and 140 C-17s and no C-33s. While the C-33 was less costly and generally did not affect MOG constraints at C-17 offload points because it used other less constrained offload locations, it meant accepting a risk below the moderate risk level due to the C-33's lack of an outsize capability. Analysis showed no C-5Ds desirable because of the aircraft's difficulty in operating in a MOG-constrained environment. UTE rate analysis did not favor one force mix over another due to system constraints, which would prevent aircraft from flying their wartime UTE rate of 15.15. To achieve the 52 MTM/D, 140 C-17s and 0 C-33s was the most cost-effective solution. While a mix of 86 C-17s and 30 C-33s was the most cost-effective in achieving the 49.4 MTM/D, it did not provide for a strategic brigade airdrop, intratheater airlift operations, nor lesser regional contingencies that focused on peace enforcement operations. The *Tactical Utility Analysis* study evaluated these airlift requirements.[666] The SAFMA study concluded:

> As all analysis to date stands, there is no existing substitute for the C-17 if that program is cancelled. There are no combinations of C-5Ds and/or C-33s that can provide the equivalent of 120 C-17s (or certainly not 140 C-17 equivalents). This analysis finding suggests that the continuation of the C-17 program beyond 40 aircraft is the only means of meetings MRS BURU requirements.[667]

Per the 14 December 1994 acquisition decision memorandum, OSD's Program Analysis and Evaluation staff, headed by William J. Lynn III, undertook a C-17 study centering on areas outlined in the Defense Planning Guidance but not addressed in MRS BURU, namely intratheater lift, direct delivery, strategic airdrop, and lesser regional contingencies. Named the *Tactical Utility Analysis* (TUA), the classified study evaluated mixes of C-17s and NDAAs and complemented the SAFMA's strategic focus. As directed, the Air Force and the Army provided inputs to the TUA.[668] Both the SAFMA and TUA played a significant role in the DAB process, as the studies would baseline the C-17 fleet. The Army and the Air Force asserted that the OSD Program Analysis and Evaluation staff should consider the tactical unit movements as additive to the C-17's strategic airlift baseline requirement. Moreover, the TUA should encompass all C-17 theater requirements—from the small units moves of a multiple launch rocket system battalion or Patriot missile battery to larger units like the 101st Airborne Division.[669] TUA results ranged from small numbers of C-17s for intratheater movements to over 100 additional aircraft.[670]

Meanwhile, the Air Mobility Command had produced an operational requirements document for the non-developmental airlift aircraft, and the NDAA System Program Office, headed by Daniel L. Kugel, released the formal request for proposal on 31 March 1995. The NDAA's course hinged on the C-17 Milestone IIIB decision. If the C-17 buy was large enough to meet the military-unique requirements, such as airdrop and outsize loads, then a NDAA might only be needed for the bulk and oversize requirements, namely a C-XX. If the C-17 buy was not sufficient to meet the military-unique requirements, then a NDAA would have to fulfill that requirement as well as bulk and oversize—the C-XY. Initially, eleven[671] companies or teams responded to the sources sought announcement. Subsequently, the C-5D, an upgraded B model, was the only aircraft competing in the C-XY military derivative category, while the DC-10-30F, B-747-400F, and MD-11F were the primary contenders for the C-XX, the commercial freighter derivative. In the end, only Boeing offered their B-747-400F in two configurations, modified and unmodified. The modified version, which increased the side opening, strengthened the deck floor, and added a crew-escape door, loadmaster station, and military avionics, was capable of transporting the Army's family of medium tactical vehicles. B-747-400F unit flyaway costs were given as $157.4 million (30 aircraft) while the C-5D was $194.1 million (50 aircraft).[672]

On the NDAA option, the Army's senior leadership weighed in. Following the January 1995 Joint Requirements Oversight Council session, which endorsed the NDAA, Army Chief of Staff Gordon R. Sullivan related the Army's position to his service counterpart, General Fogleman, "We continue to believe that the procurement of 120 C-17s is the optimum solution to the Army's airlift requirement. Again, if a mixture of C-17 and NDAA is mandated, this fleet must meet Army strategic airlift requirements reflected in the C-17 ORD [operational requirements document] and Army War plans."[673] The JROC granted Fogleman approval authority for the NDAA ORD. General Sullivan wanted to ensure there would be "no ambiguity" on the Army's position due to the council supporting the NDAA.[674]

General Rutherford expressed concern over what a C-XX might due to the Civil Reserve Air Fleet program and asked why buy NDAAs when the command had CRAF Stage III available but not activated until late in the second scenario of MRS BURU? His staff responded:

> With an objective of reaching the MRS BURU goal of 49 to 52 MTM/Ds, the mobility community needs to ensure that it is moving the 'right kind of MTMs.' Most notably, the MRC(W) scenario halting phase demands large amounts (70%) of outsize and oversize cargo arriving into an infrastructure (MOG) constrained environment. The C-17 performs this role better than any other aircraft, but if I have to add another type, an oversize capable NDAA, flying thirteen hours per day, is superior to a bulk-only CRAF carrier on contract for ten hours per day. When airplanes only deliver excessive bulk in the halting phase, adding this type of aircraft only tends to 'clog up the system' and keep more critical outsize and oversize cargo from arriving in a timely manner.[675]

There were also other considerations, which Desert Shield/Storm operations had highlighted, specifically the disruption to the commercial airlines as well as the many private industries dependent upon "just-in-time" delivery. Edward Driscoll remained adamant that the NDAA would "decimate" the CRAF program. UPS, likewise, publicly stated it did not think much of the commercial NDAA idea.[676] Certainly, buying commercial NDAAs impacted the CRAF. The Air Mobility Command directorate that oversaw the CRAF program had already concluded so. The CRAF program was critical to national defense, and General Rutherford desired to minimize the impact. At the August Milestone III Steering Committee meeting, Rutherford disclosed he was "intensely" concerned about the perception of the NDAA competing with the CRAF and secured agreement for the Air Mobility Command to provide courses of actions. Options included transferring more business flown by the retiring C-141s, decreasing flying hours programmed for the organic fleet, and increasing transportation dollars so more users would use airlift. All had trade offs; reducing organic flying hours affected rated force management, for example.[677]

"XP, Who is working NDAA above and beyond procurement of A/C [aircraft]," General Rutherford asked Brigadier General Bobby Floyd in May 1995.[678] It was an indication of just how uncertain things remained. Rutherford wanted to cover the bases. A more developed NDAA concept of operations plan followed. Commercial NDAAs raised a number of management problems that encompassed maintaining crew proficiency, maintenance, supply, basing, and the like.[679]

In contrast to General Rutherford's planning, both Lockheed and Boeing were unsure and wary that the government was seriously considering the NDAA. Pro-C-17 statements by Perry, Widnall, and Fogleman could have led to such a conclusion. The DOD had also sent a mixed signaled on the NDAA when it approved an Air Force request to cut $394 million from the NDAA's fiscal year 1996 program to address a funding shortfall in Army readiness accounts. Nevertheless, last minute efforts took place. Boeing offered a lease-to-buy arrangement as a quicker and cheaper way to get more airlift, generating congressional interest. Lockheed sought to refute the SAFMA analysis that showed the C-5 as performing poorly in a MOG-constrained environment.[680] But it was also hard for Lockheed to counter skepticism over an improved C-5 with the C-5As/C-5Bs posting such low mission capability rates. Further, the C-5D was regarded as a fallback option, coming into play only if the C-17 program were canceled. In 1995, with C-17 costs[681] down, aircraft deliveries ahead of schedule, and the program meeting performance specifications, a C-5D was ever more unlikely. Although six C-17s had flown nonstop to the Middle East in August, there was, however, an embarrassing day in September when the C-17 fleet stood down due to broken or missing bolts in the fan thrust reverser hinges while trying to support the Caribbean hurricane relief efforts.[682]

Thus as fall approached, the real question became how well would the C-17 fare against the B-747. Pre-briefings and reviews in September went well. The Joint Requirements Oversight Council chaired by Admiral William A. Owens, Vice Chairman of the Joint Chiefs of Staff, revalidated the C-17's key performance parameters as part of preparations for the Defense Acquisition Board. The JROC principals gave Dr. Kaminski a strong endorsement: "The nation requires the military unique airlift capabilities provided by the C-17."[683] The C-17 offered operational flexibility. It met current and future CINC requirements. The JROC was not interested in NDAAs. Admiral Owens was a board member of the DAB.[684]

The Army was also very clear in its position. Above all, it wanted the C-17 and only the C-17. Army Chiefs of Staff General Sullivan and General Dennis J. Reimer did not waiver. Army Vice Chief of Staff General Ronald H. Griffith had carried that message during the September JROC session. Griffith had even sought specifying a minimum number of C-17s to the DAB.[685] The Army did secure Air Force support for having the DAB consider including theater unique lift requirements.[686]

> When intratheater airlift requirements are superimposed upon the dual MRC force closure timeline, the impact of these intratheater airlift movements is clear (TAB A). The impact is an additive C-17 requirement, above the C-17 force closure requirement. In order to make this procurement decision, the TUA intratheater impact must be portrayed to the DAB. Based on operational concerns, the Army strongly cautions that decisions about the future composition of the nation's airlift fleet cannot be made with the assumption that the C-5 will be useful for brigade airdrop of either personnel or equipment. The Joint Staff supports the Army position.[687]

Meeting on 3 October, the four service chiefs supported an all C-17 solution in keeping with the regional warfighter commanders' recommendation, rejecting the NDAA.[688] Things appeared to be falling in place for the C-17.

However, the 20 October session of the C-17/NDAA Overaching Integrated Product Team caused uneasiness. "From questions and discussions, it's apparent this group is not as swayed by clear tactical advantages that 120 C-17s provide. (Surprise, Surprise!)

They appear to be more concerned about costs and the need to keep competitive pressure on MDA [McDonnell Douglas Aircraft]," Major General Hogle related to General Rutherford.[689] Most of the attendees were from the OSD staff. Darleen Druyun and Major General Childress were the senior Air Force persons attending. CRAF issues received much attention as well, with more research desired on getting commercial CRAF carriers to buy and operate B-747-400Fs. When Dr. George R. Schneiter, the OSD Director for Strategic and Tactical Systems, polled the principal attendees, Druyun and the JCS's representative roundly favored 120 C-17s and no NDAAs while OSD's representatives (Program Analysis & Evaluation, Economic Security, and Cost Analysis Improvement Group) were very much in favor of keeping some pressure on McDonnell Douglas and in supporting, at a minimum, a buy of C-33s (non-recurring engineering variant[690]).[691] Also at this time, the Congressional Budget Office released its *Options For Strategic Airlift*, which concluded a mixed fleet was $8 to 9 billion cheaper. Ron V. Dellums (D-CA), the ranking democrat on the House Committee on National Security, had requested the study.[692]

On 31 October and 1 November 1995 under the chairmanship of Dr. Paul Kaminski, the Under Secretary of Defense for Acquisition and Technology, the Defense Acquisition Board convened and considered solutions to airlift requirements. Noel Longuemare, Admiral William Owens, George Schneiter, Philip Coyle, Dr. Edward Warner, William Lynn, John Hamre, Admiral William Bowes, Gilbert Decker, and Darleen Druyun would advise Kaminski whether to purchase additional C-17s or combinations of C-17s and NDAA aircraft. Logic decided the outcome.

"It is clear that of the available options, the C-17 provides the greatest amount of flexibility to meet the nation's requirements at an effective, albeit marginally higher, price than the alternatives that came closest to meeting the requirements. All analysis indicated that a substantial number of C-17s beyond 40 are required to meet strategic and tactical missions to achieve acceptable levels of risk in any of the approved scenarios," Under Secretary Kaminski wrote in the 3 November acquisition decision memorandum.[693] On this basis he approved the C-17 program entering full rate production with a total procurement of 120 aircraft. Only William Lynn, advocated buying B-747s.[694] The C-17 had surmounted its last obstacle. Uncertainty had shadowed the program ever since its inception in 1979.

The rationale behind the decision was as follows. The DAB members regarded the C-17 as best providing the greatest amount of flexibility in meeting the strategic airlift requirements. MOG along with austere and outsize capabilities were critical considerations. McDonnell Douglas' program improvement was another key consideration (Since the end of June 1994, with the delivery of P-13, all aircraft deliveries were ahead of schedule.). Further, it did not make sense to procure small numbers of commercial NDAAs (C-33), as 18 C-33s would transport about a fifth of what the CRAF did at a comparable or slightly higher cost. It was more prudent to work through the CRAF for more wide-body capability. Nor did the C-5 prove to be a cost-effective option. The DAB made its decision taking into account the results of the SAFMA, MRS-BURU requirements, the TUA, the initial operational test and evaluation, and the contract specified reliability, maintainability and availability evaluation,which the C-17 had successfully completed in the summer of 1995, sustaining a departure reliability rate of over 99 percent.[695]

The 3 November 1995 Defense Acquisition Decision Memorandum directed the Air Force to develop and analyze a multi-year procurement alternative for the C-17 program. Accordingly, the DAB met again in January 1996 to consider an Air Force proposal to buy the remaining 80 aircraft and engines now over a seven-year period: 8, 9, 13, 15, 15, 15, and 5 aircraft between fiscal years 1997 and 2003. The multi-year procurement strategy would provide considerable savings, and on 1 February, Dr. Kaminski gave his consent in a memorandum to Secretary Widnall.[696]

Congress approved it as well but not without inserting language that ensured the government would be protected from paying McDonnell Douglas and its subcontractors any termination fees if the program incurred difficulties. Subsequently, on 31 May 1996, the Air Force signed contracts with the McDonnell Douglas Corporation and its subcontractors to purchase 80 C-17s over seven years. The multi-year contracts were valued at $16.2 billion and included $1.7 billion for 350 Pratt & Whitney engines (thus $173 million per aircraft unit). As stated, the long-term commitments would enable the Air Force to save over $1 billion.[697]

In 1997, General Walter Kross in his capacity as the Commander-In-Chief of the United States Transportation Command set the stage for securing more C-17s based upon C-17s needing to replace the retiring C-141s performing the special operations low level II (SOLL II) mission. The United States Special Operations Command had a validated requirement for airlift to support special operations. When Defense Secretary Cheney cut the program to 120 C-17s, only the strategic lift portion was considered. General Kross made the oversight known to Secretary of Defense Perry. To support the SOLL II mission from the 120 C-17s would have resulted in a three-day delay in closing a Desert Shield/Storm type of operation. There was general support for the initiative at the Air Force and OSD levels as well as in Congress. Thus, with congressional approval, the C-17 program expanded to 135 aircraft in 1998.[698]

**Disproving The Nay Sayers**

"In 10 years the country will be glad we bought the C-17," so remarked Secretary of the Air Force Dr. Sheila Widnall as Air Force and McDonnell Douglas principals grappled with resolving the program's difficulties in November 1993.[699] She was wrong. It did not take ten years. Operational missions throughout 1994 and 1995, which took the C-17 around the world, indicated to many that despite the program's problems, the plane was very reliable and capable of living up to its strategic and tactical roles, although meeting Army requirements for formation airdrops and dirt strip landings were still unresolved. Then, Bosnia, Exercise CENTRAZBAT, and Kosovo airlift operations confirmed C-17 expectations.

Joint Endeavor was the NATO deployment into Bosnia-Herzegovina and surrounding areas following the Dayton Peace Accords. Executed during the dead of winter, the operation placed the C-17 into its first demanding, real-world peacekeeping mission. C-17s flew both strategic and tactical airlift missions. Initially, the United States European Command planned on using theater-assigned ground and air assets to move personnel and equipment from Germany into Hungary and Bosnia without an extensive reliance on strategic airlift. A French railway strike, the holiday season with increased rail travel, and adverse weather thwarted the concept of operation. As a result, the Air Mobility Command/United States Transportation Command positioned C-5s, C-141s, and C-17s at Rhein-Main Air Base, Germany, to fly down range as needed. Twelve C-17s were dedicated to intratheater requirements.[700]

Despite being an immature weapon system, the C-17 gave a good accounting. The C-17 outperformed the C-141, achieving a peak day of 1.8 million pounds of cargo moved into Bosnia and Hungary while the C-141's peak day was 565,000 pounds.[701] According to Air Mobility Command statistics, the C-17 flew 26.6 percent of the intratheater missions (494), moving 31.3 percent of the passengers (2,965) and 55.9 percent of the cargo (17,279 short tons).[702] "We made believers of a lot of folks who had not been necessarily in favor of the C-17. A lot of people suddenly realized the value of the airplane—its ability to get in and out of smaller runways with narrow taxiways and parking ramps, its turn ability, its roll-on roll-off loading capability, its large outspace cargo capability, plus its heavy lift ability makes it an ideal candidate for something like going into Bosnia," Major General Charles H. Coolidge Jr. expressed. He had served as the director of mobility forces and NATO's director of the regional air movement coordination center.[703] The C-17 drew high praise from President Clinton. He was especially impressed with the C-17's performance as he toured US bases, flying aboard the aircraft.[704]

When flooding at the Sava River halted the Army's ground movement of 20,000 soldiers and tanks into Bosnia. C-17s quickly airlifted into the airfield at Taszar, Hungary, 25 pontoon bridge sections (32,000 pounds each), enabling the engineers to complete the bridge and the road march to continue without great delay. Transporting the sections via river barges from Germany would have been too slow. The rail system was unreliable, and Army flatbed trailers could not haul the oversized sections through the German autobahn tollbooths.[705] The C-17 also transported for the first time a 40-foot sideloader for taking containers off railroad cars. The C-5 had never moved the loader because of its unusual dimensions. With a taller and squarer cargo bay, the C-17 could and took it into Taszar.[706]

The C-17 was also the only aircraft capable of flying outsize cargo into Sarajevo, Yugoslavia. Although 8,530 feet long, the runway only had a useable length of 5,860 feet due to the existence of a tunnel under the runway. While the situation reduced the C-141's cargo carrying capacity, the C-17 could land fully loaded. The C-17's quick offload capability surprised the French, Lieutenant Colonel Joseph M. Reheiser recalled. With only a few forklifts, it was taking them 30 minutes to unload a C-130, carrying four cargo pallets, some 34,000 pounds. When the French got word to expect a C-17 with 18 pallets, they scheduled an hour ground time. The C-17, however, disgorged its 154,000-pound load and was airborne again in 31 minutes after touching down, taking less time to unload than the C-130. The accomplishment was a tribute to the loadmasters, who had been intimately involved in designing the aircraft's backend. That they had been successful in increasing the C-17's productivity was repeatedly demonstrated during Joint Endeavor.[707]

The C-17 served as the workhorse in Bosnia, as the airfield at Tuzla could not accommodate the C-5. Although it was possible to land a C-5, the 50-foot wide taxiway did not provide sufficient room for it to taxi off the runway, and the runway was too narrow for the C-5 to turn around. It could not offload without closing the airfield. As a result, the C-17 flew in the self-propelled 155mm howitzers, Bradley fighting vehicles, snowplows, and other large items, frequently backing up to maneuver under the tight ramp conditions. Engine running offload ground times averaged just 23 minutes. C-17 aircrews gained experience in performing steep tactical approaches to avoid ground fire.To ensure adequate protection from shoulder-launched missiles, four additional C-17s received airlift defensive systems under an accelerated effort for a total of nine aircraft, disproving those who had claimed the C-17s would not operate in threat environments. Besides the ground fire threat, the weather proved challenging. Yet, using global positioning system approaches, C-17s were able to match the low altitudes capability of the adverse weather aerial delivery system radar-equipped C-130s. Weather also disrupted plans for three C-17s to fly nonstop from Travis Air Force Base, California, to Tuzla. Only one C-17 made the 14.5-hour flight all the way, offloading 40 tons of fence posts to mark mine fields.[708] It was another demonstration of the C-17's potential for directly delivering critically needed materials to austere, forward locations from a continent away, bypassing the traditional transshipment from main operating bases in a theater.

When Joint Endeavor commenced in December 1995, the C-17 operational fleet numbered 18 aircraft. The weapon system was still maturing. As a result, the C-17 SPO, McDonnell Douglas, and the San Antonio Air Logistics Center provided additional assistance, deploying a team to Rhein-Main Air Base. Bosnia brought some operational deficiencies to light quicker. On numerous occasions, the anti-ice system shut down due to nuisance faults. The pressure switch was too sensitive, requiring a fleet-wide replacement. A faulty sensor caused the engine bleed air system to fail in flight, disabling the engine anti-ice system on the affected engine. A new design solved the problem of moisture and contaminants building up. Engine blades on four aircraft received foreign object damage (FOD) due to ingesting ice. The balky and immature on-board inert gas generating system (OBIGGS) was kept operational through a deluge of spare parts, confirming once again the need for redesigning the system. The aircraft's satellite communications were rated marginal. Bosnia showed the necessity for the C-17 to possess an autonomous self-contained precision approach landing system. Bad weather at Tuzla had hampered efforts to bring in precision approach equipment and then once delivered, the weather needed to clear before it could be tested. Despite these operational issues, the C-17 sustained high departure reliability and mission capable rates, 96 and 85.3 percents, respectively.[709] Joint Endeavor verified the results of the RM&AE. With the same number of C-17s, "we flew almost exactly twice the number of sorties in Joint Endeavor as in the RM&AE and had almost exactly the same results," related Colonel

Art Rooney, 437th Logistics Group Commander.[710] Bosnia effectively silenced the C-17's critics; words of praise became the norm. There was no longer any doubt that the C-17 would airlift outsize equipment into small, austere airfields.

C-17s decisively demonstrated their direct delivery capability during exercise CENTRAZBAT '97 (Central Asian Peacekeeping Battalion). Departing on 14 September 1997 from Pope Air Force Base, North Carolina, eight C-17s—two loaded with heavy equipment and six for personnel drops of over 500 troops—flew direct via three air refuelings to Shymkent, Kazakhstan, delivering a battalion-sized combined joint task force on 15 September. The C-17s traveled a distance of 7,897 nautical miles in 19 hours and 23 minutes. It was a powerful statement on the United States' ability to execute a rapid combat response. This mission also ranked as the longest airdrop operation (in distance). The joint jump of paratroopers from the United States, Uzbekistan, Kazakhstan, Kyrgyzstan and Turkey fostered cooperation between NATO and countries of the former Soviet Union. On a more basic level, unlike the C-141 and the C-130, the C-17's cavernous interior afforded the paratroopers an opportunity to shed their packs, stretch out, and rest on the long flight over, rigging for the drop a few hours beforehand.[711]

In 1999, the United States and its NATO allies sought an end to the ethnic cleansing of Albanians from the Kosovo province in Yugoslavia. The C-17 played a significant role and built upon its growing reputation. As they had after Bosnia, congressional leaders and defense officials extolled the aircraft's performance. C-17s merited such praise for flying 799 of the 1,108 strategic airlift mission; the C-5s and the C141s flew 205 and 104 missions, respectively, with the commercial carriers performing another 66 missions. In the intratheater role, essentially to support Task Force Hawk and Falcon deployments, C-17s flew 468 missions while the C-130s racked up 269 missions, but just in the former. C-17s executed 253 Falcon missions.[712]

As the plan unfolded, 12 C-17s from Charleston along with 30 aircrews forward deployed to Ramstein Air Base, on 18 April 1999 to move Task Force Hawk from Germany to the Rinas Airport in Tirana, Albania. Task Force Hawk contained: 24 Army AH-64 Apache helicopter gunships, support helicopters, a multiple launch rocket system artillery battalion, a support battalion, a mechanized infantry company, a military police company, a signal company, military intelligence, aviation maintenance, and other support elements. Along with the Apaches, the C-17s airlifted 58 M2 Bradleys and 36 M1 Abram tanks. Initially, flights into Tirana were restricted to day visual flight rules conditions due to the lack of radar and adequate instrument approach capability. Within two weeks, the situation was rectified, providing the C-17s a 24-hour capability. The C-17s flew on an average some 20 sorties/missions a day for Task Force Hawk and also supported humanitarian relief missions into Greece, Operation Shinning Hope.[713]

Operations into Rinas Airport, Albania's capital airport, further demonstrated the C-17's superior capability in operating into a small, poorly equipped airfield with outsize cargo loads. While Rinas only had a single, narrow runway (paved), the major problems were limited taxiways, parking areas,and an abundance of mud.

For this constrained environment, the C-17 was especially well suited. C-17s discharged rolling stock with ground times of less than 30 minutes. One C-17 flew in four times the cargo and could fly farther than a C-130, the other transport plane flying into Tirana's Rinas Airport. The C-17s and C-130s chalked up a combined launch reliability rate of 93 percent. Airfield conditions at Rinas, however, resulted in numerous tire cuts and eight foreign object damage incidents.[714]

In June, with the need to deploy Task Force Falcon (elements of the 1st Infantry Division, the US Army contingent to the peacekeeping effort) to Skopje, Macedonia and redeploy some of Task Force Hawk to Germany, 12 C-17s and the necessary crews made it possible. The C-17s flew 16-hour missions with extra pilots and loadmasters augmenting the crew. Again as in the Hawk movements, backing maneuvers and engine running offloads became the normal routine for the C-17s. In deploying Task Force Falcon, C-17s hauled into Skopje 70-ton M1 tanks and Bradley fighting vehicles. Pilots got good training in landing at faster speeds and in handling the aircraft on the ground with such heavy cargo loads. For Task Force Falcon, C-17s transported 2,525 personnel and nearly 11,886 short tons while achieving a launch reliability rate of 95.8 percent. No major problems occurred in supporting the C-17s during Kosovo.[715]

Lessons learned reports advocated adjusting logistical support policies as C-17s operated in more austere environments. And with longer deployments, C-17s needed deployable maintenance kits. There was also a desire to have readily available data on runway composition and soil samples to more quickly assess the C-17's load bearing capability.[716] Because of the threat environment, the C-17 SPO accelerated the installation of 19 crew armor kits. Kosovo operations further revealed a need for better defensive systems on the C-17s (as well as the remainder of the airlift fleet). Additionally, the C-17 still had unreliable satellite communications. Competing for satellite time, differing signal strengths, and a weak pre-amplifier in the C-17 all made for an unreliable system.[717] Nevertheless, the C-17, overall, had a stellar performance during Kosovo, disproving MIT Professor William W. Kaufmann's 1985 assessment that the C-17 is a "foolish program," as it "is not a good intercontinental lifter, and it's probably risky as an intratheater lifter. We're going along with this crazy Air Force attempt to revive the old C-5 concept—that you make [the C-17] into both an intertheater and an intratheater aircraft."[718]

**Direct Delivery Unfulfilled**

However, Kosovo C-17 operations did not advance the direct delivery (nonstop) concept. Bureaucracy was the only thing that prevented the C-17s from flying direct delivery missions from the United States to Macedonia. C-17s crews were required to land at Ramstein Air Base to obtain a briefing and special instructions (SPINS) before going into the area of responsibility. While part of the problem was working with NATO secret documents, the other was a decision by the joint force air component commander staff that no NATO air tasking orders, SPINS, airspace coordination plans, or communications plans would be sent out of the theater.[719]

Four years had passed since General Rutherford had declared the C-17's initial operational capability. Yet, direct delivery, a key concept since the program's inception, still had not come into its own. Initially, the C-141 had also been touted as a direct delivery weapon system, but, except for its airdrop role, its direct delivery of combat forces remained limited to main operating bases and not forward areas. Nor had the C-5 performed as a viable direct delivery platform, despite the high flotation offered by its 28 wheels. Disappointed before and conscious of the C-17's cost, C-17 Task Force briefers had faced unbelievers early on among the rank and file, both Air Force and Army audiences: "'What are you guys smoking? We're not going to use the airplane like that [tactical environment].'"[720] Thus, direct delivery stagnated, despite being written into the various concept documents.

In 1985, Major James N. Soligan wrote a student paper—*Direct Delivery*—for his Air Command and Staff College coursework. While assigned to Headquarters Military Airlift Command, Major Soligan was the principal author of the *US Air Force Airlift Master Plan*. The problem Soligan recognized facing the Military Airlift Command was still largely valid in 2002:

> MAC's challenge, as it enters the 1990s, is to develop a concept of operations and design an airlift system that will maximize the combat delivery capability of its planned airlift forces. . . . The DOD, Army, Air Force, and MAC have repeatedly endorsed the direct delivery concept. However, the direct delivery concept and its associated benefits are not widely understood inside or outside the airlift community; there is no thoughtful analysis of the direct delivery concept and how to implement it; and there are many major planning, procedure, and resource issues MAC must address prior to effectively integrating direct delivery into today's operational concept.[721]

As first steps, the Air Force, Army, and Marine Corps needed to fully integrate the direct delivery concept into doctrine and then into contingency plans. The concept worked best employing full planeloads, which, however, could inundate those on the receiving end. Yet, direct delivery eliminated an intermediate staging base and provided for faster deployments, robbing an enemy of time. Overall, there were many aspects requiring careful study, but none were really insurmountable.[722] Air Force Institute of Technology graduate research papers by Majors Creighton W. Cook Jr. and M. Shane Hershman offered thoughtful insights on direct delivery. Major Cook in *Integrating C-17 Direct Delivery Airlift Into Traditional Air Force Doctrine* (1998) proposed a model that would aid in determining when to employ direct delivery, as the concept was not always suited to the task. Mission length, aircrews required, availability of air refueling, productive payloads, and the operation's duration were key considerations. In *Employment Of The C-17 In Support Of National Objectives* (1997), Major Hershman developed a cost model to assist in making direct delivery employment decisions. Hershman showed the Defense Department could have saved $4.4 million by using the C-17 in a direct delivery role in Joint Endeavor during the months of December and February. Besides the savings, direct delivery would have resulted in earlier unit closures.[723] Direct delivery was a primary argument in buying the C-17 over the C-5 and B-747. Direct delivery offers efficiency, mobility, and swiftness. For a variety of reasons, the Air Force has primarily used hub-spoke/transload systems[724] for Enduring Freedom and Iraqi Freedom. Thus, after ten years of operational service, the C-17's direct delivery capability remains underutilized. To maximize the C-17 and enhance the military's logistical system, the C-17's direct delivery (nonstop) capability requires further development.

**Sorting Out Airdrop**

Resolving the Army's formation and strategic brigade airdrop issues took years. The Air Mobility Command leadership remained committed to the Army's requirements. At times, frustrations ran high, generating counterproductive behavior. There was mistrust between the two services. Did the Air Force really take the Army's airdrop requirements seriously? After all, there were many in both services that relegated paratroop operations to the past—to World War II and Korea. With no substantial operational use since then, opponents had a powerful argument. Had the contractor and the Air Force just designed a transport aircraft with little thought about airborne operations? Why weren't the airflow and vortex issues discovered during wind tunnel testing? Was there a design defect? Team building, trust, realizing mutual goals—personnel safety and fielding the best, most capable airlift aircraft ever—bridged the differences. Again, along the way to resolution, there were leaders[725] that led, and staff action officers, enlisted personnel, testers, and engineers spent many long hours working the issues. As a byproduct, the Army and the Air Force gained new analytical tools to assess potential risks to paratroopers in airborne operations. There was also a realization that the individual type testing of the initial test program did not provide an early enough opportunity for evaluating multi-aircraft characteristics.

Although the C-17's personnel formation airdrop capability progressed in 1996, final resolution remained elusive due to wake vortex interactions. The C-17 System Program Office continued its integrated product team effort—Personnel Airdrop Optimization Phase II. During the April General Officer Steering Committee session, three goals were agreed upon: increase the aircraft's airdrop gross weight above 360,000 pounds, establish a formation geometry for single (3 ship) and multiple (6 ship) elements, and find a solution to the 15-foot static line issue. In June 1996, the C-17 SPO completed weight growth testing using 20-foot static lines and had achieved an aircraft gross weight of 385,000 pounds. The additional weight extended the C-17's post-drop unrefueled range. The Army followed with a safety release for operational testing at the higher weight. Testing with the 15-foot static lines stayed suspended due to jumpers contacting the D-bags at higher aircraft gross weights. Also in June 1996, the formation geometry was decided as a result of testing the C-17's wake vortex and the interaction between the vortex and the parachute.[726] The subsequent final report (October 1997) concluded that the C-17 was capable of safely airdropping personnel (combat jump) from multiship formations of three elements with the number two aircraft 3,000 feet in trail and 650 feet upwind and the number three aircraft 6,000 feet in trail and 1,500 feet upwind, separated by 40,000 feet between element lead aircraft. But this victory of sorts had been achieved with the nonstandard 20-foot static line.[727]

Through some efforts, the Army and the Air Force came to agree over the static line. During testing, deployment bag contact occurred after approximately forty troops had exited the C-17 when using the Army's standard 15-foot static line. Testers classified the contact as "severe," and the Army issued several very specific safety releases. Technical solutions, which modified the aircraft, proved expensive at some $147 million. A less costly option was for paratroopers to use a nonstandard 20-foot static line. However, this static line was not certified for the C-130 or C-141 or other aircraft such as helicopters and smaller aircraft performing special operations.[728] Out of safety considerations, Lieutenant General Shelton and his successor, Lieutenant General John M. Keane, did not want the 20-foot static line. General Keane expressed a very firm desire to maintain one standard static line at the 17th General Officer Airborne In-Process Review in May 1996. The 20-foot static line also meant additional logistical requirements and the possibility of inadvertently mixing 15- and 20-foot lines.[729]

In December 1996 at the Warfighter Commanders Conference, the two chiefs of staffs, Generals Fogleman and Reimer, discussed the static line issue. The issue was pressing, as a solution to the static line was required by fiscal year 2000, the time the C-17 was slated to replace the retiring C-141 in the strategic brigade airdrop mission. Testing in 1998 disclosed the nonstandard 20-foot static line as unacceptable for the C-130 due to the potential for a "clothes line" effect. Accordingly, the Army and the Air Force pursued a universal static line (USL) and D-bag system. The US Army Soldier Biological Chemical Command at Natick, Massachusetts, assumed responsibilities for developing and testing the new static line, which was successfully tested in 2001 and fielded thereafter. Essentially, the universal static line was 15 feet with a 5-foot extension for jumping from a C-17. This precluded the Army from maintaining two separate static lines for every paratrooper. The USL could also be reconfigured at planeside, if need be. Additionally, jumpmasters could readily see if a jumper had the right static line for the aircraft. The new system also utilized stronger static line webbing materials and a double lock, single operated snap hook, enhancing jumper safety.[730]

**Sorting Out Brigade Airdrop**

Plans in the 1990s had the C-17 gradually replacing the C-141 in the brigade airdrop role. Per the Defense Planning Guidance, the Air Force needed to maintain the capability of airlanding and airdropping the Army's division ready brigade (Medium) over strategic distances on short notice. The closure time for the whole unit was within 29 hours, while the strategic brigade airdrop portion (Echelon A) was stipulated within 30 minutes. An all C-17 formation, however, took 51 minutes due to the extended formation pattern to offset wing tip vortices and prevent paratrooper contact. With unresolved issues, the Army would not validate the C-17 for the strategic brigade airdrop mission. The Army and the Air Force formed another team—Joint Strategic Brigade Airdrop Integrated Progress Team—to meet the challenge. By 1998, the potential existed to reduce the C-17 only airdrop pass time from 51 to 31 minutes. Initiatives such as recertifying the Army's required airdrop loads, employing dual row airdrop, installing enhanced station keeping equipment (SKE, which allowed the aircraft to fly in larger formations during inclement weather), and adjusting the spacing between aircraft elements or serials provided the time reductions. Subsequently, dual row testing reduced cargo dispersion and improved equipment survivability.[731]

**Division Ready Brigade[732]**
(Tailorable **METT-T***)

| **Echelon A (Airdrop)** | | **Echelon B (Airland)** | |
|---|---|---|---|
| Troops | 2,460 | Troops | 683 |
| Wheels | 102 | Wheels | 227 |
| Howitzers | 18 | Helicopters | 28 |
| CDS** Bundles | 54 | Pallets | 41 |
| Engine Repair Pkg | 12 | IRC/Tracks*** | 10 |
| Support Platforms | 9 | Engine Support Pkg | 12 |
| | | | |
| C-17 Aircraft | 53 | C-17 Aircraft | 46 |

*Mission, Enemy, Troops, Terrain and Weather, and Time Available
**Container Delivery System
***Immediate Ready Company

Source: Information Paper w/atch, Col Peck, "Strategic Brigade Airdrop (SBA) Update," 21 November 1998.

There were other encouraging developments. A vortex interaction laboratory study undertaken by Major Hans J. Petry, while at the Air Force Institute of Technology, indicated a potential for further reductions in formation spacing. Operational testing validated the study and offered the Army a formation spacing matrix for use during contingencies, with varying degrees of risk for vortex interaction. The Army was receptive to exploring a separation spacing between lead aircraft of each three-ship formation to less than the 40,000-foot separation. In December 1998, Major General Joseph Kellogg, the Army's Assistant Deputy Chief of Staff for Operations and Plans and former Commanding General of the 82d Airborne Division, openly stated that a separation of 28,000 feet meant one out of every 200 jumpers (.5 percent) potentially could be affected by wing tip vortices.

This was, in his view, an acceptable risk for operational missions. It would shave another several minutes off of the time to insert a strategic brigade. Testing followed in 1999.[733] However, several major interactions occurred at 28,000 feet between the mannequins and the vortices. As a result, test officials increased the spacing interval.[734] On 4 January 2000, General Charles T. Robertson,[735] Commander Air Mobility Command and United States Transportation Command, informed Air Force Chief of Staff General Michael Ryan that testing had successfully decreased separation between elements from 40,000 feet to 32,000 feet with a pass time of 26 minutes. This, however, did not end the issue. Army officials expressed concern because the time between serials carrying personnel had not decreased. For example, the C-141 required one minute and 52 seconds for six aircraft (a battalion) to deploy the troops while a C-17 took two to four times as long. Army and Air Force senior officers discussed ways of changing doctrine so that the Air Force aircraft commander and the Army on-board commander could expand or contract the formations as they deemed necessary, ensuring the element of surprise. Additionally the SKE follow-on system proved unreliable during testing. By 2004, an interim fix enabled 53 C-17s to achieve a drop pass time of 43 minutes. With the planned dual row airdrop, long-term SKE fix, and new formation spacing, the C-17 would meet the time requirements of the Army's strategic brigade airdrop mission.[736] At the program's inception, given the OSD's emphasis on the C-17's strategic role, the C-X Task Force members had done good just keeping a tactical airdrop role in the program documents.

**Science of Dirt**

"Now the C-17, we wanted it to be able to land on a dirt strip as well, which would give us even further capability. . . . In hindsight that's probably a little unrealistic to think that we could have ever done something like that. So, where we are is, we've got an enormously added capability with the C-17 to go to airfields other than very large international airfields, right now; land on a hard stand; land on something less than a hard stand but greater than a dirt strip," Lieutenant General John M. Keane explained in February 1998 during his end-of-tour interview as the commanding general of the XVIIIth Airborne Corps.[737]

The Army and the Air Force differed greatly in their views on semi-prepared runways, and for the longest while the Army made no bones about what it wanted. Initially, the Army believed the C-17 would be as capable as the C-130 in the forward area, austere operations. Some even said the Air Force oversold the Army on this feature. For sure, the Air Force had touted this capability to Congress as one of the primary reasons for buying the C-17 over the C-5. For its part, McDonnell Douglas certainly advertised it extensively in printed media, adding to the misunderstanding. One attractive poster showed a stop sign and the desert with the C-17 landing in the dirt and the catchy phrase "The Road Stops Here." Another illustrated the C-17 making a steep approach for a dirt strip landing.

Essentially, in the early 1990s, the Air Force took the view that the C-17 operational requirements document did not stipulate such a requirement as a key performance item. Lieutenant General Hogle, then the Air Mobility Command Vice Commander, remembered the moment he explained this to General Keane. "I sent him excerpts from the ORD, and, I believe, he was frankly a little shocked to find out it wasn't specified in the contract that it should operate like a C-130.[738] "Certainly, it seemed there were Army expectations," recalled Lieutenant Colonel Thomas Svisco, the Army's representative at the C-17 SPO, "and they were led to believe that the C-17 would function like a C-130 as far as landing on a dirt strip or a semi-prepared runway. Certainly that's contained, if not in Air Force briefings, in Army briefings to the senior leadership. So those expectations were always there."[739]

But where did the Army get this perception? First off, the C-17's acquisition arose from the canceled AMST program, and the AMST would have replaced the C-130. In testimony before Congress in 1976, with Army Major General Edward C. Meyer, the future chief of staff of the Army, in attendance, Military Airlift Commander General Paul K. Carlton explained in detail AMST improvements vis-a-vis the C-130. With 14 tons of cargo the AMST would land on a 2,000 foot-runway while the C-130 with a 10-ton load would require a 3,500 foot-runway. "This size airfield triples the number of airfields in Western Germany that are usable by tactical airplanes," Carlton related to Chairman John L. McClellan (AR-D). McClellan: "They have surfaces that can accommodate this plane?" Carlton: "Yes, sir. The footprint on this airplane is very light. You can land it on highways, for example, the autobahn, anyplace you can stretch out 2,000 feet you can land the plane." McClellan: "Can it land on a dirt runway?" Carlton: "Yes, sir, on a dirt runway. Dirt and gravel. We have a specification of soil consistency [CBR 6] that is required but a dry cornfield would be adequate, not a wet one, a dry one."[740]

Besides congressional testimony, the Army could also have gotten the notion from such historical documents as the *US Air Force Airlift Master Plan*. The master plan acknowledged how "the current inventory of C-130s is inadequate to support the logistical deployment, employment, and resupply requirements of the theater. In all scenarios, the requirement to transfer cargo from intertheater aircraft to intratheater aircraft causes airfield saturation at the main operating bases and later delivery to the user."[741] In the near term under Option D, the Air Force would retire 54 C-141s and 180 older C-130s and transfer 180 C-141s to the reserves as it acquired 180 (PAA) C-17s.[742] Clearly, the Army would have been left with the impression that the C-17 would perform the roles and missions of the retired C-130 and do them even better.

And what about the C-17 operational requirements document? First published in January 1980 as the C-17 preliminary system operational concept, this document defined "a small, austere airfield has a prepared (paved) or semi-prepared (unpaved or matted) runway and limited taxiways and parking areas. These airfields are normally considered the final offload bases, or in the support of ground forces, the supported agency airfield."[743] Interestingly, the PSOC stipulated under landing requirements: "3,000 feet long or less using maximum effort landing procedures (T.O. 1C-130B-1), max braking, and idle reverse, LCG [load classification group] IV for paved surfaces or CBR 9 for 100 passes on unpaved surfaces, with a payload of at least 100,000 pounds or 75% of the max 2.25g ACL, whichever is greater, and fuel to fly 500 NM plus reserves."[744] California Bearing Ratio 9 equated to a soil consistency of sandy clay with a good subgrade.

Thus, initially, from the Army's perspective, the text appeared adequate in stating their requirements. The Army was also aware that the request for proposal at this time required a landing gear ground flotation load classification number of not greater than 40 and "be capable of operating on designated, unpaved, semi-prepared, compacted surface (sand, gravel, etc.) runways."[745] But did the Army know the system operational concept document underwent continual revision and refinement as required at each major program review or milestone? They would need to continually promote their issues. Already, the March 1981 version of the C-17 system operational concept had dropped out of the above cited text on CBR 9 landing requirements.[746] Had the US Army Training and Doctrine Command staff noticed the changes during coordination? Were they always included in coordinations?

True enough, by 1993 when the C-17 operational requirements document replaced the C-17 system operational concepts document, semi-prepared (unpaved) runway operations had been relegated to the sideline, just as Lieutenant General Hogle had stated. The requirement for an unpaved landing or takeoff capability was absent from the key performance parameters. Under ground flotation it was listed as a "fallout" objective with a "goal" of CBR 9.

"The Army was on us all the time about landing in the dirt. It was almost like two people in a bar, you know, trying to get in a fight. You really didn't want to go fisticuffs, but you said things that would make the other person mad that would force them to prove it. . . . But they use to agitate, thinking that we weren't going to use the aircraft in the dirt," recalled Lieutenant Colonel R. Mark Hunter, who headed the C-17 staff at Headquarters Air Mobility Command in the 1990s.[747] From his vantage point, Lieutenant Colonel Svisco knew the Army's generals were hard over on the issue. They did not want another C-5 that only landed in the dirt one time, figuratively speaking. Once the Air Force showed the Army it would land the C-17 in the dirt, tensions eased, and both parties worked to overcome the limitations such landings posed for the C-17. Beyond the landings, there were questions surrounding the staging areas and how much the C-17s could realistically bring into an area.[748] While past experiences with other transport aircraft were of value, much remained uncharted.

When the Combined Test Force concluded small, austere airfield testing at the end of 1994, the C-17 proved capable of landing, taking off, and maneuvering. At the Alamo landing zone (CBR 12-15) in Nevada, the C-17 landed and took off at gross weights up to 423,000 pounds. The C-17 could also back up and make 180-degree star turns on a 90-foot wide unpaved surface as originally required.[749] More demonstrations followed. For example, during the May 1995 readiness review, a Charleston crew delivered an Abrams M1A1 tank to an unimproved desert surface runway at Bicycle Lake Army Airfield (CBR 20-29), California (the Army's National Training Center at Fort Irwin). With its engines running, Army and Air Force personnel quickly unloaded the tank, and the C-17 lifted off again 30 minutes later. Shortly thereafter, another C-17 arrived at the strip. With aircraft's engines whining, the tank was loaded, and the C-17 departed in a cloud of dust some 45 minutes later. Observing the event, Brigadier General J. B. Burns, 24th Infantry Division Commander, quipped, "We could use 100 more of those babies."[750] Rightly impressed, the tank rolled off the C-17 in eight minutes, and the C-17s were airborne again without much ground assistance.

Although the C-17 was demonstrating austere airfield capabilities, debris ingestion, engine vortexes, and runway surfaces had the potential to damage the C-17. On one occasion in 1997, testing was terminated, as all four engines on T-1 had to be removed and repaired. Efforts were directed at investigating different blade coatings, evaluating procedures for reverse thrust operations, and considering a nacelle redesign. The Air Force was also attempting to develop a way to classify unimproved runways for friction and compression characteristics. Additionally, aircrews, Army and Air Force engineers, and combat controllers all needed training in small, austere airfield operations.[751]

There was also the science of dirt and weight. Testing was proving the C-17 could only deliver equipment to a dirt airfield once or twice, and then "dirt starts to behave like dirt and, consequently, C-17s cannot land there anymore," recalled General Walter Kross.[752] "We pushed our Army partners to think 'concrete-capped runway.'"[753] It was the sensible approach. Both the C-130 and the C-17 were limited to the number of dirt landings. The shear weight of the C-17, some three times as heavy as the C-130, could not be ignored. The Army would have to think in terms of initially bringing in heavy equipment to build up an unpaved runway.[754] Historically, during World War II, the building and rebuilding of unpaved runways had been extensive.

In May 1998, Charleston aircrews flew their first operational training mission. On this occasion, three takeoffs and landings were conducted on a cement-stabilized runway at the Geronimo landing zone at Fort Polk, Louisiana. No aircraft damage ensued. More training followed over 1998-1999. In September 1999, the C-17 performed the first dirt-to-dirt runway operations when two C-17s flew from Bicycle Lake to Geronimo. The event validated dirt airfield procedures.[755] By late summer 1999, the Commanding General of the XVIII Airborne Corps, Lieutenant General William Kernan, had been encouraged enough to propose phase II testing for semi-prepared runway operations.[756] Several more years of testing would follow. Meanwhile, the War on Terrorism pressed the C-17s to land on austere, semi-prepared runways under hostile combat conditions. The Army and the Air Force were in accordance; the concept was here to stay.

### Politics of Basing-Additional C-17s

Originally, the basing concept had been to replace the C-141 units with C-17 units, to include reserve associate. While this reflected the military's best operational interests, it also kept basing politics status quo. When Congress directed the Air Force to increase the role of the reserve forces in 1984, another basing plan emerged. Following Cheney's Major Aircraft Review, it took the Air Force, Air National Guard, and the Air Force Reserve some time to reach a new basing agreement. After the November 1995 Defense Acquisition Board decision, the Air Force notified Congress of its plan to base 8 C-17s at Altus and 48 each at Charleston and McChord Air Force Bases. Ten other aircraft would serve as backup aircraft inventory while six others would be assigned to the Air Reserve Component.[757]

Some congressmen questioned this plan, especially due to the losses from and prospects of additional base closures. The California congressional delegation asked General Rutherford how the decision had been made. The Air Mobility Command had considered both Travis and McChord but decided a single base was more cost-efficient. McChord's proximity to Fort Lewis best served the Army's training requirements.[758] On the East Coast, Congressman H. James Saxton (R-NJ), a key C-17 supporter, pushed to have C-17s based at McGuire, given the pending C-141 retirements there. At this juncture with just 120 C-17s, General Rutherford could only offer assurances that the Air Mobility Command desired to retain McGuire and Travis Air Force Bases.[759] Senator Ted Stevens made a bid for locating the unannounced reserve unit in Alaska. A staunch C-17 supporter who had saved the program on more than one occasion, Stevens pressed noting the need to rapidly deploy the 6th Infantry Division to Korea and Northern Europe.[760] This essentially was the justification for choosing McChord over Travis. Consequently, the Air National Guard soon disclosed its plans of basing the six C-17s at Thompson Field, Jackson, Mississippi. When the number of C-17s went beyond 120, a revised basing plan followed with politics entering into decisions as well. McGuire became the next base following Altus and McChord to receive the C-17. In December 1995, Air Force Secretary Widnall had indicated to Senator Saxton that McGuire would receive C-17s, provided the buy expanded. Senators Joseph R. Biden (D-DE) and Daniel K. Inouye (D-HI) had also actively sought to have C-17s at Dover and Hickam Air Force Bases.[761]

Especially as demonstrated in Kosovo, the C-17's real world performance generated a ground swell of support for more C-17s. Additional C-17s initially awaited the results of another mobility study—the *Mobility Requirements Study 2005*—and the emphasis accorded it by the new presidential administration of George W. Bush. Although the study defined a total airlift requirement of 67 million-ton-miles per day, the joint chiefs of staff supported a goal of 54.5 MTM/D as the minimum moderate risk capability. The pending decision on upgrading the C-5 also affected the final number of C-17s. Forty to sixty more C-17s were anticipated, and on 7 September 2001, the Air Force Board approved increasing the number of

C-17s by 60 aircraft. Congress in the 2002 Defense Bill authorized the Air Force to procure 60 C-17s beyond the 120 aircraft largely due to US military actions following the September 11th terrorist attack. The War on Terrorism and the C-17's good showing in Afghanistan and Iraq raised expectations above 180 C-17s. The proposed basing plans announced in April 2002 could easily accommodate additional C-17s.[762] Thus, the thorny basing issue, with its political ramifications, also had a satisfactory resolution. C-17 congressional support had come as an IOU. Future program should factor this in from the onset while also ensuring military needs.

**Proposed Basing For 180 C-17s**
**(April 2002)**

| | | | |
|---|---|---|---|
| Charleston AFB, SC | 46 PAA* | Altus AFB, OK | 15 PAA |
| McChord AFB, WA | 42 | Elmendorf AFB, AK (ANG) | 8 |
| McGuire AFB, NJ | 12 | Hickam AFB, HI (ANG) | 8 |
| Dover AFB, DE | 12 | Thompson Field, MS (ANG) | 8 |
| Travis AFB, CA | 12 | March ARB, CA (AFRC) | 8 |

Total: 171 PAA plus 11 backup aircraft inventory
*PAA: primary aircraft authorization

Source: Briefing, Maj Gen Art Lichte, "AMC Airlift Game Plan," 8-9 April 2002.

**Foreign And Commercial Sales**

Following the 1995 Defense Acquisition Board decision and congressional approval of the multi-year contract, McDonnell Douglas actively sought to market its C-17 for both commercial and foreign military sales. In December 1996, Harry Stonecipher officially authorized selling a commercial variant, the MD-17. Scandinavia's use of the Soviet-made Antonio AN-124 for transporting humanitarian aid to Somalia had sparked McDonnell's interest. Analysis indicated the AN-124 had a $250-300 million-dollar-a year business, serving a niche market. McDonnell estimated 15-20 MD-17s could be kept sufficiently busy in this growing market of hauling large, outsize items or providing short-notice airlift requests.[763]

The going would be slow. In part this was due to the way the program was originally set up. In the beginning, the Air Force really did not seek to capitalize on the cost benefit and increased airlift that commercial and foreign military versions of the C-17 might offer. The reasons were many. Primarily, it was difficult enough just keeping the program alive each year. Nevertheless in 1992, C-17 SPO Director Brigadier General Miller had taken some initial steps in planning an international sales strategy, setting the stage for obtaining the required export policy statement. At the time, McDonnell Douglas had either contacted or received inquiries from Germany, France, United Kingdom, Italy, Saudi Arabia, and Japan. Early in 1993, the C-17 SPO had talked to German and French government representatives about a fleet of C-17s to perform European airlift as needed. [764] But then Deutch put the C-17 program on probation.

When McDonnell Douglas broached foreign countries after the 1995 DAB decision, United Kingdom, Canada, Japan, and Australia expressed interest, although the latter two countries did not proceed much beyond that. Japan thought in terms of a transporter and air refueling platform, a KC-17 variant. The US Air Force, however, had no immediate plans to replace its KC-135 and KC-10 tanker aircraft, which would have fostered KC-17 foreign purchases. On the other hand, as part of its rapid-reaction forces concept, the United Kingdom's Ministry of Defense actively sought the C-17 for carrying tanks and Chinook and Apache helicopters. Delays had occurred in moving British troops to the Middle East and Bosnia. Chinooks had broken down throughout the Mediterranean en route when supporting the Kurds in Iraq. It would have been much easier to have had C-17s lifting them. Moreover, neither the British-owned C-130s nor the yet-to-be built European-made Future Large Aircraft could carry tanks or helicopters.[765]

With many of the details worked out, the United Kingdom announced in May 2000 that it would lease four Boeing C-17s, signing in early September a $720,000 million, seven-year lease agreement with options for two annual extensions. Britain's Ministry of Defense indicated it would only use the C-17s for the seven-year period to fill the existing void in strategic airlift until the Airbus Industrie's A400M was delivered as the long-term solution. Along with Belgium, France, Germany, Italy, Luxembourg, Spain, and Turkey, the United Kingdom was supportive of European efforts in developing Airbus Industrie's A400M transport plane. The first deliveries of the A400M were scheduled for 2007. Britain's BAE Systems and Rolls Royce would be among the leading subcontractors. Thus, the C-17's long-term prospects were limited. One viewpoint, maintained by Boeing officials, was that the A400M and the C-17 were complementary. The jet-driven C-17 hauled twice the cargo of the turboprop A400M. The A400M's unit cost, however, was pegged at $80 million, compared to the C-17's nearly $200 million. Britain required strategic airlift for major deployments, as shown during Kosovo. Yet, Britain had no real need for the C-17's austere airfield landings, low-level flying, air refueling, or airdrop capabilities. With the British using the probe and drogue refueling system, the C-17's boom refueling system was also an unnecessary and costly item. The British did desire the extended-range fuel tank. The C-17 had beat out the AN-124-100, which the British had relied upon for contingency movements into Sierre Leone.[766] The Royal Air Force's 99th Squadron at RAF Brize-Norton received the first leased C-17 (UK1) on 17 May 2001 and the fourth that August. How well the C-17s were working for the United Kingdom was evident in August 2001 when the small fleet of then three C-17s flew missions into Macedonia, delivering Lynx helicopters, while simultaneously supporting an exercise in Oman.[767]

Besides the United Kingdom, Canada considered procuring six C-17s to meet its surge airlift requirement. During normal peacetime operations, Canadian Forces expected to utilize three C-17s. With one aircraft as a backup or in maintenance, two aircraft would be available for non-Canadian taskings. The initial thinking was to make these two aircraft accessible for tasking integrated with the Air Mobility Command and United States Transportation Command. The study recommendations, however, required the approval of the Canadian Air Staff, the Defense Joint Staff, and the Deputy Defense Minister, as well as the Canadian Parliament. The Air Mobility Command had questions on integration and interoperability. By the end of 2000, issues of sovereignty, use of Canadian or US crews, and foreign policy differences, such as flying aid to Cuba, made the share option less ideal. The unit cost of the C-17 and whether the A400M became operational sooner all entered into Canada's decision equation.[768] Consummating foreign ventures required much patience and energy.

Boeing officials actively sought to market the C-17 commercially in the United States as well. However, initially, commercial carriers were not interested in leasing or purchasing C-17s, as flying the C-17s did not make good economic sense. Essentially, the MD-11F and 747F provided greater range and payload capabilities for their bulk cargo movements than the C-17.[769] Secretary of the Air Force Donald Rice had discovered this in 1991 upon asking his staff to look into such arrangements. The year 2000 saw the reemergence of an idea to place the commercial version of the C-17, the BC-17X (previously designated MD-17) in the Civil Reserve Air Fleet program in exchange for government business. William Boesch, a former executive of American Airlines, had proposed such a venture to the Air Mobility Command in 1998. Boeing was supportive. General Kross regarded the offer as compromising and disruptive to the CRAF due to the amount of guaranteed government business requested—40 percent. Not willing to accept this answer, Boesch secured a meeting with then acting Air Force Secretary F. Whitten Peters, and the Air Force subsequently considered the proposal. Clouding the issue was the fact that the US government had used on occasion the AN-124 aircraft for outsize lift movements. With the preliminary results of the *Mobility Requirements Study 2005* indicating a requirement for more airlift, with the then uncertainty over the C-5 modernization decision, and with a need to maintain the C-17 production line so more C-17s could be procured if warranted, the concept was studied anew. At the request of Darleen Druyun, General (Retired) Duane Cassidy headed up a team in November 1999 to determine the feasibility of a commercial C-17 venture, termed Commercial Applications of Military Airlift Aircraft (CAMAA).[770]

The team developed a business case, which was partially dependent on government guarantees of a set amount of the peacetime CRAF business and on the potential growth of the commercial heavy outsize and short austere airfield market for air freight business. In peacetime a CAMAA carrier's government business would be limited to about 20 percent. The potential market for commercial heavy outsize lift was projected as supporting, on the low-end, 10 aircraft, but more likely between 18-26 aircraft beyond what the AN-124 was performing. The case was put forth that CAMAA could provide the last ten C-17s required by the MRS-05, for a savings of $1-2 billion in the five-year defense plan and $6-8 billion in life-cycle costs, based upon purchasing ten new BC-17Xs.[771] Besides the savings, BC-17Xs would modernize the CRAF and "for the first time put outsize capability in the Civil Reserve Air Fleet."[772] Expressing the rationalization stated above, over late summer and fall 2000, General Cassidy briefed Secretary Peters, Air Force Chief of Staff General Michael E. Ryan, Principal Deputy Under Secretary of Defense for Acquisition and Technology Jacques S. Gansler, and Under Secretary of Defense for Personnel and Readiness Rudy de Leon. He secured their support for an acquisition program.[773]

In December 2000, the Air Force and Boeing announced plans to market the C-17 as a commercial asset, with the Air Force releasing a request for information to 27 companies. The BC-17X as a cargo plane would not possess key military features, such as anti-missile countermeasures, airdrop, or inflight refueling, although it would retain its short-field landing capabilities. There was a desire to ensure commonality between the two versions. Unencumbered with such features, the BC-17X would lift more payload over a longer distance—173,330 pounds over 2,500 nautical miles. The BC-17X would require commercial rails, however. The first BC-17X deliveries were projected for 2004.[774]

Initially, the whole effort hinged on the outcome of the *Mobility Requirements Study 2005* and whether the Defense Department approved procuring more C-17s. There was also some congressional concern whether commercial designation would remove C-17 depot work from the Air Force's air logistics centers to private contractors. In the end, Congress provided no authorizing language for the CAMAA program in the 2002 Defense Bill.[775] Ongoing operations in Afghanistan and then Iraq also caused a revaluation of the number of military C-17s required, deferring the commercial BC-17X. Thus, marketing the military C-17 for both military and commercial uses was proving difficult while the historical precedence of converting the commercial Boeing B-707 and McDonnell Douglas DC-10 into the military KC/C-135 tanker/air transport and KC-10 advanced tanker/cargo aircraft, respectively, suggested the reverse was easier.

**Addressing Future Acquisitions**

Over the course of the C-17 program, the acquisition community has restructured several times. Although process improvement and integrated product teams have produced good results, problems still persist, as the F/A-22 stealth fighter program confirms. The new initiative to relocate program executive officers outside of Washington DC and collocate them with the system program offices is another positive step. But solutions are more convoluted than this, as key decision makers as well as politicians and corporate officials exist outside of the acquisition community, making the case for a more holistic approach. I believe John Deutch had the right idea when he spoke before Congress of the need for mutual trust; a willingness to take initiative to better manage programs, which meant allowances for risk taking; and the necessity for candor in disclosing problems as they occur.

As David Packard remarked, common sense should prevail. Packard also recognized the value of offering incentives for the contractor to perform, namely the firm-price, incentive fee FSED and production option 1 contracts and the Trade Agreement. The latter enabled an exchange between the contractor and the using command to incorporate changing requirements or new technologies without escalating costs. Lieutenant General Walter Hogle's view that the RM&AE reintroduced "competition" back into the process, whereby the contractor really had to ensure the C-17's performance or else, adds answerability as a leverage. All of this suggests instituting macro- and micro-teams that subscribe to attaining the high ground—an excellent weapon system—with good incentives and accountability to avoid such sinkholes as greed, politics, and poor performance/quality. Additionally, this historian has gleaned these thoughts for consideration.

***I: Acquiring a military weapon system is a business decision.*** It is the responsibility of the Congress, DOD, Air Force, and the services to come to a consensus and continually support a program or mutually decide to alter/terminate it. Sound business practices should be employed like any private corporation would. In the case of the C-17, the program and the contractor were essentially held in limbo from year to year. Only on the brink of cancellation was consensus attained. Such consensus could serve as the basis for future successful programs. But consensus—analogous to a "contractual" agreement—is needed at a program's inception.

***II: Acquisition programs cannot succeed without astute, visionary leaders ingrained with integrity.*** Future programs require astute, visionary leaders—leadership that determines early on a program's stakeholders, support base, mission roles, and costs; that expects and surmounts delays, highs and lows in funding, requirement changes, intense lobbying, alternative proposals, cutting criticism, and extensive reviews; and that fosters professionalism, honesty, openness, and communication. The C-17 faced an integrity crisis. What leaders certify or validate must be based upon integrity and soundness of judgment. The challenge is great.

***III: Expect and prepare for world order/national security changes.*** It took nearly a decade and a half to field the C-17, during which there were four presidential administrations: Carter, Reagan, Bush, and Clinton. Each administration had its own agenda. While the program experienced the lean years of the Carter administration, Reagan's buildup in defense spending left the C-17 as a long-term solution to the airlift shortfall. Thereafter, the collapse of the Soviet Union ushered in a new world order, and the national security strategy shifted from a Cold War footing of thwarting a Soviet-led Warsaw Pact invasion of Europe to responding to regional conflicts around the globe. During Bush's and Clinton's tenures, strategic airlift mobility requirements went from attaining a wartime capability of 66 MTM/D, which had justified 210 C-17s, to 49.7 MTM/D, roughly a 25 percent reduction. The United States also embarked upon a major conflict in Southwest Asia. The Gulf War brought about a renewed appreciation of airlift's reach and rapid responsiveness. Then came the War on Terrorism with the need to support conventional and nonconventional military operations. The C-17's dual-role and direct delivery capabilities enabled it to adjust well to evolving requirements. Additionally during the C-17's gestation, the United States Air Force underwent its most extensive reorganization since its inception in 1947, which resulted in strategic airlift giving way to rapid global reach with airlifters and tankers working in tandem. Will future weapon systems face similar circumstances? Highly probable. Substantiating this view is the example of the C-5 and C-141 transports. Both became operational during the Vietnam War and then endured a massive post-war draw down and reorganization of resources and mobility requirements. Anticipate such changes and plan courses of action.

***IV: What can be managed should be, otherwise bear the consequences.*** While some aspects of the C-17's troubled acquisition were unforeseeable, others could have been better managed from inception. Simply, the ducks—make it airplanes—should have been lined up. Several points can be made. At first, congressional support was lacking, which stalled the program's progress. Nor was funding forthcoming. The OSD and the Air Force also differed on what was desired before and after source selection, making the program easy prey to its competitors and powerful legislators. The initial lack of quantified mobility requirements for airlift played into the politics. The escalation of costs exposed the program to cancellation and alternative aircraft. Reactive adversarial relationships developed when the contractor failed to perform as desired, which robbed the program of efficiencies and hampered solutions. Bearing the consequences meant the C-17's IOC date changed at least seven times, resulting in a delay of some eight years. A better-managed program would have saved millions—even billions of dollars.

***V: Guard against negative cause and effect exchanges. Once initiated, they take on lives of their own.*** Acquisition programs can fall prey to a cause and effect merry-go-round. From the beginning, the C-17 program became trapped in such a cycle. Air Force and OSD indecision caused Congress to limit funding; limited funding resulted in the Air Force and OSD proposing a short-term (C-5B and KC-10) and a long-term (C-17) solution. The short-term solution caused the long-term to be delayed. Delay (and limited funding) resulted in contractor engineering and development problems, which caused . . .. In order for the C-17 program to get well, the cycle needed to stop. This proved difficult. In 1992, when the Air Force realized the program could no longer continue as it had been, the Air Force needed Congress to fund the program at adequate production rates. By this time, Congress' ingrained tendency was to cut funding. Yet, in order for McDonnell Douglas to be able to improve, the program required adequate funding of production rates. Starting from a negative means walking up a cliff.

***VI: Design weapon systems with the flexibility to grow and to adapt.*** Although doctrine, tactics, and national strategy will always accommodate changes faster than a weapon system, allowing the flexibility to incorporate changes into the design of a weapon system is a must. It just makes sense to do, thereby gaining a little extra on a huge investment that will stay in service for over thirty years. The C-141 and the C-5 illustrate this point. In the decades since the introduction of these aircraft, their mission requirements evolved. Special operations low-level requirements and the fuselage stretching and air refueling modifications to the C-141 are examples. Already the C-17 has had to adjust to the weight growth of the M1 tank from 130,000 to 145,000 pounds, the changeover from Jeeps to HMMWVs, and the new Stryker armored infantry carrier with its Stryker brigade concept. The C-17 has also added airlift defensive systems for a more forward, threat-filled role. The changeover from single row to dual row airdrop and adding the extended range within its first years of operations also speaks to the need for the flexibility to grow and adapt. McDonnell Douglas (now Boeing) has even proposed a "stretched" C-17 and a tanker version. Having the flexibility to accommodate software growth goes without question. Both the C-17 and the C-130J have faced this issue as new weapons systems. There was also the need to meet the International Civil Aviation Organization's and the Federal Aviation Administration's air navigation requirements (Global Air Traffic Management), necessitating the Air Force to plan for C-17 communication, navigation, and surveillance modifications.

***VII: Instill research and development as a continual process.*** The Air Force major commands would benefit from incorporating more research and development thinking into their operationally-focused organizations. It can't be all left to the research community and/or the contractor, as they may guess wrong, lack the operational experience, or be thinking of their bottom line. With respect to the C-17, the air mobility community should have been more proactive in initiating ongoing research and development of the things and systems that go on aircraft, developing, for instance, new omni-directional floor rollers or troop seats ahead of the C-17 acquisition program. The immaturity of OBIGGS when the C-17 began operational flying is another example of how ongoing research and development has a place before a weapon system's acquisition starts. Besides the benefit of the new item, the potential for time and cost savings is great. Simply, although the C-17 program did have proactive research and development efforts, more could have been done. The fruit is still low hanging.

***VIII: Expect flight testing to uncover bugs and expect more bugs in initial operations.*** By design, a flight test program uncovers those things that theory or a wind tunnel may not predict. Yet, only so much can be reasonably discovered in flight testing; initial operations will uncover more. Although the C-17 had a series of irritants, such as fuel leaks, main landing gear failures, flap and slats impinging, software anomalies, and an inoperable crew entrance door, none were insurmountable. Time for fixes, however, was in short supply with the concurrent schedule, inviting criticisms. All acquisition programs need some time to work out the bugs. Murphy's Law tells us some days won't be good ones.

The C-17 Globemaster III is truly an awesome, dual-role airlifter. Cost overruns and production delays almost canceled the program in the early 1990s. A concerted effort by all parties—McDonnell Douglas, Department of Defense, Services, and Congress—turned things around. By the end of the decade, the C-17 problem had become figuring out how many more aircraft were needed.

A 1903 Wright flyer placed beside a 1993 operational C-17 illustrates the air transportation leap the future holds. On the 21st century horizon are airships and hybrid aircraft/airships, providing point-to-point delivery of 200-500 tons of cargo, equipment, and personnel. Unmanned air transport vehicles utilizing an orbital upper stratospheric flight path are, likewise, less imaginary. Those procuring the next weapon systems after the C-17 need to be visionary and tenacious.

# EPILOGUE: Above The Clouds

*Effective military power is increasingly defined not by size or mass but by mobility and swiftness.*

President-elect George W. Bush, January 2001

*Is our country ever going to use this expensive airplane*, Congress and others had continually asked in the 1980s. *When the nation is at risk we will use whatever is necessary and everything needed to defeat the enemy.*[776]

General Duane H. Cassidy, December 2002

On 25 November 2001, 300 Marines aboard six helicopters undertook a nighttime assault on an airstrip in Afghanistan, securing the area and naming it Camp Rhino. Three days later under the cover of darkness and using night vision capabilities, the first C-17s set down on the hard-packed desert soil, offloading more personnel and cargo. Between 28 November and 4 January 2002, C-17s flew 64 sorties, aiding in the effort to establish a forward base within striking distance of the Taliban stronghold at Kandahar.[777] In March, C-17s transported 16 Army Apache helicopters from Fort Campbell, Kentucky to Kandahar, performing 30 direct delivery missions in support of Operation Anaconda.[778]

Then came the War in Iraq. On the night of 26 March 2003, fifteen C-17s airdropped nearly 1,000 173d Airborne Brigade paratroopers and their equipment, securing the Bashur airfield. Over the next five nights, these C-17s, relying on night vision, delivered the full brigade of 2,000 soldiers, 400 vehicles, and 3,000 tons of equipment into the austere, unimproved airfield, opening up the needed northern front when Turkey denied the United States use of bases.[779] Unequivocally, the C-17 has proven itself in the combat environment, leaving its acquisition troubles behind.

# APPENDICES

## APPENDIX I

### *C-17 Program Significant Events*

| | |
|---|---|
| | **1979** |
| 10 Dec | C-X Program Initiated with Program Management Directive (PMD) |
| 17 Dec | Draft Mission Element Need Statement (MENS) to OSD |
| | **1980** |
| 04 Jan | C-X System Program Office Organized |
| 20 Jan | Draft Preliminary System Operational Concept (PSOC) Completed |
| 28 Feb | C-X Draft Request For Proposal (RFP) Released to Industry |
| 15 Oct | RFP Released to Industry |
| 28 Nov | Milestone 0, C-X MENS Approved |
| | **1981** |
| May | Congressionally Mandated Mobility Study (CMMS) Issued, 66 MTM/D |
| 28 Aug | Source Selection Announced, McDonnell Douglas |
| 07 Dec | SECDEF Certification to Congress |
| | **1982** |
| 05 Feb | SECAF Announced 50 C-5N & 44 KC-10; C-17 Long Term Solution |
| 03 Mar | PMD, C-17 Low-Level Development |
| 23 Jul | Full-Scale Engineering Development (FSED) Contract Awarded to McDonnell Douglas |
| | **1983** |
| 29 Sep | US Air Force Master Plan Issued |
| | **1984** |
| 27 Feb | SECDEF Forwarded C-17 Validation Report to Congress |
| | **1985** |
| 15 Feb | Milestone II, FSED Decision |
| Sep | Preliminary Design Reviews Completed |
| 30 Dec | C-17 Certification to Congress |
| 31 Dec | C-17 Contract Restructure Approved |
| | **1987** |
| Jan | Long Lead for Lot I (2 aircraft) Contract Awarded |
| 02 Nov | T-1 First Aircraft Part Fabricated |
| | **1988** |
| Jan | Lot I (2 aircraft) Contract Awarded |
| Jan | Advance Procurement for Lot II (4 aircraft) Contract Awarded |
| May | First F117 Engine Delivered |

| | |
|---|---|
| 31 Jul | Critical Design Reviews Completed |
| 24 Aug | T-1 Assembly Started |
| 5 Dec | Defense Acquisition Board (DAB), Milestone IIIA |
| 8 Dec | FAA Certified F117 Engine |
| | 1989 |
| 18 Jan | Milestone IIIA Approved, Low-Rate Initial Production Decision |
| Jan | Long Lead for Lot III (4 aircraft) Contract Awarded |
| Feb | McDonnell Douglas TQM Initiated |
| May | Software Critical Design Review Completed |
| Jul | Lot II (4 aircraft) Contract Awarded |
| 30 Oct | DAB, Program Restructure |
| | 1990 |
| Jan | Long Lead for Lot IV (6 aircraft) Contract Awarded |
| 26 Apr | SECDEF Major Aircraft Review Announcements |
| 15 Jun | GE Delivered First Electronic Flight Control System |
| 30 Jun | T-1 to Final Assembly, P-1 to Major Join |
| May | New DAC VP/GM for C-17 |
| 14 Dec | SECDEF Cost Certification to Congress per Nunn-McCurdy Breach |
| 21 Dec | T-1 Final Assembly Completed |
| | 1991 |
| 17 Jan | USD(A) Initiated Review of C-17 |
| 25 Mar | USD(A) Acquisition Decision Memorandum |
| 18 Apr | DAC President Chartered Production Review Team |
| 23 May | CINCMAC Signed System Operational Requirements Document |
| 30 Jul | Lot III (4 aircraft) Contract Awarded |
| 15 Sep | T-1 First Flight |
| 15 Sep | Developmental Test & Evaluation (DT&E) Initiated |
| Oct | Static Test Article Delivered and Testing Initiated |
| | 1992 |
| 17 Jan | Flight Test Program Surpassed 100 Flight Hours |
| 23 Jan | Mobility Requirements Study (MRS) Forwarded to Congress, 57 MTM/D |
| 17 Mar | DUSD(A) Memo Milestone IIIB Full-Rate Production Decision after Reliability, Maintainability, and Availability Evaluation (RM&AE) |
| 18 May | P-1 First Flight |
| 29 May | DEPSECDEF Certification to Congress |
| 21 Jun | P-2 First Flight |
| 7 Sep | P-3 First Flight |
| 01 Oct | Static Test Article Incurred Wing Failure |
| Nov | Durability Test Article Entered Testing |
| 9 Dec | P-4 First Flight |

1993

| | |
|---|---|
| 12 Jan | USD(A) Program Review |
| 26 Jan | Long Lead for Lot V (8 aircraft) Contract Awarded |
| 31 Jan | P-5 First Flight |
| Feb | Flight Test Program Surpassed 1000 Flight Hours |
| 30 Apr | USD(A) Conducted Special DAB Review |
| 28 May | Lot IV (6 aircraft) Contract Award |
| Jun | Advance Procurement for Lot VI Contract Awarded |
| 14 Jun | First C-17s (P-6) Entered Operational Service, Initial Squadron Operations |
| Jul | First Live Personnel Airdrops (HALO) |
| 26 Aug | Second Operational C-17 (P-7) Arrived at Charleston AFB |
| 10 Sep | Second Wing Failure During Static Article Testing |
| 23 Oct | Third Operational C-17 (P-8) Arrived at Charleston AFB |
| 22 Nov | First Live Personnel Static Line Airdrops |
| 15 Dec | USD (A&T) Placed Program on Probation for Two Years; 40 C-17 |
| 30 Dec | Fourth Operational C-17 (P-9) Arrived At Charleston AFB |

1994

| | |
|---|---|
| 06 Jan | C-17 Omnibus Settlement Agreement |
| 8 Feb | Fifth Operational C-17 (P-10) Arrived at Charleston AFB |
| 25 Feb | Non-Developmental Airlift Aircraft (NDAA) System Program Office Established |
| 25 Mar | USD (A&T) Signed C-17 and NDAA Acquisition Decision Memorandum |
| 31 Mar | USD (A&T) Reported to Congress as Required |
| 1 Apr | Advance Procurement for Lot VII (six aircraft) Contract Awarded |
| 1 Apr | Final Static Test Accomplished |
| 6 Apr | Durability Testing of One lifetime (30,000 hours) Completed |
| 8 Apr | Sixth Operational C-17 (P-11) Arrived at Charleston AFB |
| 18 May | Seventh Operational C-17 (P-12) Arrived at Charleston AFB |
| 3 Jun | Lot VI (six aircraft) Contract Awarded |
| 3 Jun | C-17 Sets STOL World Record |
| 30 Jun | Eight Operational C-17 (P-13) Arrived at Charleston AFB |
| 20 Aug | Ninth Operational C-17 (P-14) Arrived at Charleston AFB |
| 28 Sep | Heavy equipment Airdrop Loads Tested to 60,000 lbs |
| 29 Sep | Tenth Operational C-17 (P-15) Arrived at Charleston AFB |
| 14 Oct | First Operational C-17 Mission |
| 18 Nov | Eleventh Operational C-17 (P-16) Arrived at Charleston AFB |
| 23 Nov | Durability Testing of 1.5 lifetimes (45,000 hours) Completed |
| 16 Dec | DT&E Completed |
| 16 Dec | Dedicated Initial Operational Test & Evaluation (DIOT&E) Initiated |
| 22 Dec | Twelfth Operational C-17 (P-17) Arrived at Charleston AFB |

1995

| | |
|---|---|
| 17 Jan | C-17 IOC Declared |
| 25 Jan | NDAA Operational Requirement Document Issued |

| | |
|---|---|
| 14 Feb | C-17 Fleet Surpassed 10,000 Flying Hours |
| 15 Feb | C-17 Awarded the Collier Aviation Trophy |
| 15 Mar | Advance Procurement for Lot VIII Contract Awarded |
| 28 Mar | MRS Bottom-Up Review Update Signed, 49.7 MTM/D |
| 31 Mar | Formal NDAA Request for Proposal Issued |
| 29 Jun | DIOT&E Completed |
| 11 Jul | Durability Testing Surpassed Two Design Lifetimes (60,000 hours) |
| 05 Aug | RM&AE Completed |
| 12 Sep | Lot VII (six aircraft) Contract Awarded |
| Oct/Nov | Milestone IIIB, DAB Decision, 120 C-17s |

1996

| | |
|---|---|
| 23 Mar | First C-17 (P-18) Delivered to Altus AFB |
| May | Congress Approved Multi-Year Purchase of 80 C-17s |
| Jun | Follow-On Operational Test & Evaluation (FOT&E) Initiated |
| 17 Jun | Durability Testing Surpassed Three Design Lifetimes (90,000 hours) |

1997

| | |
|---|---|
| 19 Dec | First Flexible Sustainment Contract Awarded to Boeing, Jan 1998-Sep 2000 |

1998

| | |
|---|---|
| Oct | Congress Approved 135 C-17s (Special Operations) |
| Dec | C-17 Operational Fleet Reached 100,000 Flying Hours |
| Dec | FOT&E Ended |

1999

| | |
|---|---|
| 30 Jul | First C-17 (P-51) Delivered to McChord AFB |
| Nov | Air Force Awarded Boeing C-17 Flexible Sustainment Contract |

2000

| | |
|---|---|
| 28 Jun | United Kingdom/Air Force C-17 Letter of Agreement Signed |
| 04 Sep | United Kingdom Contracted for Leasing Four C-17 Aircraft |
| Dec | Mobility Requirements Study 2005 Completed, 54.5 MTM/D |

2001

| | |
|---|---|
| 15 Feb | Air Force Received First Extended Range C-17 (P-71) |
| 17 May | United Kingdom RAF Received First C-17 (UK-1) |
| 15 Sep | C-17 Fleet Exceeded 290,000 Flying Hours |
| Fall | Congress Provided Authority for 60 C-17s Beyond the 120 |

2003

| | |
|---|---|
| 14 Jun | C-17 Fleet Comprised 104 aircraft and Exceeded 495,000 Flying Hours |

## APPENDIX II

### *C 17 Initial Delivery Summary*

(1991-1995)

| BUY LOT | FUSELAGE # | TAIL NUMBER | AIRCRAFT PRODUCTION NUMBER | DD 250 DATE (Boeing Mfg Complete Date) ACTUAL | CONTRACT DATE | DELTA |
|---|---|---|---|---|---|---|
| EMD | 1 | 87-0025 | T 1 | 15 Sep 91 | 30 Jun 91 | -77 |
| I | 2 | 88-0265 | P 1 | 18 May 92 | 31 Dec 91 | -139 |
| I | 4 | 88-0266 | P 2 | 21 Jun 92 | 28 Feb 92 | -114 |
| II | 6 | 89-1189 | P 3 | 7 Sep 92 | 31 Mar 92 | -160 |
| II | 7 | 89-1190 | P 4 | 9 Dec 92 | 31 Jul 92 | -131 |
| II | 8 | 89-1191 | P 5 | 12 Mar 93 | 31 Oct 92 | -132 |
| II | 9 | 89-1192 | P 6 | 10 Jun 93 | 31 Dec 92 | -161 |
| III | 10 | 90-0532 | P 7 | 26 Aug 93 | 31 Aug 93 | 5 |
| III | 11 | 90-0533 | P 8 | 29 Oct 93 | 30 Sep 93 | -29 |
| III | 12 | 90-0534 | P 9 | 30 Dec 93 | 30 Nov 93 | -30 |
| III | 13 | 90-0535 | P 10 | 8 Feb 94 | 31 Jan 94 | -8 |
| IV | 14 | 92-3291 | P 11 | 8 Apr 94 | 31 Mar 94 | -8 |
| IV | 15 | 92-3292 | P 12 | 18 May 94 | 30 Apr 94 | -18 |
| IV | 16 | 92-3293 | P 13 | 29 Jun 94 | 30 Jun 94 | 1 |
| IV | 17 | 92-3294 | P 14 | 20 Aug 94 | 31 Aug 94 | 11 |
| V | 18 | 93-0599 | P 15 | 29 Sep 94 | 31 Oct 94 | 32 |
| V | 19 | 93-0600 | P 16 | 18 Nov 94 | 31 Dec 94 | 43 |
| V | 20 | 93-0601 | P 17 | 22 Dec 94 | 31 Jan 95 | 40 |
| V | 21 | 93-0602 | P 18 | 17 Feb 95 | 28 Feb 95 | 11 |
| V | 22 | 93-0603 | P 19 | 13 Apr 95 | 30 Apr 95 | 17 |
| V | 23 | 93-0604 | P 20 | 19 Jun 95 | 30 Jun 95 | 11 |
| VI | 24 | 94-0065 | P 21 | 31 Jul 95 | 31 Aug 95 | 31 |
| VI | 25 | 94-0066 | P 22 | 29 Sep 95 | 31 Oct 95 | 32 |
| VI | 26 | 94-0067 | P 23 | 20 Nov 95 | 31 Dec 95 | 41 |

Source: HQ ASC/YCD (PO IPT), 16 January 2003.

## APPENDIX III

### *C-17 Specification Data*

**Aircraft Dimensions**

| | |
|---|---|
| Span | 169.8 feet |
| Length | 174 feet |
| Height | 55.1 feet |
| Wing Sweep | 25 degrees |
| Wing Area | 3,800 sq feet |
| Winglet Height | 8.9 feet |
| Winglet Angle | 15 degrees |

**Gross Weight Data**

| | |
|---|---|
| Maximum Takeoff Gross Weight | 585,000 pounds |
| Operating Weight | 276,500 pounds |
| | 282,500 pounds* |
| Max Payload | 167,400 pounds |
| | 164,900 pounds* |
| Typical Cargo Load | 90,000 pounds |

**Cargo Compartment**

| | |
|---|---|
| Loadable Length | 88 feet |
| Loadable Width | 18 feet |
| Loadable Height (forward) | 12.3 feet |
| Loadable Height (aft) | 14.8 feet |
| Ramp Length | 21.4 feet |
| Cargo Compartment | 20,900 cubic feet |
| Cubic Feet/pallets | 18 463L pallets |

**General**

| | |
|---|---|
| Service Ceiling | 45,000 feet |
| Cruise Speed | 0.74 Mach |
| Range w/Max Payload | 2,400 nautical miles |
| Range no Payload | 4,600 nautical miles |
| | 6,100 nautical miles* |
| Range w/Typical Cargo | 3,750 nautical miles |
| | 4,750 nautical miles* |

**Personnel Capacity**

| | |
|---|---|
| Active Crew | 3 |
| Relief Crew | 3 |
| ACM Seating | 2 |
| Sidewall Seats | 54 |
| Centerline Seats | 48 |
| Palletized Seats | 9 (15-seat) |
| Total (integral) | 102 |
| Total (integral & pallet) | 188 |

**Aeromedical**

| | |
|---|---|
| Litter 16-inch Spacing | 48 |
| Litter Floor Loaded | 60 |

**Fuel System**

| | |
|---|---|
| Total Capacity (JP-8) | 181,054 pounds |
| | 245,000 pounds* |
| Defueling Rate | 3,400 pounds/minute |
| Jettison Rate | 5,200 pounds/minute |

**Engine**

| | |
|---|---|
| Four | P&W F117-PW-100 |
| Thrust (Each) | 40,440 pounds |

*C-17 Extended Range

Source: Fact Sheet, Boeing, "C-17 Airframe Specifications," 2002; HQ AMC/DOV, November 2001; Point Paper, HQ AMC/A58A, "C-17 Palletized Seats," 18 June 2004.

## APPENDIX IV

### *C-17 Funding*

President's Budget And Appropriated (millions)

| Fiscal Year | | President's Budget | Amended | Congress |
|---|---|---|---|---|
| 1981 | RDT&E | 80.7 | 34.6 | 32.0 |
| 1982 | RDT&E | 252.0 | 0.0 | 0.0 |
| | Procurement | 22.5 | 0.0 | 0.0 |
| 1983 | RDT&E | 0.0 | 60.0 | 1.0<br>(59.0 added in 1983) |
| 1984 | RDT&E | 26.8 | 26.6 | 27.6 |
| 1985 | RDT&E | 129.3 | 123.3 | 129.3 |
| 1986 | RDT&E | 453.7 | 372.8 | 383.7 |
| 1987 | RDT&E | 612.3 | 626.3 | 650.0 |
| | Procurement | 217.3 | 182.3 | 50.0 |
| 1988 | RDT&E | 1219.9 | 1115.6 | 1119.9 |
| | Procurement | 723.7 | 667.3 | 666.2 |
| | Aircraft Buy | 2 | 2 | 2 |
| 1989 | RDT&E | 961.1 | 932.0 | 941.1 |
| | Procurement | 904.1 | 1007.0 | 900.1 |
| | Advance Procurement | 99.9 | 99.9 | 99.9 |
| | Aircraft Buy | 4 | 4 | 4 |
| 1990 | RDT&E | 954.4 | 915.2 | 885.2 |
| | Procurement | 1979.3 | 1524.0 | 1110.1 |
| | Advance Procurement | | 167.7 | 99.7 |
| | Military Construction | 4.7 | 4.7 | |
| | Aircraft Buy | 6 | 6 | |
| | Advance Aircraft Buy | 10 | 10 | |
| 1991 | RDT&E | 541.1 | 541.1 | 541.1 |
| | Procurement | 1704.5 | 834.7 | 400.0 |
| | Advance Procurement | 204.3 | 109.0 | 60.0 |
| | Spares | 237.3 | 104.7 | 80.0 |
| | Aircraft Buy | 6 | 6 | 6 |
| | Advance Aircraft Buy | 12 | 6 | 6 |

| | | | | |
|---|---|---|---|---|
| 1992 | RDT&E | 377.4 | 377.4 | 376.4 |
| | Procurement | 1975.2 | 1975.2 | 1525.2 |
| | Advance Procurement | 222.4 | 222.4 | 172.4 |
| | Spares | 176.2 | 176.2 | 126.2 |
| | Modifications | 1.6 | 0.0 | 0.0 |
| | Military Construction | 79.5 | 79.5 | |
| | Aircraft Buy | 6 | 4 | 4 |
| | Advance Aircraft Buy | 12 | 6 | |
| 1993 | RDT&E | 210.0 | 172.7 | 180.9 |
| | Procurement | 2513.9 | 1814.6 | 1810.6 |
| | Advance Procurement | 205.6 | 250.9 | 250.9 |
| | Spares | 179.2 | | |
| | Military Construction | 31 | 31.1 | 31 |
| | Aircraft Buy | 8 | 8 | 6 |
| | Advance Aircraft Buy | 12 | | 8 |
| 1994 | RDT&E | 179.8 | 232.5 | 179.8 |
| | Procurement | 2072.8 | 2285.6 | 1730 |
| | Advance Procurement | 245.5 | 222.2 | 188 |
| | Spares | 59.9 | 29.7 | |
| | Modifications | 16.5 | 2.1 | |
| | Aircraft Buy | 6 | 6 | 6 |
| | Advance Aircraft Buy | 8 | 8 | 6 |
| 1995 | RDT&E | 221.4 | 188.1 | 190.2 |
| | Procurement | 2472.9 | 2152.1 | 2168.6 |
| | Advance Procurement | 189.9 | 189.9 | 189.9 |
| | Spares | 103.1 | 103.1 | 103.1 |
| | Modifications | 6.1 | 6.1 | 6.1 |
| | Aircraft Buy | 6 | 6 | 6 |
| | Advance Aircraft Buy | 8 | ? | 8 |
| 1996 | RDT&E | 85.8 | 70.0 | 72.6 |
| | Procurement | 2402.5 | 2270.4 | 2396.0 |
| | Advance Procurement | 183.8 | 221.8 | 182.6 |
| | Spares | 117.5 | 80.0 | 95.6 |
| | Aircraft Buy | 8 | 8 | 8 |

Note: Although this appendix does not show all of the funding adjustments prior to the Presidents Budget and all of the congressional marks, it does highlight the difficult initial years. Funding numbers are best obtainable.

Source: Point Papers and memos, HQ MAC and AMC, 1981-1996; SAF/FMBIZ, September 2002.

# PHOTOGRAPHS

**I. AMST**
**II. C-17 PRODUCTION**
**III. C-17 TESTING**
**IV. C-17 OPERATIONAL**

# I. AMST

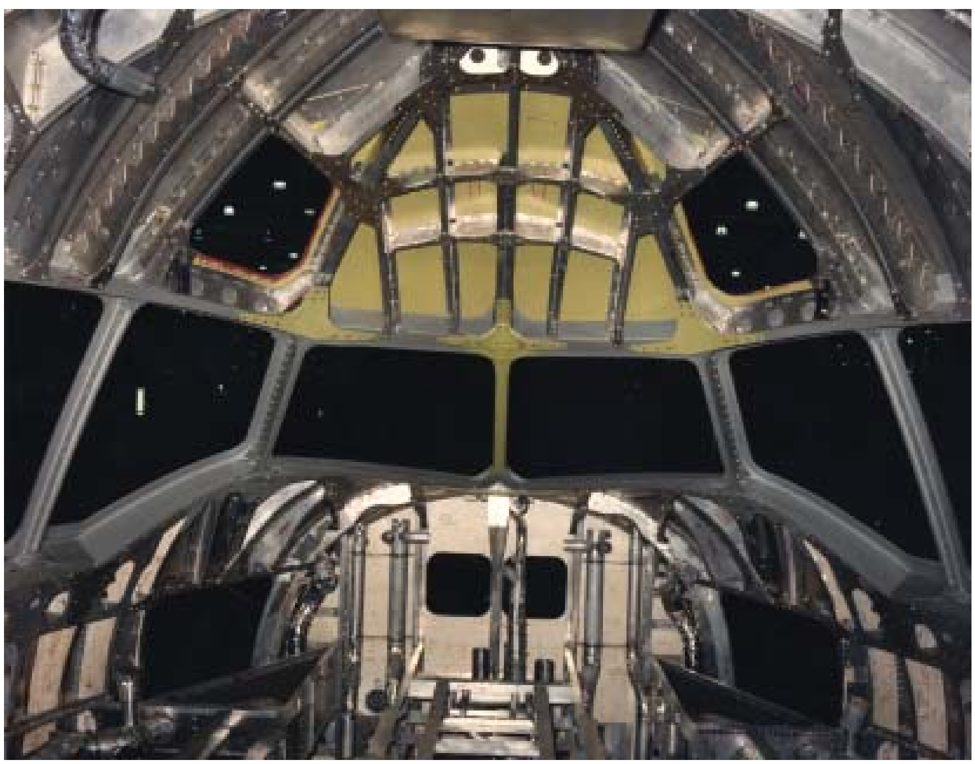
*Boeing's YC-14 taking off on its maiden flight, August 1976. (Boeing)*

*McDonnell Douglas' YC-15 performing a test flight. (McDonnell Douglas)*

# II. C-17 PRODUCTION

*One-tenth scale model. (Boeing)*

*Wind tunnel testing. (Boeing)*



*Interior of cockpit, 1988. (Boeing)*


*Forward fuselage to major join, February 1990. (Boeing)*

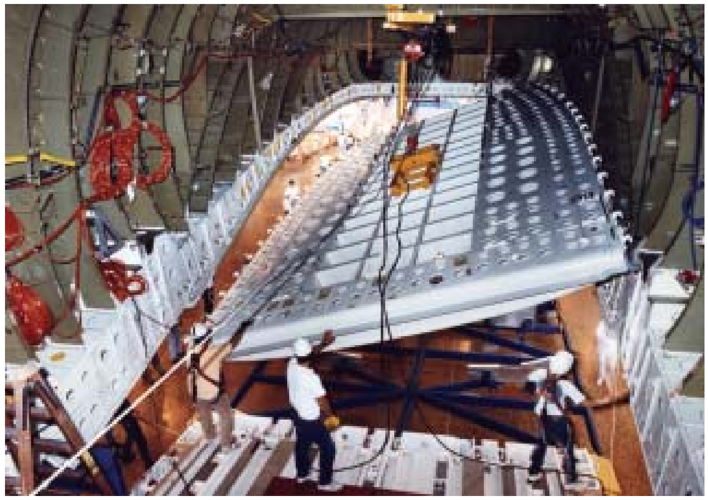
*Attaching underfloor bulkheads. (Boeing)*

*Center fuselage move. (Boeing)*

*Wings to major join move, March 1990. (Boeing)*

*Vertical spars guided to aft fuselage, April 1990. (Boeing)*

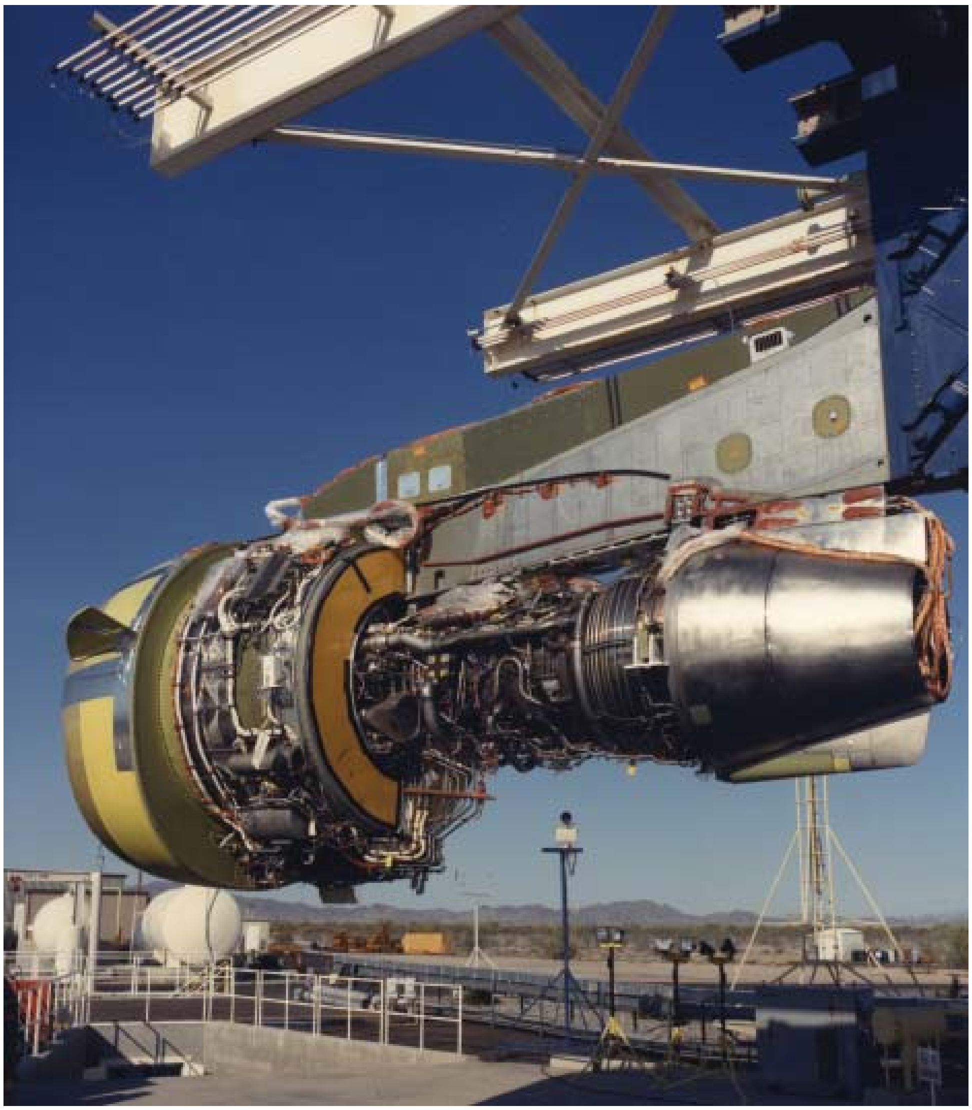
*LTV worker installing wire routing. (Boeing)*



*Installing T-1's cargo door. (Boeing)*

*Main landing gear. (Boeing)*

*T-1 out of the major join tool and moving under its own landing gear, July 1990. (Boeing)*



*Engine on test stand at Quartzsite, Arizona, July 1990. (USAF)*


*T-1 in pneumatic pit, January 1991. (Boeing)*


*T-1 undergoing ground vibration test, March 1991. (Boeing)*


*T-1 ground testing, 11 August 1991. (Boeing)*


*P-1 and P-2, January 1992. (Boeing)*

## III. C-17 TESTING

*T-1 high speed taxi with nose rotation, 12 September 1991. (Boeing)*


*First flight crew: Henry Van De Graaf, William Casey, Lt Col George London, and Ted Venturini. (Boeing)*

*T-1 landing at Edwards Air Force Base, California, after making the first C-17 flight, 15 September 1991. (Boeing)*

*Cargo door opening in flight. (Boeing)*

*Four-ship formation, one-year anniversary, 15 September 1992. (USAF)*

*T-1 making its first KC-10 refueling, 23 September 1992. (USAF)*

*P-3 landing on dry lakebed, September 1992. (USAF)*


*One of six Marine Corps light armored vehicles waiting to board P-4 for the range and payload demonstration flight of 30 January 1993. (Boeing)*

*P-3 deployed to Alaska for cold-weather testing and completed its first flight over the North Pole on 10 February 1993. (Boeing)*

*Loading the C-17 with two HUMVEES, a M1102A self-propelled howitzer (62,500 pounds), a 2.5-ton truck with trailer, and a 10-ton Oshkosh truck, Fort Hood, Texas, February 1993. (Boeing)*

*Preparing to load AH-64 Apache and OH-58C Kiowa helicopters, Fort Hood, Texas, February 1993. (Boeing)*

*Disgorging the outsized M1102A self-propelled howitzer, Fort Hood, Texas. (Boeing)*

*Loading the 130,000-pound M1A1 Abrams main battle tank, Fort Hood, Texas. (Boeing)*

*93,000-pound M-60 tank boards P-1. "Tufts" on rear fuselage record airflow patterns, Fall 1993.*

*Marines participating in emergency egress tests, Edwards Air Force Base. (Boeing)*

*Dummy drop. (USAF)*

*Practicing exiting procedures. (USAF)*

# IV. C-17 OPERATIONAL


*Operational delivery of C-17 to Charleston Air Force Base, South Carolina, 14 June 1993. General Merrill McPeak, General Ronald R. Fogleman, and Brigadier General Thomas R. Mikolajcik. (USAF)*

*First operational unit delivery. P-6 (89-1192) unloads an 110,000-pound payload upon arriving at Charleston Air Force Base, 14 June 1993. (USAF)*

*C-17 displaying anti-missile flares during a test, Eglin Air Force Base, Florida, 1994. (USAF)*

*Taszar Airfield, Hungary. When flooding along the Sava River threatened to delay the US Army's movement into Bosnia, C-17s aided efforts by transporting pontoon bridge sections, December 1995. (USAF, SrA Richard T. Kaminsky)*

*Loading a Bradley fighting vehicle during Joint Endeavor, January 1996. (USAF, TSgt Mike Moore)*

*CENTRAZBAT '97. A paratrooper from the 82d Airborne Division executes a jump from the C-17, September 1997. (USAF, SSgt Paul R. Caron)*

*Allied Force. The C-17 proved adept at flying in and out of the austere and congested Rinas Airport, Tirana, Albania. (USAF, SSgt Chris Steffen)*

*Task Force Hawk. Final approach into Tirana. Getting ready to drive off. (USAF, SSgt Efrain Gonzalez)*

*Nine-ship airdrop formation over North Field, South Carolina, January 2000. (USAF, SSgt Jeffrey Allen)*

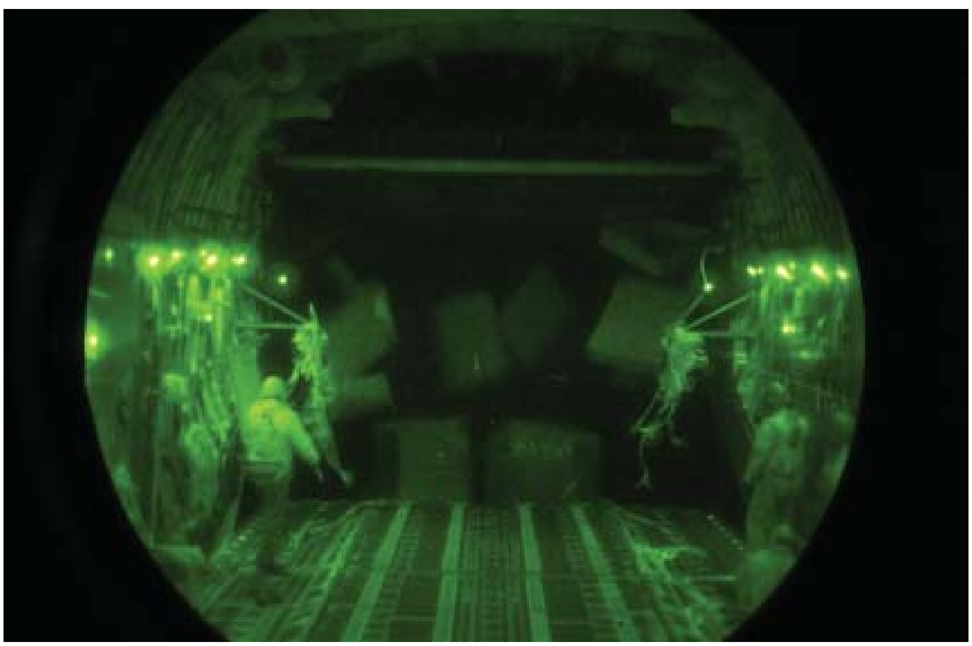

*Ramstein Air Base, Germany. Polish peacekeeping soldiers bound for Kosovo, April 2000. (USAF, MSgt Keith Reed)*


*McChord 62d Airlift Wing crew makes an assault dirt strip landing during Rodeo 2000. (USAF, TSgt James E. Lotz)*

*446th Airlift Wing crew conducting a heavy airdrop during Rodeo 2000. (USAF, MSgt James D. Mossman)*

*Air refueling from an Air National Guard KC-135 over the South China Sea in support of India earthquake relief, February 2001. (USAF, MSgt Marvin Krause)*


*82d Airborne Division Rangers jumping from a C-17 over Fort Bragg, North Carolina, August 2001. (USAF, SrA Sarayuth Pinthong)*



*Tri-walled Aerial Delivery (TRIAD) boxes breaking apart as they are dropped at high altitude over Afghanistan, releasing thousands of humanitarian daily rations, October 2001. (USAF, TSgt Cary M. Humphries)*

*Enduring Freedom. Off-loading a US Marine light armored vehicle, Pasni, Pakistan, November 2001. (USAF, TSgt Efrain Gonzalez)*

*Navy Seabee providing perimeter security for a C-17, November 2001. (USAF, TSgt Efrain Gonzalez)*

*Bundles of wheat, blankets, and dates in the cargo bay of a C-17 on a high-altitude high-opening (HAHO) airdrop mission over northern Afghanistan, December 2001. (USAF, TSgt Scott Reed)*

*Offloading a special operations MH-53J Pave Low helicopter in support of Enduring Freedom, December 2001. (USAF, TSgt Scott Reed).*

*A Charleston crew on a mission from Bagram to Kandahar International Airport, Afghanistan, February 2002. (Navy, PH1 Ted Banks)*

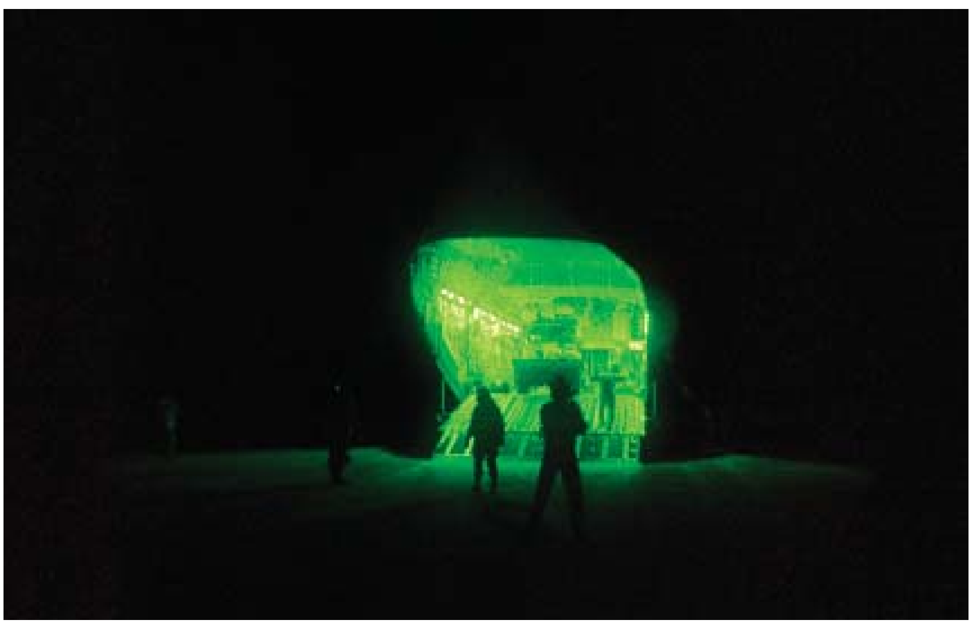
*C-17 taxis down the runway during Operation Anaconda, March 2002. (Marine, CWO-2 William D. Crow)*

*Nighttime upload of cargo, Afghanistan, April 2002. (USAF, TSgt Mike Buytas)*

*Securing stanchions on a C-17 for litter patients, Ramstein Air Base, Germany, October 2003. (USAF, TSgt Justin D. Pyle)*

*Iraqi Freedom. US Army paratroopers and Air Force tactical air controllers from the 173d Airborne Brigade preparing to move forward into northern Iraq, 26 March 2003. (USAF, TSgt Stephen Faulisi)*

*Performing the first C-17 combat heavy equipment airdrop, northern Iraq, 26 March 2003. (USAF, MSgt Billy Johnston)*



*Airlanding cargo and equipment in northern Iraq, 28 March 2003. (USAF, MSgt Billy Johnston)*

*Troops aboard a C-17 flying to Southwest Asia, Iraqi Freedom, July 2003. (USAF, SrA Karolina Gmyrek)*

*Touchdown at Bagram Airfield, Afghanistan, February 2004. (Army, SFC Joe Belcher)*

*C-17 loadmaster at his station while en route to Port-au-Prince, Haiti, March 2004. (USAF, TSgt Andy Dunaway)*

*Unloading pallets of supplies from a C-17, Balad Air Base, Iraq, April 2004. (USAF, TSgt Keith Brown)*

# GLOSSARY

| | |
|---|---|
| AFB | Air Force Base |
| AFRC | Air Force Reserve Command |
| AFSARC | Air Force Systems Acquisition Review Council |
| AFSC | Air Force Systems Command |
| AMC | Air Mobility Command |
| AMST | advanced medium short-takeoff-and-landing transport |
| ANG | Air National Guard |
| ASC | Aeronautical Systems Center |
| ASD | Aeronautical Systems Division |
| ATCA | advanced tanker cargo aircraft |
| BAI | backup aircraft inventory |
| BIT | built-in test |
| CAIG | Cost Analysis Improvement Group |
| CAMAA | Commercial Applications of Military Airlift Aircraft |
| CARP | computer air release point |
| CBR | California Bearing Ratio |
| CDR | critical design review |
| CDS | container delivery system |
| CENTRAZBAT | Central Asian Peacekeeping Battalion |
| CMMS | *Congressionally Mandated Mobility Study* |
| COEA | cost and operational effectiveness analysis |
| COMALF | commander of airlift forces |
| CONUS | Continental United States |
| CRAF | Civil Reserve Air Fleet |
| CSAF | Chief of Staff of the Air Force |
| CSS | combat service support |
| CTF | Combined Test Force |
| C-X | Cargo Transport Aircraft-Experimental |
| DAB | Defense Acquisition Board |
| DAE | Defense Acquisition Executive |
| D-bag | deployment bag |
| DIOT&E | dedicated initial operational test and evaluation |
| DIVAD Gun | division air defense gun |
| DOD | Department of Defense |
| DPRO | Defense Plant Representative Office |
| DRB | Defense Resources Board |
| DSARC | Defense Systems Acquisition Review Council |
| ECP | engineering change proposal |
| FAA | Federal Aviation Administration |

| | |
|---|---|
| FCC | Flight Control Computer |
| FEBA | forward edge of the battlefield |
| FOD | foreign object damage |
| FSED | full-scale engineering development |
| GAO | General Accounting Office |
| HLH | heavy lift helicopter |
| HMMWV | high mobility multipurpose wheeled vehicle |
| HTTB | high technology test bed |
| HUD | head-up display |
| ICA | Independent Cost Analysis |
| IDA | Institute for Defense Analyses |
| IOC | initial operating/operational capability |
| IOT&E | initial operational test and evaluation |
| IRC | Immediate Ready Company |
| JCS | Joint Chiefs of Staff |
| JROC | Joint Requirements Oversight Council |
| JWCA | Joint Warfighting Capability Assessment |
| LAPES | low-altitude parachute extraction system |
| LCG | load classification group |
| LCN | load classification number |
| LIT | light intratheater transport |
| LOC | lines of communication |
| LRIP | low rate initial production |
| LWF | Light Weight Fighter |
| MAC | Military Airlift Command |
| MAR | major aircraft review |
| MBT | main battle tank |
| MENS | mission element need statement |
| METT-T | mission, enemy, troops, terrain and weather, and time available |
| MAC | Military Airlift Command |
| MOB | main operating base |
| MOG | maximum [number of aircraft] on the ground |
| MPM/D | million passenger miles per day |
| MRC | major regional contingencies |
| MRS BURU | *Mobility Requirements Study Bottom-Up Review* |
| MTM/D | million-ton-miles per day |
| MRS | *Mobility Requirements Study* |
| NATO | North Atlantic Treaty Organization |
| NDAA | Non-Developmental Airlift Aircraft |
| OBIGGS | on-board inert gas generating system |
| ORD | operational requirements document |
| OSD | Office of the Secretary of Defense |

| | |
|---|---|
| PAA | primary aircraft authorized |
| PA&E | program analysis and evaluation |
| PEM | program element manager |
| PMD | program management direction |
| PSOC | preliminary system operational concept |
| R&D | research and development |
| RDF | rapid deployment force |
| RDJTF | Rapid Deployment Joint Task Force |
| RDT&E | research, development, test and evaluation |
| RFP | request for proposal |
| RM&A | reliability, maintainability, and availability |
| RM&AE | reliability, maintainability, and availability evaluation |
| ROC | required operational capability |
| SAF | Secretary of the Air Force |
| SAFMA | *Strategic Airlift Force Mix Analysis* |
| SECDEF | Secretary of Defense |
| SBA | strategic brigade airdrop |
| SKE | station keeping equipment |
| SLEP | service life extension program |
| SOLL II | special operations low level II |
| STOL | short-takeoff-and-landing |
| SMRP | Strategic Mobility Requirements and Programs |
| SPINS | special instructions |
| SPO | system program office |
| SSS | sources sought synopsis |
| TAC | Tactical Air Command |
| T/D | ton miles per day |
| TIM | technical interchange meeting |
| TQM | total quality management |
| TUA | *Tactical Utility Analysis* |
| USAF | United States Air Force |
| USD | Undersecretary of Defense |
| USTRANSCOM | United States Transportation Command |
| USL | universal static line |
| UTE | utilization rate |
| VAM | visual approach monitor |
| VFR | visual flight rules |
| VSTOL | vertical-short-takeoff-and-landing |
| WAMO | weight assessment management organization |

# NOTES

[1] Also known as the XC-142. This military tilt wing transport flew for the first time in 1964 but did not enter production. It was capable of hauling nearly 8 tons to include wheeled equipment and vehicles.

[2] Charles Melvin Price began his congressional career in 1945 and chaired the powerful House Armed Services Committee from 1974-1985. Headquarters Military Airlift Command, at Scott Air Force Base, was located in his district. He was especially supportive of military airlift and the C-17. However, he died in office in April 1988. Biography Sheet, Charles Melvin Price, ca 1970; Article, Jo Mannies and Patrick E. Gauen, "Humble Servant: Rep. Price Helped Mold Military Role For U.S," *St. Louis Post-Dispatch*, 23 April 1988.

[3] Hearings, House, *Military Airlift: Hearings before the Subcommittee on Military Airlift of the Committee on Armed Services*, 91st Cong., 2d sess, 1970, p 6392.

[4] Ibid. For VSTOL efforts, see: David Mondey, ed., *The International Encyclopedia of Aviation*, New York: Crown Publishers, Inc., 1977, pp 358-363.

[5] Ibid.

[6] Letter, Brig Gen George W. McLaughlin to Gen William W. Momyer, "Report of LIT Meeting with Vice Chief of Staff," 29 November 1969; Letter, Gen William W. Momyer to Gen Jack J. Catton, [Air Staff CDP on V/STOL LIT], 12 December 1969.

[7] DOD Directive, 5160.22, *Clarification of Roles and Missions of the Departments of the Army and the Air Force Regarding the Use of Aircraft*, 18 March 1957; Agreement, Gen John P. McConnell and Gen Harold K. Johnson, *Agreement Between Chief of Staff, U. S. Army, and Chief of Staff, U. S. Air Force*, 6 April 1966.

[8] Report (No. 91-59), House Armed Services Subcommittee on Military Airlift, *Military Airlift*, 91st Cong., 2d sess, 1970, pp 9230, 9231; Ray L. Bowers, *Tactical Airlift* (USAF Office of Air Force History, Washington, DC, 1983), pp 190, 191.

[9] Letter, Gen William W. Momyer to Gen Jack J. Catton, [Air Staff CDP on V/STOL LIT], 12 December 1969.

[10] Point Paper w/atch, HQ MAC/XPQA, "Advanced Medium STOL Transport (AMST)," 5 October 1976.

[11] Document, HQ TAC, *Required Operational Capability For Medium STOL Transport* (TAC ROC No. 52-69), May 1970, p 1, 2; Fact Sheet, Lt Col Vincent Hughes, AF/RDQA, "AMST," 3 February 1976.

[12] Report (No. 91-59), House Armed Services Subcommittee on Military Airlift, *Military Airlift*, 91st Cong., 2d sess, 1970, p 9230.

[13] Hearings, House, *Military Airlift: Hearings before the Subcommittee on Military Airlift of the Committee on Armed Services*, 91st Cong., 2d sess, 1970, pp 6745, 6746; Message, CSAF to PACAF and USAFE, "TAC Proposal For Modernization Of Tactical Airlift Forces, Draft TAC ROC 52-69 For Medium STOL Transport (MST)," 242045Z January 1970.

[14] In January 1967, the Air Force gained control of the C-7 Caribou and CV-7 (C-8) Buffalo tactical aircraft from the Army. In an attempt to settle who controlled and provided tactical

airlift support, the Air Force and Army chiefs of staff agreed that the Air Force assume responsibilities for the Caribous and Buffalos, as they came to be known, and relinquish rotary-wing assets except for those performing rescue and special operations while the Army retained the right to develop and operate helicopters and keep its OV-1 battlefield reconnaissance planes. See: Agreement, Gen John P. McConnell and Gen Harold K. Johnson, *Agreement Between Chief of Staff, U.S. Army, and Chief of Staff, U.S. Air Force*, 6 April 1966.

[15] Letter, Brig Gen George W. McLaughlin to Gen William W. Momyer, "Report of LIT Meeting with Vice Chief of Staff," 29 November 1969; Message, CSAF to TAC/DR, "Modernization of Tactical Airlift Forces," 051329Z May 1970; Hearings, House Armed Services, *Military Airlift*, 91st Cong., 2d sess, January and February 1970, pp 6415, 6416, 6436, 6437, 6441.

[16] Report (No. 91-59), House Armed Services Subcommittee on Military Airlift, *Military Airlift*, 91st Cong., 2d sess, 1970, 9231.

[17] Letter, Gen William W. Momyer to Gen Jack J. Catton, [Air Staff CDP on V/STOL LIT], 12 December 1969.

[18] David Packard presented before Congress his "Policies and Principles for Better Management of the Development And Acquisition of New Weapons Systems" as follows: 1. Help the services to do a better job; 2. Have good program managers with authority and responsibility; 3. Control cost by tradeoffs; 4. Make the first decision right; 5. Fly before you buy; 6. Put more emphasis on hardware, less on paper studies; 7. Eliminate total package procurement; and 8. Use the type of contract appropriate for the job. See: Hearings, House, *Hearings Before A Subcommittee On Appropriations*, 92d Cong., 1st sess, 1971, p 14.

[19] The need to support the Kennedy administration's flexible response strategy, the retirements of the C-124s, and the inability of the new C-141 and C-130Es to transport 35-45 percent of the Army's equipment resulted in the decision to build the C-5. At its onset in 1964, the cost of the C-5 program was given as $3.1 billion (not including spares). By 1969, projected costs had risen to $4.3 billion with the unit flyaway cost increasing from $18 million to $26.9 million. With the C-5 program already in question due to the cost overruns, the aircraft's wing cracked during static load testing. Based upon the cost overruns and the weak wings, Secretary of Defense Melvin Laird reduced the program from 120 to 81 aircraft. In a settlement, which allowed Lockheed to avoid bankruptcy, the acquisition cost for 81 C-5s was approximately $4.5 billion. Without an extensive wing modification program, the service life of the C-5 was estimated at 7,000 hours versus the expected 30,000. Moreover, there were operational restrictions. Thus, in the 1970s, many viewed the C-5 as an expensive acquisition, which fell far short of expected performance. Proponents pointed to the C-5's Vietnam and Israeli Airlift service. Betty R. Kennedy, ed., *Anything, Anywhere, Anytime: An Illustrated History of the Military Airlift Command, 1941-1991,* (Scott AFB, IL: Military Airlift Command Office of History, 1991), p 122; Robert F. Futrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force, 1961-1984* (Maxwell AFB, AL: Air University Press, 1989), pp 639-641.

[20] Today, it is generally acknowledged that an unrealistically low bid submitted by the Lockheed Corporation ended up distorting the total package procurement process. Lockheed underestimated costs, too, believing the C-5A to be an enhanced version of the C-141. Furthermore, the Vietnam Conflict fueled inflation beyond expectations. Prior to total package procurement, the Air Force completed a research and development phase, which amounted to 20 percent of the program's acquisition costs, and then negotiated the

production and associated equipment support contracts (the remaining 80 percent) as best it could with the contractor who had done the R&D. Assistant Secretary of the Air Force for Installations and Logistics Robert H. Charles is usually credited with the idea for total package procurement. The concept was commonly known throughout industry and in the government as the "Charles Plan." Futrell, pp 638-639; Paper, Robert H. Turtle, SAF/IL, "Total Package Procurement Concept," 10 May 1966.

[21] Hearings, House, *Hearings Before A Subcommittee On Appropriations*, 92d Cong., 1st sess, 1971, pp 3-8, 14-20.

[22] George M. Watson, *The Advanced Medium Short-Take-Off-And-Landing Transport (AMST) And The Implications Of The Minimum Engineering Development (MED) Program*, (Andrews AFB, MD: Air Force Systems Command Office of History, nd), pp 5, 6, 11; Hearings, Senate, *Department of Defense Appropriations for Fiscal Year 1977: Hearings before a Subcommittee on the Committee of Appropriations*, Part 5, 94th Cong., 2d sess, 1976, 411.

[23] Watson, *The Advanced Medium Short-Take-Off-And-Landing Transport*, pp 8-10, 12, 14; Article, Vincent C. Hughes, "The Airlift Enigma and a Plan for the Future," *Armed Forces Journal International*, October 1982, p 25; Memorandum w/atch, Robert C. Seamans Jr. to Air Force Chief of Staff, "Advanced Medium STOL Transport (AMST) Prototype Program," 10 November 1972; Fact Sheet, Lt Col Vincent C. Hughes, AF/RDQA, "AMST," 3 February 1976. While on active service with the Air Force, Col Hughes was the program element monitor for the AMST program and then the deputy director of the C-X Task Force.

[24] Document, HQ TAC, *Required Operational Capability For Medium STOL Transport* (TAC ROC No. 52-69), May 1970, p 11.

[25] Point Paper, HQ TAC/DRLL, "Advanced Medium STOL Transport (AMST)," 8 May 1974.

[26] Hearings, Senate, *Department of Defense Appropriations for Fiscal Year 1977: Hearings before a Subcommittee on the Committee of Appropriations*, Part 5, 94th Cong., 2d sess, 1976, pp 407-409; Watson, *The Advanced Medium Short-Take-Off-And-Landing Transport*, pp 17, 21.

[27] Article, Vincent C. Hughes, "The Airlift Enigma and A Plan for the Future," *Armed Forces Journal International*, October 1982, p 26.

[28]Point Paper, HQ TAC/DRLL, "Advanced Medium STOL Transport (AMST)," 8 May 1974.

[29] Watson, *The Advanced Medium Short-Take-Off-And-Landing Transport*, pp 17, 19, 21.

[30] Ibid., pp 17, 19.

[31] Letter, Gen William W. Momyer to Brig Gen Eugene W. Gauch Jr., [SEA and AMST], 31 July 1972.

[32] Point Paper, HQ MAC/XPQA, "Advanced Medium STOL Transport (AMST)," 5 October 1976; Letter w/atch, Lt Gen John F. Gonge to HQ USAF/RD, "AMST Operational Capabilities," 4 April 1977.

[33] Document, MAC, ROC (9-75), *Advanced Medium STOL Transport*, 5 December 1975, pp 1, 2; Staff Summary Sheet w/atch, HQ MAC/DOQA, "Requirement for the AMST," 30 January 1976; Background Paper, HQ MAC/XPQA, "C-14 Briefing," 22 March 1976; Letter w/atch, Lt Gen John F. Gonge to HQ USAF/RD, "AMST Operational Capabilities," 4 April 1977; E-Mail, Col (Retired) Walter S. Evans to Betty R. Kennedy, 11 June 2001.

[34] The second AN-72 prototype was on display at the 1979 Paris Air Show. In appearance, the AN-72 resembled Boeing's YC-14. In actuality, it used less sophisticated powered lift

technology. The AN-72 had a maximum payload of 8.25 tons and was built to replace the AN-26. Article, John W. R. Taylor, "Gallery of Soviet Aerospace Weapons," *Air Force Magazine*, March 1981, p 109.

[35] Watson, *The Advanced Medium Short-Take-Off-And-Landing Transport*, pp 28, 57, 69, 78; Hearings, Senate Appropriations Subcommittee, *Department of Defense Appropriations for Fiscal Year 1977*, Part 5, 94th Cong., 2d sess, 1976, pp 405-408; Comment, William R. Casey with Betty R. Kennedy, 14 August 2002. Casey, a veteran Naval aviator who flew combat missions in the F-8 and served as the Navy's V/STOL test pilot at AFFTC, joined the Douglas Aircraft Company in 1971, initially as a production and delivery pilot. Casey worked on all four of Douglas's STOL transport proposals: NASA's Q\STOL, the AMST, the C-15 production, and the C-X (C-17). He co-wrote the YC-15 Flight Manual and headed the editorial group for the initial C-17 manual. As an experimental test pilot, Casey flew the YC-15 in tests at Yuma and Edwards and in demonstrations at the Paris Air Show. He was named Douglas's chief pilot for the YC-15/C-15 in 1977 and for the C-X (C-17) program in 1980.

[36] Hearings, Senate Appropriations Subcommittee, *Department of Defense Appropriations for Fiscal Year 1977*, Part 5, 94th Cong., 2d sess, 1976, pp 488, 489; Watson, *The Advanced Medium Short-Take-Off-And-Landing Transport*, p 57; Comment, Casey, 14 August 2002.

[37] Comment, Casey, 14 August 2002.

[38] Watson, *The Advanced Medium Short-Take-Off-And-Landing Transport*, pp 15, 32, 57, 62, 64, 66, 69; Comment, Casey, 14 August 2002.

[39] Watson, *The Advanced Medium Short-Take-Off-And-Landing Transport*, pp 69, 71, 75, 78; Comment, Casey, 14 August 2002. Casey: "Only (1) the fact that the YC-15 had already demonstrated the technology and techniques required for safe and consistent short field operations to the Air Force before the YC-14 flew and (2) the blatant transfer of that technology and those techniques by Air Force [Flight Test Center] AMST personnel to the Boeing design team enabled the YC-14 to meet the short field landing criteria." Boeing initially planned a primary landing display of instrument flight rules head-down but changed to visual flight rules head up based on YC-15 results. See, Comment, Casey, 14 August 2002.

[40] Watson, *The Advanced Medium Short-Take-Off-And-Landing Transport*, pp 78, 81; Letter, Gen William G. Moore, Jr., to Gen David C. Jones, [Quarterly Activity Report], 26 July 1977.

[41] See: Study, Kenneth L. Patchin, *Flight To Israel*, (Scott AFB, IL: Military Airlift Command Office of History, 1974), pp 1-19.

[42] Besides the congressional hearings, see: Study, HQ USAF (Studies and Analysis), *Tactical Airlift in a Strategic Airlift Augmentation Role (SABER AUGMENT)*, April 1975, classified; Study, OSD, *A Report to Congress on U.S. Conventional Reinforcements for NATO*, June 1976; Study, Logistics Management Institute, Vol I: *The National Strategic Airlift Dilemma*, Vol 2: *The National Strategic Airlift Dilemma: An Approach to Solution* (commonly known as the Estes Study), April 1976; Study, JCS Memorandum 30-77, *A Report on Strategic Mobility Requirements and Programs* (known as the JCS Mobility Study), February 1977, classified; Study, Rand Corporation, *Strategic Mobility Alternatives for the 1980s*, March 1977, classified; Issue Paper, OSD (Program Analysis & Evaluation), *Strategic Airlift and Air Refueling*, July 1977.

[43] MAC ROC, "Advanced Medium STOL Transport," 5 December 1975, p 3.

[44] Ibid.

[45] Ibid., p ii; Plan, HQ MAC/XPQA, *Employment Concept For The Advanced Medium STOL Transport*, June 1975 (revised November 1976), pp 3, 12, 21.
[46] Study, HQ USAF, *Tactical Airlift Aircraft in a Strategic Airlift Augmentation Role (SABER AUGMENT)*, April 1975, p iv.
[47] Staff Summary Sheet w/atch, HQ MAC/DOQA, "Requirement for the AMST," 30 January 1976.
[48] Ibid., Article, Vincent C. Hughes, "The Airlift Enigma and A Plan for the Future," *Armed Forces Journal International*, October 1982, pp 25, 26.
[49] Staff Summary Sheet w/atch, HQ MAC/DOQA, "Requirement for the AMST," 30 January 1976; Article, Vincent C. Hughes, "The Airlift Enigma and A Plan for the Future," *Armed Forces Journal International*, October 1982, pp 25, 26.
[50] Letter, Gen Paul K. Carlton to Gen David C. Jones [Quarterly Activity Report], 3 May 1976. Memorandum, Dick Nemeth to Col Duane H. Cassidy, [Dixon Letter to Army Four-Stars], 14 May 1976.
[51] Point Paper w/atch, HQ MAC/XPQA, "Advanced Medium STOL Transport (AMST)," 14 July 1978.
[52] Report (No. 94-40), House Armed Services Subcommittee on Military Airlift, *The Posture of Military Airlift*, 94th Cong., 2d sess, 9 April 1976, 7, 8.
[53] Interview, Col (Retired) Walter S. Evans with Betty R. Kennedy, 24 September 1998.
[54] Report, Patrick J. Leahy, Senate Research & Development Subcommittee, *Strategic Mobility*, 13 May 1976.
[55] Letter, Gen Paul K. Carlton to Gen David C. Jones [C-XX], 10 January 1977; White Paper, NDTA Military Airlift Committee, "Summary Analysis," ca April 1977.
[56] Letter, Gen Paul K. Carlton to Gen David C. Jones, [Nunn Support], 24 January 1977.
[57] Message, CSAF/RD to AFSC/SD, "Use of AMST Derivative in a Strategic Airlift Primary Mission Role," 090014Z March 1976.
[58] Background Paper, HQ MAC/XPSS, "AMST Derivative for Strategic Airlift," 22 July 1976.
[59] Letter with atch, Lt Gen John F. Gonge to HQ USAF/RD, "AMST Operational Capabilities," 4 April 1977.
[60] Ibid.
[61] Background Paper, HQ MAC/XPQA, "Advanced Medium STOL Transport (AMST)," 5 July 1977.
[62] Study, USA Combined Arms Center, *Advanced Medium STOL (AMST) Study*, August 1977.
[63] Ibid.
[64] Point Paper w/atch, HQ MAC/XPQA, "Advanced Medium STOL Transport (AMST)," 14 July 1978; Letter, Gen William G. Moore, Jr., to Harold Brown, [Responses to Questions], 2 November 1977.
[65] Hearings, House Armed Services, *Military Airlift*, 91st Cong., 2d sess, January and February 1970, pp 6420, 6422, 6423, 6427, 6428; Background Paper, HQ MAC/XPQA, "C-5 Wing Modification," 8 April 1977.
[66] Proceedings, Senate, *Hearings Before Subcommittee On Priorities and Economy in Government of the Joint Economic Committee: Strategic Mobility and Military Airlift to Europe*, 95th Cong., 1st sess, 21 December 1977, pp 2, 3.
[67] Ibid., pp 31-33, 62, 63, 68, 69.
[68] Hearings, Senate Armed Services, *Department of Defense Authorization For Appropriations For Fiscal Year 1979, Part 2-Authorization*, 95th Cong., 2d sess, 1 March

1978, pp 1780, 1780.
[69] Jimmy Carter, *Keeping Faith: Memoirs Of A President*, (New York: Bantam Books, 1982), p 55.
[70] "The selection team members were never recalled after the Christmas 1977 break (the carloads of proposal material were boxed and put into storage), but it remained an active source selection. That meant that the Air Force was prohibited from any communications with the contractors except to forward queries from the source selection team. And the contractors could only communicate with the USAF in response to source selection queries. But there were no queries, because there was no source selection activity. So for several long months, Boeing, Douglas and the USAF were not permitted to communicate with one another on the subject of AMST. It was an inspired ploy." Comment, Casey, 14 August 2002.
[71] History, MAC, FY 1978, pp 216-218; Point Paper, HQ MAC/XPQA, "Advanced Medium STOL Transport (AMST)," 17 May 1977.
[72] Message, AFSC/SD to USAF/RDQ, "AMST Source Selection," 061330Z January 1978; Program Management Directive R-Q 6131 (3), USAF/RD, "Program Management Directive for Cancellation to the Advanced Medium STOL Transport (AMST) Transition Program," 10 December 1979.
[73] Report, Harold Brown, "FY 1980 Budget, FY 1981 Authorization Request and FY 1980-1984 Defense Programs," 25 January 1979.
[74] Point Paper w/atch, HQ MAC/XPQA, "Advanced Medium STOL Transport (AMST)," 14 July 1978.
[75] Letter w/atch, Gen William G. Moore, Jr., to Harold Brown, [October-December 1977 Quarterly Report], 5 January 1978; Memorandum w/atchs, Rear Admiral M. Staser Holcomb to Gen William G. Moore, "CINCMAC Quarterly Report of 3 October 1977," 17 October 1977.
[76] Statement, John C. Stetson and Gen Lew Allen, Jr., "Report to the 96th Congress," March 1979.
[77] Memorandum, Gen Edward C. Meyer to Chief of Staff of the Air Force, "Advanced Medium STOL Transport (AMST)," 5 September 1979.
[78] Report, Harold Brown, "Annual Report Fiscal Year 1979," 2 February 1978.
[79] Letter w/atch, AF/RD, "Minutes - AMST Configuration Steering Group (CSG)," 24 July 1979.
[80] Study, AF/RDQ, *Airlift Modernization: A Different Approach*, April 1979.
[81] Staff Summary w/atch, HQ MAC/XPQA, "Airlift Modernization - A Different Approach," 25 May 1979.
[82] Staff Summary w/atch, HQ MAC/XPQ, "Selling the AMST," 14 September 1979.
[83] Message, CINCMAC/CC to AFSC/CC, [Strategic STOL], 222100Z October 1979.
[84] Paper, Col Robert A. Cole, US Army War College, "The C-17: In Perspective," 23 March 1987.
[85] Report, Harold Brown, "Report of Secretary of Defense Harold Brown To The Congress On The FY 1981 Budget, FY 1982 Authorization Request and FY 1981-1985 Defense Programs," 29 January 1980, p 212.
[86] Point Paper, HQ MAC/XPQ, "Talking Paper On C-X," 2 November 1979.
[87] Interview, Col (Retired) Melvin Barrett with Betty R. Kennedy, 9 October 1998. Between 1977 and 1982, Colonel Barrett was a staff officer and mobility planner at Headquarters United States Air Force and the Office of the Joint Chiefs of Staff. He had worked on SMRP 82/83 and was part of the initial group that established the Rapid Deployment Joint

Task Force and United States Central Command. Following his retirement, he was for many years the manager of the Lockheed Martin Corporate Field Office in O'Fallon, Illinois, responsible for marketing activities with the United States Transportation Command and Air Mobility Command.

[88] Memorandum, Donald Rumsfeld to Service Secretaries, "Strategic Mobility Requirements and Programs," 12 July 1976; Study, HQ AF/RDQ, *Airlift Modernization: A Different Approach*, April 1979, pp 3, 4.

[89] Study, HQ AF/RDQ, *Airlift Modernization: A Different Approach*, April 1979, p 1.

[90] Interview, Barrett, 9 October 1998. Specifically, the five-year defense plan called for mobility forces to quickly deploy the Rapid Deployment Joint Task Force to Southwest Asia while preparing to deliver five more divisions in 10 days to Europe, joining the five divisions and two regiments already there. The plan also included tripling the number of US combat planes in Europe in 7 days. See: Report, Harold Brown, "Report of Secretary of Defense Harold Brown to the Congress on the FY 1981, FY 1982 Authorization Request and FY 1981-1985 Defense Programs," 29 January 1980, pp 110, 111, 207, 210, 211.

[91] Report, OSD, *A Report to Congress on US Conventional Reinforcements to NATO*, June 1976, pp i, III-2.

[92] Report, JCS/J3, Nifty Nugget '78 Executive Summary, ca 1979, pp EX-10-12, EX-20, EX-25, EX-26. Nifty Nugget showed "a great shortfall in lift and in effect delayed the C-17 by buying C-5B and KC-10. We made the case so well for the need for lift, [that] they satisfied it in the wrong way. The cost of the C-17 being bought today is directly related to these decisions." Comment, Gen (Retired) Duane H. Cassidy with Betty R. Kennedy, October 2002. Gen Cassidy served as the Commander-In-Chief of the Military Airlift Command from September 1985-September 1989 and as Commander-In-Chief of the United States Transportation Command from July 1987 through September 1989.

[93] Paper, Col Cole, 23 March 1987, pp 8, 9; Study (86-1270), Maj Charles L. Johnson II, Air Command and Staff College, *Acquisition of the C-17 Aircraft-An Historical Account*, 1986, pp 31, 32, 34, 35; Biography, "General Fred Keith Mahaffey," 3 October 1986; Article, "Gen. Fred K. Mahaffey Dies; Chief of Readiness Command," unkn, 16 October 1986; Biography Sheet, HQ USMC/Div of Information, "Major General George W. Smith," September 1976. Task Force date is per Headquarters USAF's *Daily Staff Digest*.

[94] The original C-X Task Force members were: Maj Gen Emil N. Block; Cols Jerry P. Harmon, Vincent C. Hughes, and Montgomery (USA); Lt Cols Bartels (USMC), Richard J. Evers, Tom R. Luce, Craig H. Mandeville (USA), Marion D. Robertson Jr., and Dalton Wirtanen; Majs Michael T. Clay, Roger Coffey, Robert A. Cole, Walter S. Evans, Robert F. Ewart, Faggard, Henry G. Hamby III, Thomas R. Mikolajcik, and William B. Owens; and civilian Mr. John Carlson. When the task force disbanded in the summer of 1980, Col Hughes, Lt Col Robertson, and Majs Ewart and Evans continued with the C-17 program at Headquarters Military Airlift Command. Maj Mikolajcik became part of the Congressionally Mandated Mobility effort on the Air Staff. Lt Col Mandeville and Maj Ewart would work for McDonnell Douglas following their military careers.

[95] Biography Sheet, HQ USAF/Office of Information, "Major General Emil N. Block Jr.," August 1979; Interview, Walter S. Evans, 24 September 1998; Interview, Barrett, 9 October 1998; Paper, Col Cole, p 9.

[96] Interview, Walter S. Evans, 24 September 1998.

[97] Ibid.; Study, Johnson, pp 32, 34, 35.

[98] Directive (PMD R-C 0020(1), Maj Gen Emil N. Block Jr., HQ USAF/RD-CX, "Implementation Of C-X Program," 10 December 1979; Interview, Walter S. Evans, 24

September 1998; Paper, Col Cole, pp 8, 9.
[99] Paper, Dyke McCarthy, "The Acquisition of Major Systems," 1986, extracted from Air Command and Staff College Correspondence Lesson Booklet 35A L12 8805, circa 1988. For background on organizational and management changes, see: Lawrence C. Benson, *Acquisition Management in the United States Air Force and its Predecessors* (Washington, D.C.: Air Force History and Museums Programs, 1997).
[100] Directive (PMD R-C 0020(1), Maj Gen Emil N. Block Jr., HQ USAF/RD-CX, "Implementation Of C-X Program," 10 December 1979.
[101] Letter, Col Vincent C. Hughes to AF/RD, "General Officer Review of C-X Program on 14 December 1979,"13 December 1979.
[102] Study, Johnson, p 31.
[103] Per HQ Aeronautical Systems Division organizational charts, the following people comprised the initial C-X SPO effort: Brig Gen Elbert E. Harbour, director; David G. Ward, deputy director; Sgt. T. Ellis, administration; Thomas J. Griffin and then Thomas Volmer, configuration and data management; J. Carlson, engineering; E. J. Raimondi, engineering; Roger M. Ashley and then Col Richard F. Gillis, integrated logistics support; Lt Col Dalton Wirtanen and then Col Robert S. Jennings, projects; Lt Col Andrew Loundermon and then Lt Col H. H. Carothers, test and evaluation; Cpt Louis R. Albani and then Maj Ronald Swenka, quality assurance; Thomas F. Higgins Jr.; contracts; Lt Col Leonard R. Tavernetti, Army projects, and Lt Carolyn Walker, program control. Lt Col Tavernetti later worked for McDonnell Douglas. Study, Johnson, p 33; Biography Sheet, HQ USAF/PA "Major General Elbert E. Harbour," September 1988.
[104] Study, Johnson, p 33; Biography Sheet, HQ USAF/PA "Major General Elbert E. Harbour," September 1988.
[105] Study, Johnson, p 33.
[106] Report, ASD/SD29, "Semiannual Historical Report, 1 July - 31 December 1979," ca January 1980; Memorandum w/atch, Jacob W. Reichert, "Submittal of Historical Data for the C-X Aircraft Program Covering the Period of 1 Jan 80 thru 30 Jun 80," 7 August 1980; Report, David G. Ward to AFH, "Historical Report for the Directorate of C-X 1 July - 31 Dec 80," 9 January 1981; Study, Johnson, p 33; Comment, Casey, 14 August 2002. Casey provided: "The C-X Program was, for several years, administered by the Trainer-Airlift SPO which, as the names implies, also handled all the Lockheed Marietta airlift products. Any C-X enthusiasts at that SPO were overwhelmed by the Lockheed advocates there, and as a result, the C-X Program got short shrift from the SPO for years. Only when a dedicated C-17 SPO was created did the program begin to receive appropriate oversight. I think there is a lesson for program planners here. Letting the competition run a program's SPO does not promote program well-being."
[107] Paper, Col Cole, 23 March 1987, pp 10-11.
[108] Interview, Walter S. Evans, 24 September 1998.
[109] Ibid., Paper, Col Cole, pp 11,12; Briefing, HQ AF/RD, C-X Task Force, "C-X An Airlift Aircraft," circa January 1980.
[110]Interview, Walter S. Evans, 24 September 1998.
[111] Paper, Col Cole, pp 12-14; Briefing, HQ AF/RD, C-X Task Force, "C-X An Airlift Aircraft," circa January 1980; Interview, Brig Gen Charles L. Johnson II with Betty R. Kennedy, 22 December 1999. Lt Gen Johnson had a long association with the C-17 program: first serving as a young captain and major on Brig Gen Harbour's C-17 SPO staff, then Chief of the C-17 Division at Headquarters Military Airlift Command, Commander of the 97th Operations Group at Altus Air Force Base, C-17 SPO Director, and lastly Director of

Plans and Programs at Headquarters Air Mobility Command. Col Evans related that interested contractors understood the Air Force did not want an aircraft with too many working parts—the lessons from the C-5's main landing gear, kneeling, and dual doors. See, Interview, Walter S. Evans, 24 September 1998.

[112] Document, HQ AF/RD, "C-X Preliminary System Operational Concept," 22 January 1980, p 5. This same statement is repeated in the "C-X System Operational Concept" dated March 1981.

[113] Ibid., pp 12, 13.

[114] Ibid., p 20.

[115] Ibid.

[116] Ibid., pp 4, 14-17

[117] Interview, Walter S. Evans, 24 September 1998.

[118] History, MAC, 1980, p 75; Paper, Col Cole, p 14.

[119] Message, HQ USAF/RD-CX, "C-X Performance Criteria, Cost and Schedule," 151755Z February 1980; Letter w/atch, HQ AF/RD-CX, "Revisions to the C-X Preliminary System Operational Concept," 25 March 1980; Directive, R-C0020(4), Maj Gen Emil N. Block Jr., HQ USAF/RD-CX, "Program Management Directive for C-X Program," 18 April 1980; Letter, Maj Gen Emil N. Block Jr. to HQ AFSC/SD, "Revisions to the C-X Preliminary System Operations Concept (PSOC) and Request for Proposal (RFP), 26 April 1980; Letter, Maj Gen Emil N. Block Jr. to HQ AFSC/SD, "Revisions to the C-X Preliminary System Operations Concept (PSOC)," 15 July 1980; Directive, R-C0020(6), Brig Gen Click D. Smith, HQ USAF/RDQ-CX, "Program Management Directive for Implementation of C-X Program," 21 July 1980; Study, Johnson, p 31.

[120] Memorandum, Russell Murray to Hans Mark, "CX Analysis," 3 March 1980.

[121] Ibid.

[122] Ibid.

[123] Ibid.

[124] Memorandum, Hans Mark to Russell Murray, "C-X Analysis," 17 March 1980.

[125] Ibid.

[126] Ibid.

[127] Memorandum, Russell Murray to Hans Mark, "CX Analysis," 3 March 1980.

[128] Staff Summary Sheet, HQ MAC/XPQ, "C-X Related Issues for the 1981 Congressional Committee Hearings," 30 October 1980.

[129] The administration revised the budget request to $81.3 million.

[130] Letter, Richard H. Ichord to Harold Brown, [C-X funding], 20 March 1980.

[131] Ibid.

[132] Study, Johnson, p 51; Paper, Col Cole, 23 March 1987, pp 16, 17; Hearings, House Armed Services Committee, *Military Posture and Department of Defense Authorization For Appropriations For Fiscal Year 1981*, Part 1, Part 3, Part 4, Part 5, 96th Cong., 2d sess, 4 February, pp 866; 7 February, pp 3, 530-541; 8 February, pp 4, 7, 14, 15; 5 March, pp 483, 484; and 14 March 1980, pp 2479.

[133] Quoted in Study, Johnson, p 51.

[134] Willard J. Webb and Ronald H. Cole, *The Chairmen of the Joint Chiefs of Staff*, (Washington, D. C. : Historical Division, Joint Chiefs of Staff, 1989), pp 101, 103.

[135] Hearings, House Appropriations Subcommittee, *Department of Defense Appropriations For 1981*, 96th Cong., 2d sess, 1980, p 601.

[136] Ibid.

[137] Memorandum, W. Graham Claytor Jr., "Congressionally Mandated Mobility Study," 27 June 1980.
[138] Ibid.
[139] Ibid.
[140] Paper, Col Cole, p 17.
[141] Study, Johnson, p 52.
[142] Extract, HQ USAF Budget Digest 4, "Congressional Action Items - Appropriation," 9 March 1981.
[143] Article, Everett A. Chambers, "Airlift: Finding the Plane to Fit the Mission," *Armed Forces Journal International*, November 1982, p 48. While in the Air Force, Col Chambers served as chief of airlift operational requirements at Headquarters USAF from 1975-1979. After his retirement, he worked for McDonnell Douglas as the manager of government marketing.
[144] Letter, Lt Gen Lawrence A. Skantze to The Boeing Co., McDonnell Douglas Corp., and Lockheed Corp., "C-X Acquisition Program Request for Proposal," 15 October 1980; Message, HQ USAF/RDQ to HQ AFSC/SD, "PMD #R-Q0020(8) C-X Program," 151600Z October 1980; Letter w/atchs, Col James D. Kellim to CINCMAC, Advisors to C-X Source Selection Evaluation Board (SSEB)," 27 October 1980.
[145] Memo, Gen John W. Vessey Jr. to Gen Robert E. Huyser, [C-X Tactical], 30 September 1980.
[146] Letter w/atch, HQ AFLD/SD to AFLC/LOA, "General Officer Steering Group: C-X Aircraft (Your Ltr, 21 Dec 79)," 10 January 1980.
[147] Memorandum, Gen John W. Vessey Jr. to AF Vice Chief of Staff, "C-X Airlift Aircraft," September 1980.
[148] Ibid.
[149] Letter, Gen Robert E. Huyser to Gen John W. Vessey Jr., [Army Tactical Concerns], 14 October 1980.
[150] Ibid.
[151] Letter w/atch, HQ MAC/XPQA to HQ MAC/DO/IG/LG/XO/TR, "MENS for C-X," 6 December 1979; Memorandum for Secretary of the Air Force, "Mission Element Need Statement (MENS) for C-X," 28 November 1980; Staff Summary Sheet w/atch, HQ MAC/XPQA, "C-X Mission Element Need Statement (MENS)," 5 December 1980.
[152] Paper, Col Cole, p 18.
[153] Article, Benjamin F. Schemmer, "Pentagon's Top Civilians Almost Belly-land C-X Before It Takes Off," *Armed Forces Journal International*, December 1980, pp 23, 30, 57.
[154] Ibid.
[155] Quoted in Message, HQ USAF/RD to AFSC/CV, "Airlift and C-X Program Objective," 261510Z November 1980.
[156] Letter, Brig Gen Elbert E. Harbour to Boeing, McDonnell Douglas, and Lockheed, "Near Term Additional Airlift Capability," 8 December 1980.
[157] Letter, Lt Gen Thomas M. Ryan Jr. to ASD/CC, "Commercial Freighters as A Near-Term Solution to the Airlift Shortfall," 7 August 1980; Staff Summary Sheet, HQ MAC/XPQA, "Commercial Freighters as a Near-Term Solution to the Airlift Shortfall," 5 August 1980.
[158] History, MAC, 1980, pp 447, 449, 451; Letter, Hans Mark to Gen Robert E. Huyser, [CRAF Program], 25 March 1980.
[159] Memo, Gen Robert E. Huyser to Lt Gen Thomas M. Ryan Jr., [DC-10 and Interim Solution], 11 August 1980.

[160] Letter, Lt Gen William H. Tunner to Gen Lew Allen Jr., [C-X], 1 September 1980.
[161] Article, Maj Edward F. Wittel, "Interview Robert E. Huyser General," *Airlift Operations Review* (Scott AFB, IL), January 1981, p 5.
[162] Ibid.
[163] Hearings, Senate Armed Services, *Department of Defense Authorization For Appropriations For Fiscal Year 1979*, Part 2, 95th Cong., 2d sess, 1 March 1978, p 1781.
[164] Letter, Hans Mark to Gen Robert E. Huyser, [End-Of-Tour Letter], 2 February 1981.
[165] Staff Summary Sheet w/atch, Major Walter S. Evans, "C-X Update," 1 December 1980.
[166] Notes, Col Vincent C. Hughes, "C-X Review," 1 December 1980.
[167] Ronald Reagan, *An American Life* (New York: Simon and Schuster, 1990), p. 562.
[168] Caspar W. Weinberger, *Fighting For Peace: Seven Critical Years in the Pentagon* (Warner Books, 1990), pp. 50, 69, 77-79, 332; Roger R. Task, *The Secretaries of Defense A Brief History, 1947-1985* (Washington, D. C.: Historical Office, Office of the Secretary of Defense, 1985), pp 50-51.
[169] Ronnie Dugger, *On Reagan: The Man & His Presidency* (New York: McGraw-Hill, 1983), p 27.
[170] Task, pp 49-51; Weinberger, *Fighting For Peace*, pp. ix, 42; Biography Sheet, HQ USAF/PA, "Verne Orr," November 1983.
[171] Task, p. 51; Weinberger, *Fighting For Peace,* pp. 42-45.
[172] Ronnie Dugger, *On Reagan: The Man & His Presidency* (New York: McGraw-Hill, 1983), p 27.
[173] Brief History, Dr. Jay E. Hines, US Central Command, circa 2001.
[174] National Security Decision Directive No. 219 (classified), *Implementation of the Recommendations of the President's Commission on Defense Management*, 1 April 1986, information used unclassified; Memorandum, Ronald Reagan to Caspar W. Weinberger, "Establishment of the Unified Transportation Command," 18 April 1987; Short History, Dr. James K. Matthews, United States Transportation Command, January 2000.
[175] Hearings, Senate Armed Services Committee, *Department of Defense Authorization For Appropriations For Fiscal Year 1981*, Part 4, 96th Cong., 2d sess, 22 April 1980, p 2610.
[176] The Navy desired a more in-depth look at sealift and included the Northeast Asian Theater. The classified study postulated that additional prepositioning and sealift resources were needed if funding constraints prevented achieving the airlift programs.
[177] The 1986 baseline of forces included the following programs: the C-5 wing modification, additional C-141/C-5 spares and crews, the Civil Reserve Air Fleet Enhancement program, the SL-7 Fast Dedicated Sealift program, six divisions of prepositioning of materiel configured to unit sets (POMCUS) in NATO, additional Air Force and Marine prepositioning in NATO, the Maritime Prepositioning Ship program.
[178] Letter, Frank C. Carlucci III to John G. Tower, [CMMS], 15 April 1981; Study (classified), DOD, *Congressionally Mandated Mobility Study*, Vol 1, 30 April 1981, pp 1-14, 21-25, 34, 37, information used is unclassified.
[179] Study (classified), DOD, *Congressionally Mandated Mobility Study*, Vol 1, 30 April 1981, p 26, information used is unclassified.
[180] Per the 1999 edition of *The World Almanac*, the public debt of the United States was $997.9 billion in 1981; five years later it had more than doubled to $2,125.3 billion (1986). For these same years, the federal deficit rose from $78.936 billion to $221.140 billion.
[181] Interview, Barrett, 9 October 1998.

[182] Letter, Howard W. Cannon to Gen Robert E. Huyser, [C-X Support/Funding], 30 April 1981.
[183] Memo, Gen Robert E. Huyser to XP, [C-X Support Warner and Kelley], 25 March 1981; Message, MAC/CC to REDCOM/CC, "C-X Program Support," 262415Z March1981.
[184] Message, MAC/CC to REDCOM/CC, "C-X Program Support," 262415Z March1981.
[185] Hearings, Senate Armed Services, *Department of Defense Authorization For Appropriations For Fiscal Year 1982, Sea Power And Force Projection*, Part 4, 97th Cong., 1st sess., 9 March 1981, pp 1721, 1728, 1729.
[186] Message, MAC/CC to REDCOM/CC, "C-X Program Support," 262415Z March1981.
[187] Notes, HQ MAC, "C-X," April-June 1981.
[188] Press Release, Senate Armed Services Committee, [Department of Defense Authorization Bill for FY 1982], 28 April 1981; Staff Summary Sheet w/atchs, HQ MAC/XPSA, "Congressional Support for C-17," 16 October 1981.
[189] Staff Summary Sheet w/atchs, HQ MAC/XPSA, "Congressional Support for C17,"16 October 1981; Notes, HQ MAC, "C-X," April-June 1981.
[190] Interview, Barrett, 9 October 1998; Biography Sheet, HQ USAF/PA, "General Robert E. Huyser," December 1979.
[191] Extract, Department of Defense Authorization Act, 1982, "Conference Report," 3 November 1981; Letter, Frank C. Carlucci III to John G. Tower, [Funding], 16 October 1981; Letter, Frank C. Carlucci, III to Melvin Price, [Funding], 17 November 1981; Letter, Gens Robert H. Barrow, Edward C. Meyer, and Lew Allen Jr. to Ted Stevens, [C-17 Funding], 25 November 1981; Article, George C. Wilson, "City Hall-Style Politics Spill Over Into Pentagon Plane Selection," *The Washington Post*, 28 November 1981, p A2.
[192] Article, "Orr on CX Cuts: 'I Don't Think You Can Fault Congress,'" *Aerospace Daily*, 10 November 1981, p 53.
[193] Memorandum, Gen Edward C. Meyer to Gen Lew Allen Jr., "C-X Aircraft," 15 June 1981.
[194] Letter, Lt Gen Robert C. Kingston to Lt Gen James E. Dalton, [C-X Support], 4 August 1981; Notes, HQ MAC, "C-17 Program," October-December 1981.
[195] Letter, Gens Robert H. Barrow, Edward C. Meyer, and Lew Allen Jr. to Ted Stevens, [C-17 Funding], 25 November 1981.
[196] History, ASD, 1 October 1980-September 1981, p 32.
[197] Study, Johnson, pp 159, 160.
[198] Memo w/atchs, Brig Gen Elbert E. Harbour to Maj Gen James W. Stransberry, "C-X Unit Price Matrix," 3 October 1980.
[199] Memorandum, Hans Mark to Gen Lew Allen Jr., "C-X Source Selection," 6 December 1980; Chart, ASD, "C-X Source Selection Organization," ca December 1980; List, HQ ASD, "C-X Source Selection Evaluation Panel Participants/Assignment," ca December 1980; Letter, HQ MAC/CS-CX to CINCMAC/CVE, "CINCMAC/CV Opening Remarks to C-X Source Selection Team," 24 October 1980; Biography Sheet, HQ USAF/PA, "Brigadier General Thomas D. Pilsch," February 1993. The January 1980 C-X Preliminary System Operational Concept document defined the alternate missions under consideration. Col Donald Dessert recalled that out of the AMC source selection team only he and a few other members had flown both tactical and strategic airlift aircraft. Thus, the experiences source selection members brought required careful consideration. Interview, Col (Retired) Donald M. Dessert Jr. with Betty R. Kennedy, 12 June 2002. Besides serving as the C-17 OT&E Test Director (1989-1996), Col Dessert was a test manager at HQ MAC (1976-1979), a member of the operational utility panel evaluating ground operations on the C-17

source selection team (1981), and a C-17 program element manager at HQ USAF (1983-1986).
[200] Extract, HQ ASD, C-X RFP, "Section M," 15 October 1980.
[201] Extract, HQ ASD, C-X RFP, "Appendix 2 Mission Scenarios," 15 October 1980.
[202] Extract, HQ ASD, C-X RFP, "C-X System Specifications," 15 October 1980.
[203] Interview, Walter S. Evans, 24 September 1998; Interview, Barrett, 9 October 1998; Interview, Dessert, 12 June 2002.
[204] Schedule, C-X SPO, "C-X Source Selection Schedule," 15 December 1980; Study, Johnson, pp. 165, 167.
[205] Interview, Walter S. Evans, 24 September 1998. Col Dessert, likewise, agreed that Lockheed's proposal was minimal due to their desire to sell more C-5s and actually offended source selection members, most of whom flew Lockheed aircraft. Interview, Dessert, 12 June 2002.
[206] Letter, Verne Orr to John G. Tower, [C-5 Elimination], 24 April 1981.
[207] Notes, HQ MAC, "C-17 Program (Formerly C-X Program)," June-September 1981.
[208] Ibid. The notes also disclosed that Secretary Orr had requested from Deputy Secretary of Defense Carlucci that he be allowed to announce the C-X contractor before the Defense System Acquisition Review Council. Carlucci agreed to this arrangement. As it happened, the council was briefed on 21 August, and the source selection announcement was made on 28 August. The council session revealed that not everyone at the OSD level was totally behind the C-X decision. Ms. Deborah P. Christie, the OSD Director of Mobility Forces Division, wanted the C-5 considered.
[209] Memorandum, Verne Orr to ASD/CC, "C-17 Research and Development," 12 June 1982; Notes, HQ MAC, "C-17 Program (Formerly C-X Program)," June-September 1981. Actual designation date for C-17 was 8 September.
[210] Paper, Col Cole, p 22.
[211] Interview, Johnson, 22 December 1999.
[212] Ibid.
[213] Document, "Specifications of the McDonnell Douglas C-X Aircraft," ca 1980.
[214] Report, HQ MAC, *Validation of the Requirements Concepts and Design for the C-17*, November 1983, pp 11- 15, 22-25; Brochure, McDonnell Douglas, "USAF/McDonnell Douglas C-17," ca 1982, p 14; Brochure, McDonnell Douglas, "C-17: Airlift For The 21st Century," April 1989; Interview, Dessert, 12 June 2002.
[215] In April 1981, at the request of the source selection board, HQ USAF had issued Program Management Directive #10, which revised the IOC date and number of aircraft from 16 to 12.
[216] Document, "Specifications of the McDonnell Douglas C-X Aircraft," ca 1980; Study, Johnson, p. 167.
[217] Memorandum, Verne Orr to ASD/CC, "C-17 Research and Development," 12 June 1982.
[218] Later in 1981, Lockheed offered 50 C-5Ns for $4.557 billion. 50 provided for spare aircraft. Point Paper, HQ MAC/XPQA, "C-5B Program Status," 2 March 1984.
[219] Letter, Roy A. Anderson to Verne Orr, [Lockheed's Proposal], 14 September 1981.
[220] Ibid.
[221] Proposal, Lockheed Georgia Company, *C-5 Airlift Augmentation Proposal*, September 1981, pp. v, vi, 4-1, 4-3, 4-4.
[222] Ibid., p 4-4.

[223] Ibid., p. 4-5. Col Dessert, a C-5 pilot, participated in these tests and remembered: "The C-5 was capable but its size was the LIMFAC [limiting factor]. Soil strength was a difficult argument even for the C-17." Interview, Dessert, 12 June 2002. Likewise, with firsthand knowledge, Col Evans expressed the same view as Col Dessert. See, Interview, Walter S. Evans, 24 September 1998.
[224] Ibid., pp. 4-5, 6-3, 6-4; Point Paper, HQ MAC/XPQA, "C-5B Program Status," 2 March 1984.
[225] Message, CINCMAC/CV to HQ USAF/RD/SA, "Lockheed Corporation Ltr, 25 Sep 1981," 121630Z October 1981.
[226] Ibid.; Letter, Maj Gen Wayne E. Whitlatch to Gen Lew Allen Jr., [C-5A OUE], 19 November 1981.
[227] Point Paper, HQ MAC/XPQA, "C-5 Proposal," 24 September 1981.
[228] Notes, HQ MAC, "C-17 Program (Formerly C-X Program)," September 1981; Staff Summary Sheet w/atchs, HQ MAC/XPQA, "C-17 Certification Update," 17 September 1981; Notes, HQ MAC, "C-17 Program," December 1981.
[229] Letter, Caspar W. Weinberger to John G. Tower, [C-X Certification], 7 December 1981.
[230] Ibid.
[231] Memorandum w/atch, Richard D. DeLauer to Secretary of Defense, "Airlift Acquisition," 27 November 1981.
[232] Ibid.
[233] Letter, Maj Gen Perry M. Smith to James P. Wade Jr., [C-17/C-5 debate], 16 December 1981.
[234] Ibid.
[235] Memorandum, Frank C. Carlucci III to Secretary of the Air Force, "Airlift Acquisition," 22 December 1981; Memorandum, Edward C. Aldridge Jr. to Secretary of Defense, "C-X Congressional Certifications," 22 September 1981.
[236] With the 16 KC-10s already on order as the advanced cargo tanker aircraft (ACTA), the Air Force would have an inventory of 60 KC-10s.
[237] Notes, HQ MAC, "C-17 Program," December 1981; House Congressional Record, January 1982, pp 4267, 4268; Article, Clarence A. Robinson Jr., "Decision on C-5 Bypasses Military Leaders," *Aviation Week & Space Technology*, 25 January 1982, p. 18.
[238] Hearings, Senate Armed Services, *Department Of Defense Authorization For Appropriations For Fiscal Year 1983, Defense Management Report, Army Programs, Navy-Marine Programs, Air Force Programs*, Part 2, 97th Cong., 2d sess., 16 April 1982, pp 1288, 1289, 1346, 1347; Briefing, Lt Gen Kelly H. Burke to Pentagon Press, [C-5 Decision], 26 January 1982. Col Gallagher remarked that he and others left the Pentagon Friday afternoon thinking the C-17 program was fine, only to be shocked by Secretary Orr's announcement on Monday. See, Interview, Col Michael R. Gallagher with John W. Leland, 2 February 1994, p 18. Assigned to the Airlift Forces Division, Col Gallagher worked C-17 force structure issues at Headquarters United States Air Force from 1982-1985. In July 1991, he became the assistant deputy chief of staff for requirements at Headquarters Military Airlift Command, subsequently Air Mobility Command.
[239] Briefing, Lt Gen Kelly H. Burke to Pentagon Press, [C-5 Decision], 26 January 1982.
[240] Ibid.
[241] A figure of $11 billion was also cited but this included the KC-10 program for about $3 billion and $2.5 billion for C-17 research and development.
[242] Ibid.

[243] Memorandum w/atch, Verne Orr to Chairman Joint Chiefs of Staff, "Airlift Enhancement Program," 5 February 1982.
[244] Ibid.
[245] Ibid.; Memorandum, Thomas S. Falatko to Under Secretary of Defense for Research and Engineering, and others, "Airlift Enhancement Program," 8 February 1982; Message, USAF/LL to ALMAJCOM, "The Following Text Was Released To Selected Members of Congress Today, 27 January 1982, And Constitutes an Official Air Force Position On The C-5/C-17 Issue," 272035Z January 1982.
[246] Memorandum w/atch, Verne Orr to Chairman Joint Chiefs of Staff, "Airlift Enhancement Program," 5 February 1982.
[247] Memorandum, David C. Jones to Secretary of the Air Force, "Airlift Enhancement Program," 26 February 1982.
[248] Ibid.
[249] Article, Edward W. O'Brien, "McDonnell Loses to Lockheed," *St. Louis Post-Dispatch*, 20 January 1982, pp 1A, 4A.
[250] Article, George C. Wilson and Morton Mintz, "Choice of C-5 Transport Over McDonnell Jet Called 'Scandal,'" *St. Louis Globe-Democrat*, 15 April 1982, p 18A; Letter w/atch, John T. Sant to William H. Taft IV, [Restart of C-5 Production Contract], 5 November 1981.
[251] Quoted in Study, Johnson, p 255.
[252] Editorial, William H. Gregory, "Fallout From the C-17 Decision," *Aviation Week & Space Technology*, 1 March 1982, p 11.
[253] Ibid.
[254] It should be noted that these 44 KC-10s were tanker/cargo capable and were assigned to the Strategic Air Command. The Military Airlift Command could request their use as airlifters as long as the request did not conflict with other commitments.
[255] Letter, Thornton A. Wilson to Caspar W. Weinberger, [Boeing Proposal], 17 March 1982; Letter, Thornton A. Wilson to Caspar W. Weinberger, [Boeing Proposal], 12 April 1982; Point Paper, HQ MAC/XPQA, "Evaluation of Operational Impact of Purchasing B747 Vice C-5B," 9 April 1982.
[256] Letter Lew Allen Jr. to John Tower, [Boeing Proposal], 24 March 1982.
[257] Ibid.
[258] Article, "Three Manufacturers Vie To Build World's Biggest Airplane," *American Aviation*, 1965, pp 167-172; Article, "'Breakthrough' on Cargo Jets," *Business Week*, 13 April 1961, p 2.
[259] Letter, Frank C. Carlucci III to Thornton A. Wilson, [Boeing Proposal Reply], 6 May 1982. This was the same position that the Military Airlift Command took. See: Message, HQ MAC/XP to HQ USAF/RDQ, "User Assessment of B747," 131538Z April 1982.
[260] For more background, see: Kennedy, ed., *Anything, Anywhere, Anytime*, pp 94-98.
[261] Letter, Thornton A. Wilson to Frank C. Carlucci III, [Boeing Reply], 11 May 1982.
[262] Article, Edward W. O'Brien, "Committee OKs Money for Two C-5s," *St. Louis Globe-Democrat*, 2 April 1982, pp 1A, 15A; Article, Edward W. O'Brien, "Fight Launched to Cut C-5 Plane from Arms Bill," *St. Louis Globe-Democrat*, 24 April 1982; Article, Alton K. Marsh, "Senate Backs 747 Over C-5 Transport," *Aviation Week & Space Technology*, 24 May 1982, pp 21-23.
[263] Senator Jackson's untimely death in September 1983 meant Lockheed could concentrate on opposing just the C-17 over the next years.

[264] Article, Alton K. Marsh, "Senate Backs 747 Over C-5 Transport," *Aviation Week & Space Technology*, 24 May 1982, p 23; Article, Ella Reilly, "Percy Throws Support To McDonnell's C-17," *Belleville News Democrat* (Belleville, Illinois), 27 June 1982, p 3A; Draft Letter, Henry M. Jackson, Howard W. Cannon, Slade Gorton, Harrison H. Schmitt, and Nancy L. Kassebaum to Dear Colleague, [Jackson-Gorton Amendment], 22 April 1982.

[265] Letter, Ronald Reagan to Robert H. Michel, [Airlift Enhancement Program], 16 July1982. The letters went to Representative Thomas P. O'Neill Jr., Speaker of the House; Robert H. Michel, House Republican Leader; Melvin Price, Chairman of the House Armed Services Committee; William L. Dickinson, House Armed Services Committee; Joseph P. Addabbo, Chairman of Defense Subcommittee, House Appropriations Committee; Jack Edwards, Defense Subcommittee; Trent Lott, Minority Whip; Jim Wright, Majority Leader; Jamie L. Whitten, Chairman of the House Appropriations Committee; and Sitvio O. Conte, House Appropriations Committee. Reagan also instructed that letters be sent to Senators Howard H. Baker Jr., Majority Leader; John Tower; and Ted Stevens.

[266] Interview, Dessert, 12 June 2002.

[267] Article, Storer Rowley, "Defense-spending Bill Clears House 290-73," *St. Louis Globe-Democrat*, 30 July 1982, pp 1A, 4A.

[268] Letter, Verne Orr to Melvin Price, [C-5 vs 747], 4 June 1982; Letter, John O. Marsh Jr. to Melvin Price, [Need For C-5], 9 June 1982; Letter, Gen Lew Allen Jr. to Melvin Price, [Support C-5], 14 June 1982; Letter, Gen Lew Allen Jr. to William L. Dickinson, [Support of President's Budget], 14 June 1982; Letter, Gen Charles A. Gabriel to Jack Brooks, [AF Budget request], 19 July 1982.

[269] Hearings, House Armed Services, "Department of Defense Authorization For Appropriations For Fiscal Year 1983," Part 7, 97th Cong., 2d sess., 15 June 1982, p 1129.

[270] Hearings, Senate Armed Services, "Department of Defense Authorization For Appropriations For Fiscal Year 1983," Part 2, 97th Cong., 2d sess., 16 April 1982, pp 1289, 1290.

[271] Letter, John O. Marsh Jr. to Melvin Price, [Need For C-5], 9 June 1982.

[272] Article, Bob Blanchard, "Army Supportive of C-17, General Says," *St. Louis Globe-Democrat*, 26-27 June 1982, p 5A.

[273] Letter w/atch, Charles A. Bowsher to Jack Brooks, "Improper Lobbying Activities by the Department of Defense on the Proposed Procurement of the C-5B Aircraft," 29 September 1982.

[274] Ibid.

[275] Ibid.; Press Release, DOD, "GAO Report on DOD Lobbying Activities Concerning the C-5B Aircraft," circa October 1982.

[276] Statement, Frank C. Carlucci III to House Investigations Subcommittee, "Statement of the Honorable Franck C. Carlucci Deputy Secretary of Defense," 30 November 1982.

[277] Letter w/atch, Charles A. Bowsher to Jack Brooks, "Improper Lobbying Activities by the Department of Defense on the Proposed Procurement of the C-5B Aircraft," 29 September 1982; Statement, Charles A. Bowsher to House Investigations Subcommittee, "Statement of Charles A. Bowsher Comptroller General of the United States," 30 November 1982.

[278] Article, Vicki Ostrolenk, "C-5B Plane Wins Battle, May Lose War," *St. Louis Globe-Democrat*, 14-15 August 1982, pp 1A, 14A; Article, Vicki Ostrolenk, "Lockheed C-5B Plane Gets Bulk of Money in Conferences' Bill," *St. Louis Globe-Democrat*, 17 August 1982, p 5A; Article, Alton K. Marsh, "Defense Authorization Passed By Congress," *Aviation Week & Space Technology*, 23 August 1982, pp 14-16.

[279] The next year, Senator Stevens and his appropriations committee provided strong support for the C-17, even proposing new missions for the C-17 (namely wartime airborne command posts and emergency command headquarters for the Strategic Air Command) and endorsing an aircraft buy profile of 200 aircraft. See: Article, Edward W. O'Brien, "C-17 Project Given Boost By Committee," *St. Louis Globe-Democrat*, 7 November 1983.
[280] Article, Edward W. O'Brien, "Senate, House Conferees OK $60 Million for McDonnell C-17," *St. Louis Globe-Democrat*, 20 December 1982, p 17A.
[281] Memo, David G. Ward to AFSC/SDNI and AF/RDQL, "Suggested Restructuring of C-17 R&D Program," 1 February 1982; Study, Johnson, pp 257, 258.
[282] Memorandum, Verne Orr to ASD/CC, "C-17 Research and Development," 12 June 1982. See also, Memorandum, Verne Orr to ASD/CC, "C-17 Research and Development," 12 July 1982.
[283] Letter, Col Albert L. Barbero to John G. Tower, [C-17 R&D Contract Notification], 23 July 1982.
[284] Memorandum, Verne Orr to ASD/CC, "C-17 Research and Development," 12 June 1982.
[285] Interview, Johnson, 22 December 1999.
[286] Study, Johnson, pp 305-310
[287] Interview, Johnson, 22 December 1999.
[288] Ibid.; Interview, Walter S. Evans, 24 September 1998.
[289] Interview, Johnson, 22 December 1999.
[290] Study, Johnson, pp 310-312; Comment, Col (Retired) Thomas J. Crowley with Betty R. Kennedy, 1 August 2002. Col Crowley was the assistant deputy director at the C-17 SPO from 1981-1985 and then became the Chief of the C-17 Program Office at HQ Military Airlift Command from August 1985-December 1988. Following his retirement from military service, he worked for Boeing.
[291] Ibid., pp 305, 311.
[292] Plan, HQ USAF, *US Air Force Airlift Master Plan*, 29 September 1983, pp I, I-1-3, III-1-18, IV-1-2. This master plan was a collaboration effort between the headquarters staffs of the Military Airlift Command and the United States Air Force. A year later the Air Force issued *USAF Airlift Total Force Plan: The Active-Air Reserve Force Mix*, which provided the force mix plan on transferring airlift assets from the active to the Air Reserve Forces.
[293] As the master plan explained, the Army had embarked upon the High Technology Division at the direction of its Chief of Staff, Gen Edward C. Meyer. General Meyer's backing of this concept does much to explain why he strongly supported the C-17.
[294] Plan, HQ USAF, *US Air Force Airlift Master Plan*, 29 September 1983, pp III-6-7; Report, HQ MAC, *Validation of the Requirements Concepts and Design for the C-17*, November 1983, pp 16, 17.
[295] Plan, HQ USAF, *US Air Force Airlift Master Plan*, 29 September 1983, pp III-12-13, V-1-5, V-8.
[296] Ibid., pp V-5-7, V-9.
[297] Report, HQ MAC, *Validation of the Requirements Concepts and Design for the C-17*, November 1983, pp 55, 56; Letter w/atchs, Caspar W. Weinberger to John G. Tower, [C-17 Validation Report], 27 February 1984. While the report drew upon and restated the C-X Task Force analysis, the *Congressionally Mandated Mobility Study*, and the *US Air Force Airlift Master Plan*, it also assessed what the C-17's direct delivery capability could have provided during the Ahuas Tara 83 exercise in Central America and pitted the C-17 against the C-5 using the M-14 strategic airlift model to simulate a deployment to Southwest Asia.

[298] Memorandum, John W. Vessey Jr. to Secretary of Defense, "Long-Term Airlift Modernization," 23 February 1984.
[299] Webb and Cole, *The Chairmen of the Joint Chiefs of Staff*, pp 105-107.
[300] Point Paper, HQ MAC/XPQA, "C-17 Program Status," 10 February 1984.
[301] Letter, Lawrence O. Kitchen to Lt Gen Robert D. Russ, [Lockheed Proposal], 22 February 1984.
[302] Ibid.
[303] Document, Lockheed, "Statement of Work for C-5 Enhanced Capability Test Program," 21 December 1983; Schedule, Lockheed, "C-5 Enhanced Capability Test Program," ca December 1983.
[304] Interview, Lt Col James Allen with Betty R. Kennedy, 28 October and 5 November 1998. Lt Col Allen began working the C-17 program at Headquarters Air Mobility Command in August 1994 and then became the deputy branch chief for the C-17 program. His direct association with the program ended in 1997. Allen remarked that he had landed the C-5 on 5,000-foot and semi-prepared runways as well as flown it at 500 feet during nighttime missions.
[305] Gen Thomas M. Ryan Jr. was a strong supporter of the C-17. Following his retirement from the military in 1985, he went to work for McDonnell Douglas first as a vice president for products support for Douglas Aircraft Company and then later, in 1991, as a vice president general manager for the C-17 program.
[306] Letter, Gen Thomas M. Ryan Jr. to Gen Charles A. Gabriel, [Lockheed Proposal], 7 March 1984.
[307] Report, HQ MAC/XPQ, "XPQ Input to MAC Quarterly Historical Report," January-March 1984.
[308] Point Paper, HQ MAC/XPQA, "C-5B and C-17 Unit Cost Comparisons," 22 March 1984. Also, the cost of developing the C-17 compared favorably with nonmilitary, commercial product development costs. For example, Saturn had spent $4.5 billion to launch its car manufacturing business, and Ford's "world car" development effort was estimated at $6 billion. See, Point Paper, HQ AMC/XPQC, "C-17 Development Cost Comparison," 23 November 1994.
[309] Letter, Roy A. Anderson to Verne Orr, [Lockheed Fixed-Price Offer], 19 February 1985.
[310] Staff Summary Sheet, HQ MAC/XPSA, "Secretary Orr's Letter to Congress on C-5B Unsolicited Proposal," 4 March 1985.
[311] Letter, Verne Orr to Barry Goldwater, [Lockheed Fixed-Price Offer], 22 February 1985.
[312] Letter, Roy A. Anderson to Verne Orr, [Lockheed Fixed-Price Offer Additional Reductions], 17 July 1985.
[313] Letter, Lawrence O. Kitchen to Gen Lawrence A. Skantza, [Lockheed Fixed-Price Offer], 21 January 1986.
[314]Background Paper, HQ MAC/XPSA, "Critics of C-17," 31 January 1986.
[315] Jeffrey Record, National Security Paper: 2, *U.S. Strategic Airlift: Requirements and Capabilities*, Institute for Foreign Policy Analysis, Inc., January 1986, p 22. In a December 1985 article, Record stated: "The C-17 is a plane of hybrid design that lacks the range and payload of the proven and fixed-price C-5 but is far larger and seven times more expensive as the C-130." He ended by calling the C-17 "the most expensive strategic airlift program in U.S. history." See: Article, Jeffrey Record, "Strategic Mobility Getting There," *Baltimore Sun*, 20 December 1985, pp 3-F, 4-F.
[316] Jeffrey Record, *Determining Future U.S. Tactical Airlift Requirements*, Institute for Foreign Policy Analysis, Inc., 1987, pp 7, 8.

[317] Ibid., p 39.
[318] Kim R. Holmes, *Closing the Military Airlift Gap*, Heritage Foundation, 23 January 1986, pp 6, 7.
[319] Ibid., pp 8-11.
[320] Statement, US Senate, Kim R. Holmes, "Statement of Dr. Kim R. Holmes Before the Subcommittee on Seapower and Force Projection, Committee on Armed Services," 20 March 1986.
[321] Background Paper, HQ MAC/XPSA, "Critics of C-17," 31 January 1986.
[322] Article, William M. Leary, "Strategic Airlift: Past, Present, and Future," *Air University Review*, September-October 1986, p 85.
[323] Interview, Walter S. Evans, 24 September 1998; Interview, Barrett, 9 October 1998.
[324] Point Paper, HQ USAF/PRPFM, "C-17 Funding Reductions," 3 May 1984. So intense was the need to justify the program that two more papers were issued at the Secretary of the Air Force level: *The Case for the C-17: An Air Force Perspective* (1990) and *Airlift and U.S. National Security: The Case for the C-17, An Air Force Perspective* (1991).
[325] Interview, Barrett, 9 October 1998; Interview, Walter S. Evans, 24 September 1998; Conversation, Col (Retired) Thomas J. Crowley with Betty R. Kennedy, 24 July 2002.
[326] Comment, Cassidy, October 2002.
[327] Ibid.
[328] James K. Matthews and Roger D. Launius, *General Duane H. Cassidy: Commander In Chief United States Transportation Command and Commander In Chief Military Airlift Command, An Oral History* (Scott AFB: IL: United States Transportation Command, October 1998), pp. 77, 78; Interview, Barrett, 9 October 1998; Comment, Cassidy, October 2002; Conversation, Gen (Retired ) Duane H. Cassidy, with Betty R. Kennedy, 9 December 2002.
[329] Among these officers were: Maj Tony DeFerdinado, Col Edward N. Brya, Maj Melvin R. Barrett, Maj Charles W. Seifert, Maj George A. Gray III, Col Gary H. Mears, Maj David S. Hinton, Maj Bobby O. Floyd, Col Jimmie L. Jay, Maj Stump Sowada, Col Jerry P. Harmon, Maj Thomas R. Mikolajcik, Lt Col Scott Hansen, Col Vernon J. Kondra, Lt Col Hamby, Lt Col Michael R. Gallagher, Maj/Lt Col Walter J. Evans, Col Thomas D. Pilsch, Col Robert A. Larsen, Col Larry D. Parsons, Col John W. Handy, Maj/Lt Col James N. Soligan, Col Smith Barnum, Col William J. Begert, Lt Col Steven A. Roser, Lt Col Chester H. Mauchline, Col Harvey Shelton, Col Donald A. Streater, Maj Winfield Scott III, Maj Bruce E. Burda, Col Richard B. Bundy, and Col Richard A. Mentemeyer.
[330] Comment, Cassidy, October 2002; James K. Matthews, *General Alfred G. Hansen: Establishment of the United States Transportation Command, An Oral History* (Scott AFB, IL: United States Transportation Command, March 1999), p. 6. Gen Hansen retired from the Air Force in 1989 and worked for Lockheed Martin, retiring as Executive Vice President for Lockheed Martin Aeronautical Systems in 1998. Thereafter, he established his own consulting company. Col Mel Barrett remarked that Gen Allen's tour as deputy commander-in-chief of United States European Command had impressed upon Allen the value of airlift. Gen Robert E. Huyser's tenure in the same position had likewise made him an airlift advocate. See, Barrett, 9 October 1998.
[331] Biography Sheet, HQ USAF/PA, "Brigadier General Thomas D. Pilsch," February 1993; Biography Sheet, 443d MAW/PA, "Colonel Jimmie L. Jay," ca 1981; Biography Sheet, HQ USAF/PA, "Lieutenant General Vernon J. Kondra," October 1991; Biography Sheet, 89th MAW/PA, "Colonel Robert A. Larsen," October 1985; Biography Sheet, HQ USAF/PA, "Lieutenant General William J. Begert," December 1999.

[332] Interview, Barrett, 9 October 1998.
[333] Kennedy, ed., *Anything, Anywhere, Anytime*, pp 110, 122. Referencing the C-141's and C-5's gestations: "Had the AF/MAC done the same sort of work on the AMST—would there have been a C-17?" Comment, Cassidy, October 2002.
[334] Study, Johnson pp 337, 338, 342, 343; Memorandum, James P. Wade Jr. to Caspar W. Weinberger, "C-17 Aircraft Full Scale Engineering Development (FSED)," 14 February 1985; History, ASD, January-December 1984, p 194; Extract, HQ ASD, Appendix B, "Decision Coordinating Paper for C-17A Airlift Aircraft System," October 1984.
[335] Memorandum, Thomas E. Cooper to AF/CV, "C-17 AFSARC Memorandum," 17 October 1984.
[336] Ibid.
[337] Study, Johnson, pp 343-346.
[338] Ibid., p 343; Interview, Johnson, 22 December 1999.
[339] Memorandum, Caspar W. Weinberger, to SECAF, "C-17 Full Scale Engineering Development (FSED)," 15 February 1985.
[340] Extract, HQ ASD, Appendix B, "Decision Coordinating Paper for C-17A Airlift Aircraft System," October 1984; Memorandum, Joe Van Dyke to David Ward, "Variant Analysis," 31 August 1984; Memorandum, OSD R&E to Joint Staff, "C-17 Cargo Compartment Configuration," November 1984.
[341] Memorandum, Joe Van Dyke to David Ward, "Variant Analysis," 31 August 1984; Letter w/atchs, Lt Gen Robert F. Coverdale to AF/RD, "DSARC Issues," 6 November 1984; Letter w/atch, Lt Gen Robert F. Coverdale to HQ USAF/RD, "C-17 DSARC Issues," 20 November 1984; Memorandum, James P. Wade Jr. to Deputy Secretary of Defense, "C-17 Aircraft Full Scale Engineering Development (FSED)," 20 December 1984; Interview, Gallagher, 2 February 1994, p 21; Comment, Crowley, 1 August 2002.
[342] Interview, Dessert, 12 June 2002.
[343] Memorandum, James P. Wade Jr. to Caspar W. Weinberger, "C-17 Aircraft Full Scale Engineering Development (FSED)," 14 February 1985; Memorandum, Under Secretary of Defense for Research and Engineering to Assistant Secretary of the Air Force for Research, Development, and Logistics, "Issues for C-17 Milestone II DSARC Meeting," ca October 1984; Memorandum w/atch, Milton A. Margolis to DSARC Chairman, "CAIG Analysis of the C-17 Bottoms-Up Estimate," 12 February 1985, Point Paper, HQ MAC/ACMC, "C-17 Independent Cost Analysis (ICA), for CINCMAC's Attendance at C-17 DSARC, 2 Nov 84," 31 October 1984; Memorandum, James P. Wade Jr. to Deputy Secretary of Defense, "C-17 Aircraft Full Scale Engineering Development (FSED)," 20 December 1984.
[344] Memorandum w/atch, Milton A. Margolis to DSARC Chairman, "CAIG Analysis of the C-17 Bottoms-Up Estimate," 12 February 1985.
[345] At the time of the reorganization, key staff members were: David Ward, deputy director; Lt Col Thomas J. Crowley, assistant deputy director; Lt Col William Rhode, chief of projects; Lt Col F. Jack Pledger Jr., chief of flight systems; Lt Col Wayne Mathieu, chief of special projects; Lt Col Joe Burch, chief of structures and training; Lt Col Lawrence Kuzma, chief of computer resources; Maj Charles Johnson II, chief of power systems; Maj Stanley Bishop, chief of mission systems; and Maj Terry Lindholm, chief of test and evaluation.
[346] Study, Johnson, pp 339, 340, 508, 509; Report, C-17 SPO, C-17 Quarterly Historical Report, October-December 1986; Interview, Johnson, 22 December 1999.
[347] Point Paper, HQ MAC/XPQC, "C-17 Program Status," 7 August 1989; Point Paper, HQ MAC/XPQA, "C-17 Program Status," 1 October 1985; Study, Johnson, pp 391-393; Report,

C-17 SPO, C-17 Quarterly Historical Report, July-September 1986.
[348] News Release, McDonnell Douglas, "Air Force Awards C-17A Full-Scale Development Contract," 2 January 1986; History, HQ ASD, January-December 1987, pp 188, 191. The ASD history subsequently gave a figure of $4.14 billion which included development tooling.
[349] Schedule, McDonnell Douglas, "C-17 Summary Program Master Schedule," 19 September 1985; Directive, HQ USAF/RDQL, PMD 0020 (17), "Program Management Directive For C-17 Program," 2 October 1985.
[350] Letter, Gen Duane H. Cassidy to Caspar W. Weinberger, Fall 1985.
[351] Point Paper, HQ MAC/XPQA, "C-17 Program Status," 2 August 1985; Point Paper, HQ MAC, "C-17 Program Status," 1 October 1985; Memo w/atchs, Brig Gen Paul E. Landers to CINCMAC, "C-17 Congressional Language," 19 August 1986; Article, Leonard Famiglietti, "Sealift Alternative to Airlift, Hill Office Says," *Air Force Times*, 3 November 1986, p 52.
[352] Message, Gen Duane H. Cassidy to Gen Bernard W. Rogers, [C-17 Support], 031430Z March 1986.
[353] Ibid.
[354] Article, "AF Willing to Shave Programs to Save C-17, ATB," *Air Force Times*, 30 June 1986, p 43.
[355] Letter, James R. Sasser and Albert Gore Jr. to Caspar W. Weinberger, 12 March 1986.
[356] Letter, Marilyn Lloyd to Russell A. Rourke, 17 March 1986.
[357] Letter, Joseph P. Addabbo to Russell A. Rourke, 26 March 1986.
[358] Letter, Thomas E. Cooper to Bill Chappell Jr., 11 August 1986; extract, Defense Subcommittee, House Appropriations Committee, [C-17 Wing Competition], 1986; Letter, Robert. L. Johnson to Thomas E. Cooper, [C-17 Wing Competition], 29 October 1986.
[359] Letter, Gens John A. Wickham, Larry D. Welch, and Paul X. Kelley to Bill Chappell Jr., 26 September 1986.
[360] Letter, Robert L. Johnson to Thomas E. Cooper, [C-17 Wing Competition], 29 October 1986. Report, HQ ASD, "A Report on C-17 Wing Competition," ca 1987; News Release, HQ ASD/PA, "Douglas Selects Lockheed To Build Wings For C-17s," 26 May 1987.
[361] Report, GAO, *DOD Procurement: Geographic Dispersion of C-17 and C-5B Subcontracts*, April 1988.
[362] Article, James R. Carroll, "C-17 Becomes National Project," *Long Beach Press-Telegram*, 23 May 1993. Northrop Grumman had the largest share of work among the major subcontractors, producing the ailerons, vertical and horizontal stabilizers, rudders, elevators, engine nacelles, and universal aerial-refueling receptacle slipway. See, Article, "Northrop Grumman's Role," *Aviation Week and Space Technology*, 19 August 1996, pp S16, S17.
[363] Memo w/atch, Brig Gen Paul E. Landers Jr. to CINCMAC, " C-17 Congressional Language," 19 August 1986; Point Paper, HQ MAC/XPQC, "C-17 Program Status," 4 February 1987; Article, Leonard Famiglietti, "Sealift Alternative to Airlift, Hill Office Says," *Air Force Times*, 3 November 1986, p 52.
[364] Report, GAO, *Military Airlift: Air Force Analysis Supports Acquisition of C-17 Aircraft*, March 1987; Testimony, Harry R. Finley, GAO, "Acquisition of the C-17 Aircraft," 26 March 1987. See also: Article, Lt Col J. David Patterson, "The C-17 In An Iran Scenario: A Perspective Beyond 66-Million Ton-Miles Per Day," *Air Forces Journal International*, January 1988, pp 42, 43, 46, 48. A C-5 pilot, Lt Col Patterson was the deputy executive assistant to the chairman of the JCS when the article was published.
[365] Letter, George Darden, Wayne Owens, and Ed Jenkins to Dear Colleague, [Cancel

C-17], 30 April 1987; Letter, George Darden, Wayne Owens, and Ed Jenkins to Dear Colleague, "40 Billion 1.7 Billion," 5 May 1987; Letter, George Darden, Wayne Owens, and Ed Jenkins to Dear Colleague, "The C-17: Ten Years Too Late or Ten Years Too Early," 7 May 1987; Letter, Dave McCurdy and others to Dear Colleague, [Support C-17], 30 April 1987; Letter, Dave McCurdy and others to Dear Colleague, "No Gimmicks . . . Just the Facts," 6 May 1987; Memo, MAC/XPPB, "Capitol Hill Update," 13 May 1987.

[366] Message, DA to USCINCEUR and others, "Air Force Airlift Program," 161600Z August 1987; Memorandum, Craig H. Mandeville to R. H. Kinder, "Association of U.S. Army Annual Conference-AAR," 19 October 1987.

[367] Report, Frank C. Carlucci, "Annual Report to the Congress," January 1989, p 175.

[368] Report, HQ MAC/XPQC, Weekly Activity Report, 29 April 1988; Article, "C-17 Future is Dim: Costello Eyes Killing Effort in FY-90 USAF Slashes Funds," *Inside The Pentagon*, 29 April 1988, pp 1, 2.

[369] Remarks, Steve Coltrin, Speaker Introduction Honorable Robert B. Costello, ca 1995.

[370] Report, HQ MAC/XPQC, Weekly Activity Report, 3 June 1988.

[371] Report, HQ MAC/XPQC, Weekly Activity Report, 10 June 1988.

[372] Ibid.

[373] Report, HQ MAC/XPQC, Weekly Activity Report, 24 June 1988.

[374] Directive, HQ USAF/RDQL, "Program Management Directive For C-17 Program," 2 October 1985.

[375] History, HQ USAF, 1988, pp 235-237, 251, 252; History, HQ USAF, 1989, pp 223-224.

[376] Report, HQ USAF/AQQL, "Air Force Systems Acquisition Review Council C-17 Program Review Subject Summary," ca 1988.

[377] In September 1986, Maj Gen Harbour became the deputy commander for airlift and trainer systems within HQ ASD and also continued oversight of the C-17 SPO until January 1987 when he served as the director for the B-1B SPO. Brig Gen (sel) Butchko became the C-17 SPO director in August 1987. In the interim, Col Jack Stone directed the C-17 SPO. Biography Sheet, HQ USAF/PA "Major General Elbert E. Harbour," September 1988; Biography Sheet, USAF/PA, "Major General Michael J. Butchko Jr.," August 1991; Comment, Crowley, 1 August 2002.

[378] Biography Sheet, USAF/PA, "Major General Michael J. Butchko Jr.," August 1991; Interview, Johnson, 22 December 1999; Report, HQ MAC/XPQ, Weekly Activity Report, 11 September 1987; Report, HQ MAC/XPQC, Weekly Activity Report, 25 March 1988; Letter w/atch, Maj E. Craig Moore to HQ MAC/XRSC/XRS/XR, "T-1 Schedule Milestone Report (Executive Summary)," 7 September 1990.

[379] Memo w/atch, Brig Gen Paul E. Landers to CINCMAC/CC, "Update as of 25 Mar 87," 26 March 1987.

[380] Ibid., Point Paper, HQ MAC/XPQC, "C-17 Program Status," 4 February 1987; Point Paper, HQ MAC/XPQC, "C-17 Program Status," 3 August 1987.

[381] Memorandum, Milton A. Margolis to Chairman, "Preliminary CAIG Review of the C-17 Program," 14 October 1987; Point Paper, HQ MAC/XPQC, "C-17A Electronic Flight Control System," 13 August 1987.

[382] Memorandum, Milton A. Margolis to Chairman, "Preliminary CAIG Review of the C-17 Program," 14 October 1987.

[383] Report, HQ MAC/XPQ, Weekly Activity Report, 23, 29 October 1987; Col Michael J. Butchko Jr. to James F. McGovern, "C-17 System Program Director's Monthly Status Letter," 2 November 1987. As Gen Cassidy related it was very difficult for the Air Force to carry the airlift position if you did "you in fact hurt other Air Force programs." This was

probably the first time the DAB got the "true story" or not "adjusted" or "clouded" view. "With the establishment of US Transportation Command, I didn't have to worry. When I needed to go and get support, I was in the system [JCS]." "I don't know if you could say that establishing the Transportation Command got the C-17, but the Transportation Command gave a voice for airlift." With regard to General Herres, he was a good supporter of airlift and the C-17 as well, partly due to his assignment to Scott Air Force Base and association with airlifters there. In 1980, during his tenure as commander of the Air Force Communications Command headquartered at Scott, Herres was also a neighbor to then Brigadier General Cassidy. Conversation, Cassidy, 9 December 2002.

[384] Report, HQ USAF/AQQL, "Air Force Systems Acquisition Review Council C-17 Program Review Subject Summary," ca 1988; Report, HQ MAC/XPQ, Weekly Activity Report, 5 November 1987; Memorandum, William H. Taft IV to Secretary of the Air Force, "C-17A Aircraft Program—Acquisition Decision Memorandum," 10 December 1987.

[385] Letter, Brig Gen Michael J. Butchko Jr. to John J. Welch Jr., "C-17 System Program Director's Monthly Status Report," 8 February 1988.

[386] Briefing, Col Charles M. Andrean, "Issues and Criteria," May 1988.

[387] Point Paper, HQ MAC/XPQC, "Weight Growth," 1987; Letter, Brig Gen Michael J. Butchko Jr. to John J. Welch Jr., "C-17 System Program Director's Monthly Status Letter," 8 February 1988; Document, "Specifications of the McDonnell Douglas C-X Aircraft," ca 1980; Notes, "C-17 Operating Weight," ca 1989.

[388] Per the agreement, the C-17 received such new capabilities as data burst via UHF satellite or HF communications, an aircraft diagnostics and integrated test system, a dedicated computer for the loadmaster, and full night vision goggle compatible cockpit. McDonnell Douglas, in return, got reductions in the landing gear ground flotation load classification number (LCN) and ferry range requirements to include associated weight reduction design changes. Specifically, General Cassidy recommended changing the LCN from 40 to 48, reasoning that with reduced tire pressure, the C-17 could still operate on LCN 40 runways and still remain within the load classification group IV (LCN 31-50) as desired. And although the C-5 with an LCN of 37 had a better ground flotation than the C-17, the C-141 and KC-10 had LCNs of 72 and 82, respectively. Another aspect of this decision was the ability of material handling equipment to offload in LCN 37 conditions. Staff Summary Sheet, HQ MAC/XPQC, "Briefing on C-17 Specification Changes and Trade Items to Air Force Council," 5 February 1988; Briefing, Lt Col Charles L. Johnson II, "C-17 SOC/SPEC Changes & Trades List," ca 1988; Comment, Cassidy, October 2002.

[389] Briefing, USAF/McDonnell Douglas, "C-17 Weight/Performance Status," April 1987; Conversation, CMSgt (Retired) James Lis with Betty R. Kennedy, 29 August 2000. Chief Master Sergeant Lis retired from the Air Force in 1992, part of the C-17 program effort at Headquarters Military Airlift Command, subsequently Air Mobility Command. Thereafter, he worked for McDonnell Douglas on the C-17 program, initially the deputy for the mission systems group, later part of the mission systems integrated product team.

[390] Notes, "C-17 Operating Weight," ca 1989; Briefing Slides, HQ ASC, "Weight Changes," & "C-17 Operating Weight History," August 1987; Letter, Brig Gen Michael J. Butchko Jr. to John J. Welch Jr., "C-17 System Program Director's Monthly Status Letter," 8 February 1988; Letter, Brig Gen Michael J. Butchko Jr. to John J. Welch Jr., "C-17 System Program Director's Monthly Status Letter," 8 April 1988; Briefing, WAMO, "Weight Assessment Management Organization Meeting," 20 October 1988.

[391] Reports, HQ MAC/XPQC, Weekly Activity Report, 11, 18 March and 8, 15 April 1988; Point Paper w/atch, HQ MAC/XPQC, "C-17 Weight Reduction Effort," 3 August 1987;

Briefing, USAF/McDonnell Douglas, "C-17 Weight/Performance Status," April 1987; Interview, Johnson, 22 December 1999.
[392] Ibid.
[393] Ibid.
[394] Ibid.
[395] Memo, HQ MAC/XP to HQ MAC/XO, "Effects of Reducing C-17's Max Payload," 10 July 1986; Letter, Brig Gen Michael J. Butchko Jr. to John J. Welch Jr., "C-17 System Program Director's Monthly Status Report," 8 February 1988; Report, C-17 SPO, C-17 Quarterly Historical Report, July-September 1986; Notes, "C-17 Operating Weight," ca 1989; Point Paper, HQ MAC/XPQC, "C-17 Engine vs Weight Growth," 17 August 1987; Briefing, USAF/McDonnell Douglas, "C-17 Weight/Performance Status," April 1987; Briefing Slides, HQ ASC, "Weight Changes," & "C-17 Operating Weight History," August 1987; Report, Cpt Thomas J. Dolney to HQ AMC/PA, "Trip Report—C-17 Public Affairs Working Group Mtg," 29 March 1990.
[396] Memorandum, Gens M. R. Thurman and Louis C. Wagner, Jr., to James R. Ambrose, "Abrams Growth," 25 February 1988; Document, HQ MAC/XPQ, "C-X System Operational Concept," March 1981, p 8; Interview, Lt Col Thomas Svisco with Betty R. Kennedy, 3 May 2000. Lieutenant Colonel Svisco served as the Army's representative to the C-17 System Program Office from 1997 through 2000.
[397] Talking Paper, C-17 SPO, "Logistics Concerns," October 1988.
[398] Letter, Brig Gen Kenneth G. Miller to HQ AMC/XR, "Weight Reduction Program," 21 December 1992; Briefing, McDonnell Douglas, [C-17 Flight Test Update,] 4 January 1993.
[399] Publication, USAF AMWC/LG, *C-17 First Look Aircraft Systems Handbook*, May 1995, p 1-3; Publication, HQ AMC/LGQRT, *C-17 Command Aircraft Systems Training (CAST) Programs 5401-5403*, 15 January 1999, p I-1-2.
[400] Point Paper, HQ MAC/XPQC, "C-17 Head-Up Display (HUD)," 11 April 1988; Report, HQ MAC/XPQC, Weekly Activity Report, 11 March 1988; Comment, Crowley, 1 August 2002; Comment, Lawrence E. Fielding with Betty R. Kennedy, July 2002. Mr. Fielding, an engineer at the C-17 SPO, had the distinction of working on the C-17 program for over 18 years. His last position was as the Co-Lead of the Air Vehicle Integrated Product Team.
[401] Point Paper, HQ MAC/XPQC, "C-17 Head-Up Display (HUD)," 11 April 1988; Reports, HQ MAC/XPQC, Weekly Activity Report, 1 April, 17 June 1988; Comment, Crowley, 1 August 2002; Comment, Fielding, July 2002.
[402] Memorandum w/atchs, Maj Erdie O. Lansford II to HQ AMC/XPQC, "C-17 Display Evaluation Group Meeting, 18-19 August 1989," 30 August 1989; Minutes, Maj Richard L. Kellahan, "Minutes of C-17 Cockpit Display Evaluation, 10-18 Aug 89," 21 August 1989; Letter, Brig Gen Michael J. Butchko Jr. to HQ AMC/DO, "C-17 Cockpit Operational Utility Committee (COUC) Membership," 18 June 1990; Minutes, HQ ASD/YCT, "C-17 Display Evaluation Group (DEG) IDDS Evaluation Minutes, 1-5 Oct 90," 18 October 1990; Minutes, HQ ASD/YCT, "C-17 Cockpit Operational Utility Committee (COUC) Meeting Minutes, 5-7 Nov 1990," 20 November 1990.
[403] Point Paper, HQ MAC/XPQC, "C-17 MLG Jacking," 30 March 1988.
[404] Ibid; Comment, Fielding, July 2002.
[405] Ibid.; Report, HQ MAC/XPQC, Weekly Activity Report, 25 March 1988; Article, HQ MAC/PAI, "Kelly Engineers Lifting Weighty C-17 Problem," 17 February 1989; Publication, USAF AMWC/LG, *C-17 First Look Aircraft Systems Handbook*, May 1995; Comment, Fielding, July 2002.
[406] Report, HQ MAC/XPQC, Weekly Activity Report, 13 May 1988.

[407] Reports, HQ MAC/XPQC, Weekly Activity Report, 19, 27 May; 3, 24 June; 1, 8,14, 29 July, 5, 11, 26 August, 4 November, 2 December 1988; Report, Brig Gen Michael J. Butchko Jr. to John J. Welch Jr., "C-17 System Program Director's Monthly Status Letter," 8 March 1988; Report, Brig Gen Michael J. Butchko Jr. to John J. Welch Jr., "C-17 System Program Director's Monthly Status Letter," 8 April 1988.
[408] Memo w/atch, Lt Col Charles L. Johnson II to MAC/XPQ, "C-17 Mission Computer CDR," 22 May 1989.
[409] Report, HQ MAC/XPQC, Weekly Activity Report, 26 August 1988; Press Release, McDonnell Douglas, [T-1 Assembly], 24 August 1988.
[410] New Release, ASD, "Pratt and Whitney Ships First C-17 Flight Test Engines," 9 May 1989; Report, AF Audit Agency, *Acquisition Of The F117-PW-100 Engine And Its Related Logistics Support*, 20 June 1988.; Briefing, Pratt & Whitney, "F117 Program Review-C-17 Multi Role Airlifter" 1986; Briefing Slide, United Technologies Pratt & Whitney, "PW2000 Technical Description," January 1989. Subsequently, the '94 Package provided additional F117 improvements—longer on wing time, lower maintenance costs, increased fuel consumption, and reduced noise. In the future, if the C-17 needed more thrust, the PW2043 (43,700 pounds) and the planned PW2047 were available. See, Article, "The Evolving P&W F117," *Aviation Week and Space Technology*, 19 August 1996, pp S14, 15.
[411] Letter, Ed Carroll to DOD/PESCO-XB, "C-17 Program Assessment," 4 November 1988.
[412] Memorandum, DOD Product Engineering Services Office to Conventional Systems Committee, "C-17 Program Assessment," 10 November 1988.
[413] Ibid.
[414] Letter, Ed Carroll to DOD/PESCO-XB, "C-17 Program Assessment," 4 November 1988.
[415] Memorandum, John E. Krings, to Chairman, DAB Conventional Systems Committee, " C-17A Milestone IIIA Review," 7 November 1988.
[416] Ibid.
[417] Memorandum with attachment, Charles E. Adolph to Conventional Systems Committee, "Test and Evaluation Assessment of the C-17A Program for Milestone IIIA," 10 November 1988.
[418] Ibid.
[419] Ibid.
[420] Ibid.
[421] Briefing, Brig Gen Michael J. Butchko Jr., "C-17 Program Review," 5 December 1988.
[422] Memo, HQ MAC/XPQC, "Significant Event Update For CINCMAC," 27 December 1988; Talking Paper w/atch, Lt Col Charles L. Johnson II, "C-17 Milestone IIIA Status," 9 January 1989.
[423] Memorandum, Donald N. Fredericksen to Defense Acquisition Executive, "C-17A Aircraft Program Conventional Systems Committee Milestone IIIA Program Review," 1 December 1988; Memorandum, William H. Taft IV to Secretary of the Air Force, "C-17A Aircraft Program-Acquisition Decision Memorandum," 18 January 1989; Memorandum w/atch, Dr. Costello to Secretary of the Air Force, " C-17A Aircraft Program-Program Review," 26 January 1989.
[424] Biography Sheet, HQ USAF/PA, "Dr. Donald B. Rice," 1993.
[425] Biography Sheet, OSD Internet Defense Link, Histories of Secretaries of Defense, "Richard B. Cheney," circa 1995; Colin L. Powell with Joseph E. Persico, *My American Journal* (New York: Random House, 1995), pp 405, 436, 437, 439, 444, 451-455, 458,

549; Merrill A. McPeak, *Selected Works, 1990-1994*, (Maxwell AFB: Air University Press, 1995), p 320.

[426] Biography Sheet, HQ USAF/PA, "General Merrill A. McPeak," May 1993; McPeak, pp 309-315.

[427] White Paper, HQ USAF, "Air Force Restructure," September 1991, pp 1-6.

[428] Statement, Gen Duane H. Cassidy, "Presentation to the Committee on Appropriations, Subcommittee on Defense United States House of Representatives," 31 January 1989, pp 16, 17.

[429] Article, "As Pentagon Budget Unfolds, Space Missile Shield Is Intact," *New York Times*, 2 March 1989, p B11; Article, George C. Wilson, "Air Force Proposes Cuts In Big Weapon Programs," *Washington Post*, 17 March 1989, p 5.

[430] Reports, HQ MAC/XPQC, "Weekly Activity Report," 10, 17, 24 February; 3 March 1989.

[431] Article, George C. Wilson, "Air Force Proposes Cuts In Big Weapon Programs," *Washington Post*, 17 March 1989, p 5.

[432] Memo, Lt Col Charles L. Johnson II to HQ MAC/XP/CV/CC, "Air Staff Point Paper on Airlift/C-17/MAC," 29 March 1989.

[433] Point Paper, Air Staff, "Reorganization of Military Airlift Command," ca March 1989.

[434] Article, John D. Morrocco, "Cheney Endorses MX Rail Garrison, Calls For Few Cuts In USAF Budget," *Aviation Week & Space Technology*, 24 April 1989, p 22.

[435] Article, Rowan Scarborough, "Cassidy Sees Clear Skies For The C-17," *Defense Week*, 30 January 1989, p 5; Article, David Fulghum, "Departing Weapons Czar Tried To Kill B-2, C-17," *Air Force Times*, 22 May 1989, p 6; "Scrap C-17, Private Panel Recommends," *St. Louis Post-Dispatch*, 8 January 1989, p 8B; Gen Duane H. Cassidy, "Plane Truth," *St. Louis Post-Dispatch*, 25 January 1989, p 3B; Lawrence J. Korb, "The Plane Truth Revisited," *St. Louis Post-Dispatch*, 15 February 1989, p 3B. In July 1989, *U.S. News & World Report* listed the C-17 as one of the worst weapon programs; C-5s were more economical. Lawrence Korb had been interviewed. See, Article, Peter Cary and Bruce B. Auster, "Best & Worst Weapons," *U.S. News & World Report*, 10 July 1989, p 26.

[436] Reports, HQ MAC/XPQC, "Weekly Activity Report," 7 April, 26 May 1989; Article, David Fulghum, "Cheney Would Spare Big AF Weapons Systems," *Air Force Times*, 8 May 1989, pp 4, 24.

[437] In 1991, Colonel Seifert stated the C-17 had over 200 computer processors with 52 different software builds. At this time, software code for just the airplane was estimated at 1.5 million lines. In 1994, the software code for the mission computer was given as 650,000 lines. See: Point Paper, HQ AMC/XPQC, "C-17 Program Status and Update," 1 September 1994; Col Charles W. Seifert, "The C-17 Program in 1991, An Insider's View," circa 1992, p 474. Regarding the latter citation, although a separate document, the Aeronautical Systems Division History, January-December 1991 made it a supplement section of Chapter VIII. Colonel Seifert was the Assistant Program Director at the C-17 SPO. Earlier in his career he had worked C-17 program issues at Headquarters United States Air Force.

[438] "Total Quality Management System (or Time to Quit and Move to Seattle). Everyone had to redefine their organization and then competitively bid for the newly defined jobs. In the C-17 program, entire design groups fled back to commercial (DC-9, MD-11). For example, when the dust settled many months later, the entire Pressurization/Conditioned Air group was comprised of personnel new to the program; all the veterans had bailed out. Many in DAC Avionics took the opportunity to get out before it hit the fan on their products. And several weeks later it was found, by accident, that there was no Landing Gear group.

Not that there were no personnel remaining in the Landing Gear group, but that the group no longer existed, no one had redefined it, no jobs had been defined or bid, no one was doing the job, it had vanished. Structures thought that Hydraulics was doing it and vice versa. Truly an amazing spectacle to behold." Comment, Casey, 14 August 2002.

[439] Article, Bruce A. Smith, "Douglas Grapples With Delays In Three Transport Programs," *Aviation Week & Space Technology,* 10 April 1989, p 88; Article, George Leopold, "Software Woes Drive C-17 Cost Up $500 Million," *Defense News*, 17 April 1989, p 4; Article, Peter Cary and Bruce B. Auster, "Best & Worst Weapons," *U.S. News & World Report*, 10 July 1989, p 26; Article, Ralph Vartabedian, "The Remaking of Douglas by McDonnell," *Los Angeles Times*, 15 October 1989, p D1; Point Paper, HQ MAC/XRSC, "C-17 Program Status," 2 November 1989; Report, HQ MAC/XPPB, "FY90 Congressional Budget Track ($M)," December 1989; Program Budget Decision No. 734 w/atchs, SAF/FMBIA, "C-17 Airlift Aircraft," 31 October 1989; Point Paper, HQ MAC/XPQC, "C-17 Program Status," 14 January 1989.

[440] Memorandum, J. A. Betti to Secretary of the Air Force, "C-17A Program Review Acquisition Decision Memorandum," 6 November 1989.

[441] Point Paper, HQ MAC/XRSC, "C-17 Requirements Review/Major Aircraft Review," 13 April 1990; Memorandum, Brig Gen Vernon J. Kondra to Command Section, "Strategic Airlift Review," 3 August 1989; Article, John D. Morrocco, "Cheney Orders Reassessment of Major Aircraft Programs," *Aviation Week & Space Technology*, 8 January 1990, pp 18, 19.

[442] Message, Director Material Management to HQ MAC/LGM, "Flight Restrictions for C-141B Aircraft," 182235Z August 1989; Message, HQ MAC/LG to AIG 8338, "Flight Restricted for C-141B Acft," 182345Z August 1989; Message, CINCMAC/CC to CSAF/CC, "C-141 Airlift Capability," 170015Z January 1990. In November 1989, the Air Force had compiled four options: cancel the C-17 and SLEP the C-141; buy some C-17s and retire C-141s on a one-for-one basis, maintaining the current 48 MTM/D capability; buy 145 C-17s; and buy 139 C-17s. Secretary of the Air Force Donald Rice elected to brief Deputy Secretary of Defense Donald Atwood on a reduced buy of 145 C-17s, which included retiring the C-141s and maintaining a 48 MTM/D capability. See, Memo, Col Donald E. Loranger Jr. to MAC Command Section, "Program Adjustment Briefing to DEPSECDEF," 16 November 1989; Memo, Col William D. Cummings to MAC Command Section, "Program Adjustment Briefing AFC," 16 November 1989. At this time, some individuals on the OSD staff, in particular David M. Shilling, believed testing had shown the C-5 capable of direct delivery into forward and austere airfields. See, Memo w/atch, David M. Shilling to Frank Kendall, "C-5 Operational Test Data," 26 February 1990.

[443] Position Paper, HQ MAC/XRSL, "C-141 Service Life Extension Program (SLEP)," 31 January 1990; Article, "Aloha Upgrades Maintenance Program, Modernizes Fleet," *Aviation Week & Space Technology*, 24 July 1989, p 29.

[444] Position Paper, HQ MAC/XRSL, "C-141 Service Life Extension Program (SLEP)," 31 January 1990.

[445] Ibid.; Memo w/atch, Col Roger J. Purcell to Col Tedrow, "C-17 Data," 12 January 1990; Memo w/atchs, HQ AF/LEYY to HQ MAC/LGMW/XRS, "C-141 SLEP Options," 2 February 1990; Memo w/atchs, HQ AF/LEYY to HQ MAC/LGMW/XRS, "OSD Major Acft Review," 7 February 1990.

[446] Report, HQ MAC/XPPB, "SECDEF Testimony Before Senate Armed Services Committee," 30 April 1990; Point Paper, HQ MAC/XPPB, "Impacts of C-17 Reduction," 18 May 1990. Not missing the opportunity, Jeffrey Record argued for "postponing a

production decision on the C-17, at least until post-Cold War strategic airlift requirements are thoroughly examined." See, Article, Jeffrey Record, "The C-17: A Transport Headed For Hold?" *Baltimore Sun*, 11 April 1990, p 15.

[447] Point Paper, HQ MAC/XRSC, "C-17 Program Information," January 1990; Point Paper, HQ MAC/XRSC, "FY91 Budget Impacts to C-17," 29 October 1990; Point Paper, HQ MAC/XRSC, "Status of C-17 Assembly and Funding," 21 December 1990. Point Paper, HQ MAC/XPPB, "C-141 Retirement," 3 August 1990; Memorandum, Gen Colin L. Powell to Dep SECDEF, "Clarification of the DOD Strategic Airlift Goal," ca July 1990; Point Paper, HQ AF/XOTA, "C-141 Retirement Issue," 7 February 1991; Memorandum w/atch, David S. C. Chu to Donald B. Rice and John A Betti, "C-141 Retirements," 27 July 1990.

[448] Donald J. Yockey to Thomas S. Foley, [C-17 PAUC], 13 December 1990; Reports, HQ ASD/C-17 SPO, C-17 "Selected Acquisition Report," 31 December 1989, 30 September 1990, 31 December 1990.

[449] Report, HQ ASD/C-17 SPO, C-17 "Selected Acquisition Report," 31 December 1990; Point Paper, HQ MAC/XRSC, "FY91 Budget Impacts to C-17," 29 October 1990; Point Paper, HQ MAC/XRSC, "Status of C-17 Assembly and Funding," 21 December 1990.

[450] The analysis replaced 117 C-141s with 80 C-17s. The C-17s could have closed ten days earlier or delivered more combat forces. In the first 12 days, the C-17s could have delivered approximately 50 percent more combat forces (fighter squadrons and light infantry brigades). See: Briefing, HQ MAC/XPY, "C-17 In First 45 Days of Desert Shield," circa August 1990; Pamphlet, HQ MAC/XR, "The C-17 In Desert Shield/Desert Storm: Impact," 13 April 1991.

[451] Article, "The C-17: A History," *Long Beach Press Telegraph*, 23 May 1993; Article, McDonnell Douglas, "Chronology," *Orange County Register*, 3 September 1995.

[452] Article, David Montgomery, "How The A-12 Went Down," *Air Force Magazine*, April 1991, pp 44, 46, 47; Memorandum, Col Philip W. Bruce to Military Assistants, "C-17 Review," 22 January 1991. The A-12's true state of affairs had not come out during the April 1990 Major Aircraft Review. Moreover, Defense Secretary Cheney had testified before Congress that the program was in no serious difficulties.

[453] Point Paper, HQ MAC/XR, "OSD Review of C-17," 7 February 1991.

[454] Memorandum, Michael P. W. Stone to Donald J. Atwood Jr., "C-17 Program," 26 February 1991.

[455] Point Paper w/atchs, HQ USAF/AQQL, "C-17 Briefings to OSD(A)," 1 February 1991; Point Paper, HQ MAC/XR, "C-17 Review Status," 17 February 1991; Report, HQ DCMC, "Performance Assessment Review," circa April 1991; White Paper, HQ AF PEO/TA, "C-17," June 1991; Point Paper, HQ USAF/AQQU, "C-17 Issues," 26 July 1991; Congressional Hearing Resume, SAF/LLP, "McDonnell Douglas Corporation's Technical and Financial Difficulties Associated with its Major Weapons Systems," 3 October 1991; Article, Tony Capaccio, "Yockey Directs Major Review Of McDonnell Douglas Management," *Defense Week*, 7 October 1991, pp 3, 13.

[456] Article, Jeffrey Record, "Moving The Military Wherewithal To Where The War Is," *Baltimore Sun*, 5 April 1991, pp 9, 16.

[457] Notes, [Swain Briefing], 30 May 1991; Report, SAF/PATT to HQ MAC/PA, "C-17 Trip Report," April 1991.

[458] Report, Brig Gen Michael J. Butchko Jr. to AFPEO/TA and SAF/AQ, "Acquisition Executive Monthly Report (AEMR) as of 31 March 1991," 9 April 1991. Another B-2 lesson was integrating maintainers and logisticians into the test program, performing test

points. See, Interview, Col (Ret) George G. London Jr. with Betty R. Kennedy, 2 February 2000.

459 Col Charles W. Seifert, "The C-17 Program in 1991, An Insider's View," circa 1992, pp 454, 455.

460 Letter, Brig Gen Michael J. Butchko Jr. to AFPEO/TA and SAF/AQ, "C-17 First Assessment," 29 April 1991.

461 Memo w/atch, Maj Gen Frank E. Willis to Command Section, [Secretary Rice Douglas visit], 30 May 1991; Report, Maj E. Craig Moore, "T-1 Aircraft Milestone Report, Executive Summary," 31 May 1991; Comment, Casey, 14 June 2002.

462 Point Paper, HQ MAC/XRSC, "C-17 First Flight Prerequisites," 16 June 1991.

463 Message, Lt Col Walter J. Evans to Brig Gen Michael Butchko and others, "SPO West Status," 18 June 1991.

464 Ibid.

465 Point Paper, HQ MAC/XRSC, "SECAF-Directed White Paper on C-17 Production," 14 June 1991.

466 Report, HQ MAC/XRSC, "C-17 First Flight Progress," 19 June 1991; Report, HQ MAC/XRSC, "C-17 First Flight Progress," 21 June 1991; White Paper, HQ AF PEO/TA, "C-17," June 1991.

467 Col Charles W. Seifert, "The C-17 Program in 1991, An Insider's View," circa 1992, pp 430, 431.

468 Comment, Casey, 14 June 2002.

469 Article, "Manager Added to C-17 Program*," St. Louis Post-Dispatch*, 21 August 1991, p 6C.

470 Ibid., p 433; Reports, HQ MAC/XRSC, "C-17 First Flight Progress," 25 June; 16, 18, 30 July; 2, 6, 9, 22 August 1991.

471 Col Charles W. Seifert, "The C-17 Program in 1991, An Insider's View," circa 1992, pp 434, 435; Letter w/atchs, Robert L. Clepper to Brig Gen Michael Butchko, [Schedule Recovery Plan], 16 August 1989.

472 History, AFFTC, 1 October 1989-30 September 1991, p 376; Article, Bruce A. Smith, "First C-17 Flight Marks Key Program Milestone," *Aviation Week & Space Technology*, 23 September 1991, pp 18, 19; Interview, London, 2 February 2000; Reports, HQ MAC/XRSC, "C-17 First Flight Progress," 22 August, 9 September 1991.

473 The C-17's initial aircrew members were among the best. William R. Casey, a Naval aviator, had flown F-8 combat missions and served as the Navy's V/STOL test pilot before joining the Douglas Aircraft Company in 1971. Lt Col George G. London Jr., a former T-38 instructor and seasoned C-141 airlift pilot, had been a test pilot for the Air Force since 1983 to include a tour as an instructor at the Test Pilot School. He had flown over forty aircraft types. Theodore R. Venturini, a retired Air Force loadmaster, experienced in the C-124, C-133, and C-130, and test loadmaster for the JC-130, C-5A, AMST, YC-14 and YC-15 programs, had joined Douglas Aircraft in 1979 as the project loadmaster for the C-17 program. Henry C. van de Graaf had previously been a project engineer and manager for the F-16 test program at Edwards. Graaf had joined Douglas Aircraft in 1986 as an airborne flight test conductor and had amassed 1,200 hours in experimental flight tests. Comprising the C-17's first flight alternate crew were pilot Charles N. Walls, co-pilot Maj Ronald D. McElroy, loadmaster William M. Cannon, and flight test engineer Wayne T. Anselmo. Walls' military credentials included a stint as a tactical airlift pilot in Vietnam, F-4 test pilot, and YC-14 project pilot. He joined Douglas Aircraft in 1986 as a

C-17 engineering test pilot, subsequently selected as the project pilot. Maj McElroy, an experienced C-141 and VC-140B pilot, instructor pilot, and test pilot, served as the chief pilot for the C-17 test program. He had amassed over 5,600 hours in over 40 military and 30 civilian aircraft. Cannon, with over thirty years experience as a military loadmaster to include 300 combat hours in Vietnam, had been one of eighteen loadmasters serving on the C-X source selection board. After retirement, he first worked for Lockheed and then for Douglas Aircraft in 1985, associated with the C-17 program. Joining Douglas Aircraft in 1988 as part of the MD-11 program, Anselmo brought experience from his work with Boeing and Grumman. See, Biographies, William R. Casey, Lt Col George G. London Jr., Theodore R. Venturini, Henry C. van de Graaf, Charles N. Walls, Maj Ronald D. McElroy, William M. Cannon, and Wayne T. Anselmo, circa 1991.

[474] Following the 14 September delay, Bill Casey requested that the aircraft not be refueled or the minor write ups worked on that night to ensure T-1 was ready for another attempt on 15 September. Weather forecasts for the next several days predicated overcast skies. Thus, the plane took off some 11,000 pounds lighter than originally planned.

[475] Point Paper, HQ MAC/XRS, "C-17 First Flight Flight [sic]—15 Sep 91," 15 September 1991; Briefing, McDonnell Douglas, "Flight Test, First Flight Plan," September 1991; Article, Sgt. Elton Price, "Thousands See C-17's First Flight," *MAC News Service*, September 1991; Article, Bruce A. Smith, "First C-17 Flight Marks Key Program Milestone," *Aviation Week & Space Technology*, 23 September 1991, pp 18-20; Article, 1st Lt E. Butterbaugh, "Cleared For Takeoff," *Leading Edge*, November 1991, pp 18, 19.

[476] Article, 1st Lt E. Butterbaugh, "Cleared For Takeoff," *Leading Edge*, November 1991.

[477] Interview, London, 2 February 2000; Article, Sgt. Elton Price, "Thousands See C-17's First Flight," *MAC News Service*, September 1991; Article, William B. Scott, "C-17 First Flight Triggers Douglas/Air Force Test Program," *Aviation Week & Space Technology*, 23 September 1991, pp 21, 22.

[478] Letter w/atchs, Lt Col Michael H. Cox to Maj Gen Frank E. Willis, "Public Affairs Activities Surrounding C-17 First Flight," 23 August 1991; Article, Sgt. Elton Price, "Thousands See C-17's First Flight," *MAC News Service*, September 1991; Interview, Dessert, 12 June 2002; Comment, Fielding, July 2002.

[479] Point Paper, HQ MAC/XPQA, "C-17 Program Status; For CORONA SOUTH 85, 14-17 Feb 85," 6 February 1985; Point Paper, HQ MAC/XPQC, "C-17 Programmatics and Schedule," 9 September 1988.

[480] Comment, Casey, 14 August 2002.

[481] Table, C-17 SPO, "C-17 Aircraft Delivery Summary," June 2000.

[482] Article, Tony Capaccio, "Yockey Directs Major Review Of McDonnell Douglas Management," *Defense Week*, 7 October 1991, pp 3, 13; Congressional Hearing Resume, SAF/LLP, "McDonnell Douglas Corporation's Technical and Financial Difficulties Associated with its Major Weapons Systems," 3 October 1991; Congressional Hearing Resume, SAF/LLP, "The Current Status of the C-17 Aircraft Program," 14 November 1991; Col Charles W. Seifert, "The C-17 Program in 1991, An Insider's View," circa 1992, pp 446-449; Letter, John Conyers Jr. to Dick Cheney, [Hearings on C-17], 26 November 1991. By the early 1990s, the DOD made it a policy not to award fixed-price developmental contracts if there were risks. The government had learned that fixed-price contracts made it possible for contractors to underbid the developmental contracts and then recover losses at high productions rates.

[483] Press Release, US Senate Armed Services Committee, "National Defense Authorization Act For Fiscal Years 1992 and 1993," 1 November 1991; Program Budget Desision No.

719, "Air Force Aircraft," November 1991.
[484] Report, DOD, "C-17 Acquisition Program: Report to Congress (Public Law 102-190)," September 1992. The report stated the full-scale engineering development contract ceiling price was $6.7 billion. The Air Force estimated the contract, which included two production options, to be $7.8 billion with the contractor responsible for the amount above $6.7 billion. In 1989-1990, the DOD established a policy of not awarding fixed-price development contracts when risk was perceived. In the case of McDonnell Douglas, some believed the company had understated its bid at the time of the original contract award.
[485] Memo w/atchs, AMC/XP to Command Section, "Feedback From Congressional Staffers on 1991 AF Budget Issues," ca December 1991.
[486] Ibid.
[487] Comments, Maj Gen Charles E. Franklin, "PEO Comments," 18 April 1992.
[488] Point Paper, HQ AMC/XP, "C-17 Program," ca June 1992.
[489] Comments, Maj Gen Charles E. Franklin, "PEO Comments," 13 October 1992.
[490] Ibid.; Statement, HQ USAF, "C-17 Static Aircraft Testing," 1 October 1992; Point Paper, HQ AMC/XPQC, "C-17 Program Status and Update," 15 June 1994.
[491] Staff Summary Sheet w/atchs, AMC/XPDIL, "Senate Armed Services Committee (SASC) Authorization Bill Information on the C-17," 5 August 1992; Report, House Armed Services Committee, "FY93 Defense Authorization Act House-Senate Conference Summary of Major Actions," 1 October 1992.
[492] Study (classified), JCS, *Mobility Requirements Study*, 23 January 1992, pp ES-1-ES-5, I-1, I-2, information used is unclassified; Briefing, HQ AMC/XP, "Measures of Airlift Capability," April 1993; Point Paper, HQ AMC/XPDIJ, "Mobility Requirements Study (MRS)," 13 August 1993; Oral History, Drs. James K. Matthews and Jay H. Smith, *General Hansford T. Johnson Commander In Chief United States Transportation Command and Air Mobility Command: An Oral History*, (Scott AFB, IL: Office of History USTC, December 1992), p 64.
[493] In comparison, between October 2001 and December 2003, the United States Transportation Command oversaw the movement of more than a million passengers and 2.75 million tons of cargo in support of the Global War on Terrorism, specifically Operations Enduring Freedom and Iraqi Freedom. News Release, USTC/PA, "Armed Forces Reach Milestone-One Million Moved," 9 December 2003.
[494] Oral History, Matthews and Smith, *General Hansford T. Johnson*, pp xi, 64.
[495] Ibid., p 64.
[496] Gen Ronald R. Fogleman began expressing interest in alternatives in December 1992. Notes, Jay Smith, "Roundtable," 23 December 1992; Notes, Jay Smith, "Roundtable," 20 January 1993.
[497] Interview, Gen (Retired) Ronald R. Fogleman with Betty R. Kennedy, 28 January 2000; Watson, *Secretaries and Chiefs of Staff of the United States Air Force*, pp 187-189. General Fogleman served as the Commander of the Air Mobility Command and Commander-In-Chief of the United States Transportation Command from August 1992 through October 1994 and as the Chief of Staff of the Air Force from October 1994 until September 1997.
[498] Interview, Fogleman, 28 January 2000.
[499] Ibid.; Interview, Lt Col Gwen Linde with Betty R. Kennedy, 29 January 1996.
[500] Notes, Jay Smith, "CC Report on 18 Dec 92 Brfg to CSAF," 19 December 1992; Memorandum w/atch, Maj Kenneth R. Wavering to HQ AMC/XP, "Air Staff Response For C-141 Buy Back," 30 December 1992.
[501] Notes, Jay Smith, "Roundtable," 23 December 1992.

[502] Memorandum, Lt Gen Walter Kross to Gen Ronald R. Fogleman, 1 February 1993.
[503] Memorandum, Col Joseph H. Mulherin to AMC/XR, "Operational Impact of C-17 IOC Slip," 13 January 1993; Memo, Col Michael R. Gallagher to AMC/CS/CV/CC, "Impact of Delays in C-17 Program," 29 January 1993; Staff Summary Sheet, AMC/XRSC, "Operational Impact of Continued Slips in C-17 Production," 24 February 1993.
[504] Memo w/atchs, Maj Gen Phillip J. Ford to Gen Ronald R. Fogleman, [Strategy], ca 3 March 1993.
[505] Interview, Linde, 29 January 1996.
[506] Note, Gen Ronald R. Fogleman to Maj Gen Philip J. Ford, 27 March 1993; Staff Summary Sheet w/atch, HQ AMC/XPPF, "C-17/C-141 Force Structure Profiles, AFSAA Briefing to CSAF," 17 March 1993.
[507] Interview, Fogleman, 28 January 2000; Interview, Linde, 29 January 1996; Article, "Air Force Officials Considering Options If C-17 Program Falters," *Inside the Pentagon*, 16 February 1993, pp 1, 12; Article, Jeff Cole, "Air Force Official Orders Limits on Use of C-141s, Urges Buying New Planes," *Wall Street Journal*, 17 May 1993, pp 1, 3.
[508] Transcript, Gen Ronald R. Fogleman, Senate Armed Services Committee, *Hearing To Receive Testimony From The Unified And Specified Commanders On Their Military Strategy And Operational Requirements, And The Defense Authorization Request For Fiscal Year 1994 And The Future Years Defense Program*, 22 April 1993, p 57.
[509] News Release, HQ AMC/PA, "AMC Restricts C-141 Fleet From Carrying Full Cargo Loads," 16 May 1993; New Release, HQ AMC/PA, "AMC Restricts Portion Of C-141 Fleet From Flight," 9 August 1993; Memorandum, Col Eric A. Zimmerman to HQ AFMC/PKT, "Technical Evaluation of Snow Aviation International Unsolicited Proposal, 7 Feb 94," 11 April 1994; Staff Summary, HQ AF/XORM, "Jan 94 Scientific Advisory Board (SAB) Technical Feasibility of C-141 Service Life Extension Program (SLEP)," 25 May 1994.
[510] Point Paper, Betty R. Kennedy, "National Airlift Policy 1950-1998: A Historical Perspective," March 2001; National Security Decision Directive No. 280, "National Airlift Policy," 24 June 1987. This directive essentially reaffirmed the 1960 *Presidentially Approved Courses of Action*.
[511] Letter w/atch, E. J. Driscoll to L. Aspin, [Acquisition Of Off-The-Shelf Commercial Aircraft], 20 May 1993.
[512] Point Paper, HQ AMC/XPPF, "Southern Air Transport Proposal," June 1993; Letter, William G. Langton to Gen Ronald R. Fogleman, 8 June 1993; Letter, Edward J. Driscoll to Gen Ronald R. Fogleman, 2 June 1993; Letter, Edward J. Driscoll to Les Aspin, 1 July 1993; Memorandum, Maj Gwen M. Linde to HQ AMC/XPPF/XPP/XP/CV, "CRAF Alternatives to Commercial Derivatives," 5 August 1993; Memorandum, Maj Gwen M. Linde to HQ AMC/XPPF/XPP/XP, "Request from OSD PA&E (Organic Airlift Requirement)," 6 October 1993; Paper, HQ AMC/XPPF, "Organic Airlift Requirement," 6 October 1993.
[513] Interview, Linde, 29 January 1996; Interview, Fogleman, 28 January 2000; Staff Summary Sheet, HQ AMC/XRSA, "AMC Staff Comments on Boeing Commercial Derivative Airlifter Options Briefing," 30 April 1993; Letter, Robert H. Hood Jr. to Gen Ronald R. Fogleman, [DC-10-30 and MD-11 Offer], 23 June 1993; Point Paper, HQ AMC/XPYA, "Use of KC-10s As Airlifters," 17 Jun 1994; Staff Summary Sheet, HQ AMC/XRSC, "Comments on the Lockheed Briefing Entitled, 'C-5B for National Airlift,'" 8 April 1993; Memo w/atch, Maj Mark A. Caslen to HQ AMC/XRSC/XRS, "LASC Brief to Staffers," 16 April 1993;

Memorandum, Col Stephen R. Cornish to HQ AMC/XP/CV/CC, "Airlift Alternative Issues," 15 October 1993.
[514] Interview, Fogleman, 28 January 2000.
[515] Ibid.
[516] Kennedy, ed., *Anything, Anywhere, Anytime*, pp 105, 106, 109.
[517] Article, Neff Hudson, "Conyers Urges Suspension of C-17 Work," *Air Force Times*, 8 February 1993, p 18; Article, John D. Morrocco, "Pentagon Report Faults USAF C-17 Program Officials*," Aviation Week & Space Technology*, 25 January 1993, p 51.
[518] Article, Barbara Opall, "AF Disputes Report Alleging C-17 Irregularities," *Air Force Times*, 1 February 1993, p 28; Article, John D. Morrocco, "Pentagon Report Faults USAF C-17 Program Officials," *Aviation Week & Space Technology*, 25 January 1993, p 51; Article, "Generals OK'd For Testimony On C-17 Costs," *St. Louis Post-Dispatch*, 25 March 1993, p 8A; Article, Jon Sawyer, "John McDonnell To Testify," *St. Louis Post-Dispatch*, 24 March 1993, p 1B; Article, "Pentagon Heaps Criticism on McDonnell's C-17 Jet," *St. Louis Post-Dispatch* (from *Chicago Tribune*), 29 March 1993, p 5A.
[519] Report, OSD/T&E, *Early Operational Assessment Of The C-17 Aircraft*, December 1992, p 24, information used is unrestricted. This report came from Draft Report, Col Donald M. Dessert, *C-17 IOT&E Status Report*, 14 September 1992.
[520] Article, "Pentagon Heaps Criticism on McDonnell's C-17 Jet," *St. Louis Post-Dispatch* (from *Chicago Tribune*), 29 March 1993, p 5A; Point Paper, HQ AMC/XTRA, "C-17 Flight Test Program Status," 1 February 1993; Hearings, House Armed Services, *C-17 Aircraft Program Review*, 103d Cong., 1st sess, 10 March 1993, p 85; List, HQ ASC/YCDB, "C-17 Aircraft Delivery Summary," 3 May 2001; Staff Summary, HQ AMC/XRSC, "C-17 Static Display at Andrews AFB," 11 February 1993.
[521] Hearings, House Armed Services, *C-17 Aircraft Program Review*, 103d Cong., 1st sess, 10 March 1993, pp 92, 93.
[522] Ibid., p 94.
[523] Ibid., pp 5-25. In April 1990, Col Tollefson bluntly stated when interviewed by McDonnell Douglas' in-house paper *Quality Times*: "The fact is DAC does not yet have disciplined systems that will produce a high-quality product at the lowest possible cost. The massive overtime at DAC attests to this fact, as do the 34 Contractor Deficiency Reports issued by the Air Force against the company. The message about how bad things really are at DAC never gets communicated to employees through *Quality Times*." Overall, Tollefson said, Douglas lacked focus and leadership. See, Article, Holly Rawlinson, "Col. Tollefson Speaks Out About Q.T.," *Quality Times* (Douglas Aircraft Company), 23 April 1990 and Article, Holly Rawlinson, "Tollefson Talks About DAC's Downfalls," *Quality Times*, 16 April 1990.
[524] Article, Tony Capaccio, "Testimony Raises Questions About Air Force Credibility*," Defense Week*, 15 March 1993, p 9; Article, Jon Sawyer, "C-17 Costs Are Called a 'Con Job,'" *St. Louis Post-Dispatch*, 18 March 1993, p 1A; Statement, House Legislation and National Security Subcommittee, Russell Murray II, "The Origin Of The C-17," 22 April 1993.
[525] Hearings, House Armed Services, *National Defense Authorization Act For Fiscal Year 1994—H.R. 2401 and Oversight Of Previously Authorized Programs*, 103d Cong., 1st sess, 1 April 1993, p 416.
[526] Ibid., pp 420, 421.
[527] Ibid., pp 415, 420-423.

[528] Ibid., pp 422, 423.
[529] Article, Tony Capaccio, "Murtha Mulls C-17 Death; Says USAF's 'Done It All Wrong,'" *Defense Week*, 29 March 1993, p 3.
[530] Memorandum, Les Aspin to Act SECAF, "Air Force Review of the DOD Inspector General Report on the C-17 Aircraft (January 14, 1993)," 29 April 1993.
[531] Ibid.
[532] Ibid.; Memorandum, OSD/PA, "Memorandum for Correspondents," 30 April 1993.
[533] Article, "An Air Force Watergate?," *St. Louis Post-Dispatch*, 29 January 1993, p 2C.
[534] Letter, John M. Deutch to John F. McDonnell, [C-17 Program], 11 May 1993.
[535] Between May 1995 and December 1996, John Deutch served as the director of the CIA, returning to MIT after having failed to secure the secretary of defense position. Upon his departure from the CIA, it came to light that John Deutch had grossly mishandled classified materials. The stage was set for a misdemeanor plea agreement, but President Clinton pardoned Deutch as one of his last acts in office. Article, James Risen, "C.I.A. Inquiry Of Its Ex-Director Was Stalled At Top, Report Says," *New York Times*, 1 February 2000; Article, Bill Miller and Walter Pincus, "Deutch Had Signed Plea Agreement, Sources Say," *Washington Post*, 24 January 2001.
[536] Biography Sheet, Internet MIT, "John M. Deutch," circa 1996; Interview, Fogleman, 28 January 2000; Interview, Lt Gen Walter S. Hogle Jr. with Betty R. Kennedy, 17 November 1999.
[537] Letter, John M. Deutch to John F. McDonnell, [C-17 Program], 11 May 1993; Memorandum, John M. Deutch to SECAF, "C-17 Defense Acquisition Board Preparation," 11 May 1993; Memorandum, John M. Deutch to Defense Science Board, "Terms of Reference—Defense Science Board Task Force on C-17 Review," 11 May 1993.
[538] Memorandum, John M. Deutch to SECAF, "C-17 Acquisition Decision Memorandum," 21 May 1993; Memorandum, John M. Deutch to SECAF, "C-17 Defense Acquisition Board Preparation," 11 May 1993.
[539] Interview, Fogleman, 28 January 2000; Staff Summary Sheet, HQ AMC/XRSC, "Visit of Mr John F. McDonnell, Mr Gerald A. Johnston, Mr Kenneth A. Francis, and Maj Gen Charles E. Franklin," 13 May 1993; Talking Paper, HQ AMC/XR, "C-17 Airlift," 14 April 1993. In April, the command was already planning a meeting with McDonnell, following a Lockheed briefing.
[540] Statement, John M. Deutch, House Armed Services Committee, "C-17 Program," 11 May 1993; Report, Maj Tom McGovern, Testimony of Dr. John M. Deutch before Senate Subcommittee on Regional Defense and Contingency Forces, "Mobility Requirements and Programs (Strategic Airlift/Sealift)," 22 June 1993.
[541] Article, "Pentagon: $37 Billion C-17 Program Could Be Killed," *Reuters*, 11 May 1993.
[542] Letter, John F. McDonnell to John M. Deutch, [C-17 Actions], 15 June 1993.
[543] Attending the meetings were John McDonnell, his executive vice president, and C-17 program manager. The principal Air Force attendees included the secretary of the air force, the assistant deputy secretary for acquisition, the PEO, the C-17 program director, and commanders or vice commanders from Air Force Materiel Command, Air Mobility Command, and Defense Contract Management Command. These meetings continued into 1996.
[544] Minutes, Lt Col John A. Weimer, AFPEO/TA, "C-17 Chief Executive officer (CEO) meeting Minutes," 7 July 1993; Minutes, Lt Col Bud Vazquez, AFPEO/TA, "C-17 Chief Executive officer (CEO) meeting Minutes," 13 August 1993.

[545] The task force, headed up by Robert Fuhrman and Lieutenant General Fain, had a senior level review group, which included Edward C. Aldridge Jr. (President of Aerospace Corporation); Oliver C. Boileau Jr. (President and General Manager of Northrop's B-2 Division); and Dr. Malcolm R. Currie (Chairman and retired CEO for Hughes Aircraft). Seven integrated product teams tackled reviewing the C-17 program.
[546] Memorandum, Robert A. Fuhrman, Lt Gen James A. Fain Jr., Edward C. Aldridge Jr., Oliver C. Boileau Jr., and Malcolm R. Currie to Chair Defense Science Board, "Report of the Defense Science Board C-17 Task Force," circa Fall 1993.
[547] Ibid.; Briefing, DSB Task Force, "C-17 Senior Level Group Final Briefing," 23 August 1993; Memorandum w/atch, Charles E. Adolph to DAB, "C-17 Test and Evaluation Assessment," 24 August 1993; Briefing, Maj Gen Charles E. Franklin, "C-17 Program Review," 5 October 1993; Briefing, Col Gene Kluter, "DCMC Taskings Per USD(A) 11 May Letter," 5 October 1993; Report, DSB Task Force, "C-17 Review," December 1993; Interview, Fogleman, 28 January 2000; Minutes, Lt Col John A. Weimer, AFPEO/TA, "C-17 Chief Executive officer (CEO) meeting Minutes," 7 July 1993.
[548] Report, IDA, Cost and Operational Effectiveness Analysis of the C-17 Program, December 1993, pp iii, ES-1-ES-9.
[549] Memorandum, John M. Deutch to DAB Principals, "C-17 DAB Review," 26 August 1993; News Release, OSD/PA, "Secretary of Defense Announces Future Airlift Plans," 15 December 1993; Statement, L. Aspin, "Statement By Honorable Les Aspin Secretary of Defense: C-17," 15 December 1993. In early June 1993, the Headquarters Air Mobility Command Plans staff advanced the idea to Gen Fogleman that Dr. Deutch may want to consider slowing procurement for a couple of years with the program facing cancellation or program ramp up based upon McDonnell Douglas' performance. See, Memo, Col Joseph Mulherin, "Session With CC, 9 June 1993," 9 June 1993.
[550] Letter w/atchs, John M. Deutch to John F. McDonnell, [Omnibus Agreement], 3 January 1994.
[551] Ibid.; Memorandum w/atch, Col Robert J. Boots to AMC/CV/CC, "31 Jan Version of Draft Acquisition Decision Memorandum," 3 February 1994; Memorandum, John M. Deutch to SECAF, "C-17 and Non-Developmental Airlift Aircraft Acquisition Decision Memorandum," 25 March 1994.
[552] Letter w/atchs, John M. Deutch to John F. McDonnell, [Omnibus Agreement], 3 January 1994; Statement, Les Aspin, "Statement By Honorable Les Aspin Secretary of Defense: C-17," 15 December 1993; Interview, Fogleman, 28 January 2000. McDonnell Douglas also agreed to pay a $500,000 civil penalty, neither admitting nor denying the SEC's allegations that the corporation should have reported a loss on the C-17 at the end of 1990. See, Article, "McDonnell Settles Lawsuit For $500,000," *Belleville New-Democrat*, 25 June 1996, p 3A.
[553] Article, Sgt James L. Davis, AMC News Service, "C-17 Globemaster III Arrives At Charleston AFB," June 1993; Schedule, 437th AW, "Proposed C-17 Arrival Ceremony Time Sequence, 14 June 1993, Charleston AFB, SC," 10 June 1993. Aircrew members on this first flight were: Lieutenant Colonel Giles D. Gentry, Major Joseph B. Niemeyer, Major Paul J. Sykes, Master Sergeant Kenneth D. Nicholson, and Master Sergeant John P. Shiflet. Major Sykes was a reservist assigned to the 317th Airlift Squadron, 315th Airlift Wing (reserve associate).
[554] Article, Sgt James L. Davis, "C-17 Globemaster III Arrives At Charleston AFB," AMC News Service, June 1993.

[555] Article, Neff Hudson, "1st C-17 Arrives With Pomp, Uncertain Future," *Air Force Times*, 28 June 1993; Article, TSgt David P. Masko, "C-17 Arrives," *Air Force News*, 14 June 1993.
[556] List, 437th AW, "RSVP Status," 9 June 1993.
[557] Note, Lt Gen Walter Kross to Gen Ronald R. Fogleman, [C-17 Delivery], 14 February 1993.
[558] Letter, Col Barry F. Creighton to HQ AMC/CV and others, "C-17 Delivery to Charleston," 12 February 1993.
[559] Letter, Maj Gen Frank E. Willis to Lt Gen Walter Kross, "C-17 Delivery to Charleston," 12 February 1993.
[560] Note, Gen Ronald Fogleman to Lt Gen Walter Kross, [C-17 Delivery], 20 February 1993.
[561] Memorandum, Brig Gen Kenneth G. Miller to AFPEO/TA & SAF/AQ, "Decisions Documentation," 2 March 1993; Memo, Maj John Schmedake to HQ AMC/XR, "AMC/CC Direction for C-17," 12 April 1993; Letter w/atchs, Maj Gen Frank E. Willis to AMC/XO/LG, "C-17 SPO Status Update Briefing, 3 May 93," 11 May 1993; Interview, Lt Col Richard Mark Hunter, Lt Col Douglas F. Jamieson, and Maj Chris Davis with Betty R. Kennedy, 29 March 1999. Lt Col Hunter served as the chief of combat systems Development at HQ Air Mobility Command under which the C-17 program was managed, working with Lt Col Jamieson and Maj Davis. From August 1992 until June 1995, Lt Col Jamieson served as the government's flight representative at Douglas Long Beach. Prior to their headquarters assignments, Lt Col Hunter and Maj Davis were the fifth and sixth operational test and evaluation pilots assigned to the C-17 Test Force at Edwards Air Force Base. Lt Col Jamieson related that both AMC and the SPO pressured to have aircraft released for Air Force delivery acceptance.
[562] Interview, Allen, 28 October and 5 November 1998; Letter, HQ AMC/XOT to AMC/XRS, "Aircraft Capability at Initial Squadron Operations," 8 December 1992; Letter, Maj Gen Frank E. Willis to HQ ASC/YC, "P-6 Delivery to Charleston," 30 March 1993; Letter, Maj Gen Frank E. Willis to HQ ASC/YC, "Aircraft Configuration for Initial Operational Capability," 9 April 1993; Letter, Kenneth L. Marten and Col Donald M. Dessert Jr., "C-17 Combined Test Force (CTF) Recommendations for C-17 Initial Operations Guidelines," 2 7 May 1993; Letter, Brig Gen Kenneth G. Miller to HQ AMC/XR, "C-17A Operational Capability Release Recommendation-Day/Night VFR Local (Blocks 1 /2 with Restrictions)," 16 June 1993; Letter, Brig Gen Kenneth G. Miller to HQ AMC/XR, "C-17A Operations at Charleston AFB," 18 June 1993; Letter, HQ AMC/XO to 21st AF/DO and others, "C-17 Capability Restrictions Letter #01," 23 June 1993; Message, HQ AMC/XO to 21st AF/DO, "C-17 Capability Release Message Number (05)," 021400Z August 1993; Memo, Col Norman W. Raines to HQ ASC/YCT, "In-flight Aircraft Emergency Support," 14 October 1993; Briefing, 437th Logistics Group, "Progress Toward Organic Capability," December 1993; Briefing, 437th Operations Group, "Operations, Charleston ISO Progress/Outlook," December 1993; Point Paper, AMC/OR, "The Impending Failure to Release Capability Release Block 14," 28 January 1994; Interview, Dessert, 12 June 2002; Interview, Hunter, Jamieson, and Davis, 29 March 1999.
[563] Briefing, 437th Operations Group, "Operations, Charleston ISO Progress/Outlook," December 1993; Minutes w/atchs, "Site Activation Conference, 7-10 Dec 93, Operations Working Group," December 1993; Minutes w/atchs, "Site Activation Conference, 7-10 Dec 93, Logistics Working Group," December 1993.

[564] Briefing, Col Donald M. Dessert Jr. and Lt Col Terry E. Tomeny, "C-17 Combined Test Force Joint Assessment of Initial C-17 Day/Night VFR Local Operational Capabilities," 6 July 1993.
[565] Briefing Slide, C-17 CTF, "Top 20 Inherent Failures," December 1993.
[566] Comment, Casey, 14 August 2002.
[567] The paint on the first aircraft chalked. Also, because of the curing process, it is difficult to get paint to stick to titanium. Conversation, Rene N. Chabannes with Betty R. Kennedy, 10 July 2002. Mr. Chabannes is a manufacturing quality assurance manager in production operations at the C-17 SPO. Additionally, paints formulated to be more environmentally safe did not bond as well. This was an Air Force-wide problem in the 1990s. See, Staff Summary, HQ AMC/XPQL, "C-17 Aircraft Appearance," 1 May 1996.
[568] Article, Ralph Vartabedian, "The Remaking of Douglas by McDonnell," *Los Angeles Times*, 15 October 1989, p D1; Article, Rick Wartzman, "McDonnell Douglas To Furlough 3,000 At Its Transport-Aircraft Subsidiary," *Wall Street Journal*, 27 March 1990, p 5; News Release, McDonnell Douglas, 19 December 1989; News Release, McDonnell Douglas, 26 April 1990; Letter, John F. McDonnell to Teammates, "Our Financial Situation," 8 May 1990; Interview, Hogle, 17 November 1999; Interview, Allen, 28 October and 5 November 1998; Interview, Johnson, 22 December 1999; Comment, Casey, 14 August 2002. Apparently, moisture in the epoxy during the manufacturing process caused at least one of the wing panel failures.
[569] Interview, Walter S. Evans, 24 September 1998; Interview, Johnson, 22 December 1999; Article, "What could have been, and what can be," *Profile* (Vought Aircraft Company), 21 October 1993, pp 3, 4; Article, Neff Hudson, "Crews: Globemaster Outperforms Other Lifters," *Air Force Times*, 24 May 1993, p 16; Article, William Flannery, "Air Force Crew Gives High Praise To Latest C-17," *St. Louis Post-Dispatch*, 5 November 1993, pp F-1, F-8; Article, Dave Moniz, "Crews in Charleston Defend New C-17s," *The State* (South Carolina), 30 January 1994, pp 1B, 9B.
[570] Article, Dave Moniz, "Crews in Charleston Defend New C-17s," *The State* (South Carolina), 30 January 1994, p 9B.
[571] Article, David M. North, "C-17 Should Fulfill USAF Airlift Mission," *Aviation Week & Space Technology*, 10 May 1993, p 44.
[572] Article, Harry Hopkins, "Big-Time Doorstep Delivery," *Flight International*, 19-25 May 1993, p 35.
[573] Letter w/atchs, Brig Gen Kenneth G. Miller to HQ AMC/XP, "C-17A Operational Capability Release Recommendation-IMC Local (Block 3 with Restrictions)," 27 September 1993; Letter, Col Paul W. Essex to 21st AF/DO and others, "C-17 Capability Restrictions Letter #03," 30 September 1993.
[574] Staff Summary Sheet, HQ AMC/XOVG, "C-17 Operational Launch Problem," 15 November 1993.
[575] As designed the C-17 could be flown with all the screens blank. Although not mission capable, it was safe to fly to recovery. Comment, Casey, 14 August 2002.
[576] Letter w/atchs, Brig Gen Ronald T. Kadish to HQ AMC/XP, "C-17 Operational Capability Release Recommendation (Blocks 4A-10A)," 26 March 1994; Letter w/atchs, Col William T. Tuttle to 21st AF/DO and others, "C-17 Capability Restrictions Letter #04," 1 April 1994.
[577] Notes, "Site Activation Conference: Operations Working Group, 7-10 Dec 93," December 1993; Interview, Hogle, 17 November 1999; Briefing, Col Donald M. Dessert Jr. and Lt

Col Terry E. Tomeny, "C-17 Combined Test Force Joint Assessment of ISO Blocks 4-10 Operational Capabilities," 28 March 1994.

[578] Memorandum w/atch, Eric E. Abell to HQAMC/XP, "C-17 Operational Capability Release Recommendation (Blocks 12, 13 and 14)," 27 July 1994; Memorandum, Eric E. Abell to HQ AMC/XP, "C-17 Operational Capability Release Recommendation for Night Aerial Refueling from a KC-135," 16 August 1994; Memorandum, Brig Gen Ronald T. Kadish to HQ AMC/XP, "C-17 Operational Capability Release Recommendation (Blocks 11 and 15)," 26 August 1994; Memorandum w/atch, Brig Gen Ronald T. Kadish to HQ AMC/XP, "C-17 Operational Capability Release Recommendation (Blocks 10B and 16)," 27 September 1994; Staff Summary Sheet, HQ AMC/XPQC, "C-17 Capability Release blocks 10b and 16," 5 October 1994; Memorandum, Brig Gen Ronald T. Kadish to HQ AMC/XP, "C-17 Operational Capability Recommendation," 20 October 1994; Memorandum, Brig Gen Ronald T. Kadish to HQ AMC/XP, "C-17 Operational Capability Release Recommendation," 1 November 1994; Memorandum, Brig Gen Ronald T. Kadish to HQ AMC/XP, "C-17 Operational Capability Release Recommendation," 30 November 1994; Interview, Hogle, 17 November 1999.

[579] Memorandum w/atch, Brig Gen Ronald T. Kadish to HQ AMC/XP, "Requirements & Planning Council Minutes," 24 April 1995.

[580] Interview, Hogle, 17 November 1999.

[581] Biography Sheet, HQ USAF/PA, "Lieutenant General Walter S. Hogle Jr.," February 2000.

[582] Interview, Johnson, 22 December 1999.

[583] Rudy de Leon would later become a senior vice president of Boeing's Washington DC operations. Article, Marianne Brun-Rovet, Joshua Chaffin, Caroline Daniel, and James Harding, "A Cosy Relationship: Boeing's Pentagon Deal Bears Testament To Its Skilful Lobbying Efforts," *London Financial Times*, 8 December 2003.

[584] Biography Sheet, HQ USAF/PA, "Lieutenant General Ronald T. Kadish," October 1999; Bulletin, John F. McDonnell to MDC Management, "C-17 Program Leadership Appointment," 3 December 1993; News Release, McDonnell Douglas, [New Management Appointments], 3 December 1993; Interview, Johnson, 22 December 1999; Biography Sheet, Internet MIT, "John M. Deutch," circa 1996; Biography Sheet, HQ USAF/PA, "Major General James S. Childress," January 1996; Article, Col Randy Davis, Lt Col Bill Phillips, and Lt Col Bud Vazquez, "The Phoenix Rises," *Acquisition Review Quarterly*, pp 416, 417.

[585] Upon leaving government service, Darleen Druyun began working for Boeing but was subsequently let go over allegations that she had not excused herself from Airbus proprietary data or the Boeing tanker lease transactions prior to beginning employment discussions with Boeing. Article, J. Lynn Lunsford and Anne Marie Squeo, "Boeing CEO Condit Resigns In Shake-Up At Aerospace," *Wall Street Journal*, 2 December 2003, p 1.

[586] Biography Sheet, HQ USAF/PA, "Darleen A. Druyun," October 2001; Biography Sheet, OASD/PA, "Rudy de Leon Under Secretary of Defense for Personnel and Readiness," September 1997; Watson, *Secretaries and Chiefs of Staff of the United States Air Force*, pp 94, 96, 186; Biography Sheet, HQ USAF/PA, "Lieutenant General James A. Fain Jr.," February 1995; Minutes, Lt Col Bud Vazquez, AFPEO/TA, "C-17 Chief Executive Officer Meeting," 29 November 1993.

[587] Minutes, Lt Col Bud Vazquez, AFPEO/TA, "C-17 Chief Executive Officer Meeting," 29 November 1993; Letter, Darleen A. Druyun to Gen Ronald R. Fogleman, "C-17 IOC,

RM&A and Milestone IIIB Dates," 24 November 1993; Minutes, AFPEO/TA, "C-17 CEO Forum," 7 March 1994; Interview, Allen, 28 October and 5 November 1998.
[588] Statement, John M. Deutch, House Armed Services Committee Subcommittee on Military Acquisitions, "Statement of Mr. John Deutch Under Secretary of Defense For Acquisition and Technology," 10 February 1994.
[589] Hearings, House Armed Services, *National Defense Authorization Act For Fiscal Year 1995—S. 2182 (H.R. 4301) and Oversight Of Previously Authorized Programs*, 103d Cong., 2 sess, 3 March 1994, p 556.
[590] Testimony, House Appropriations Defense Subcommittee, [Testimony of General Ronald R. Fogleman], 20 April 1994.
[591] Memorandum w/atch, HQ AMC/XP to CV/CC, "Where did '70-80' Come From," 24 April 1994; Memorandum, HQ AMC/XP to CV/CC, "Militarily Significant Number of C-17s," 28 April 1994; Memorandum w/atch, HQ AMC/XP to CV/CC, "Militarily Significant Number of C-17s," 4 May 1994; Article, Vago Muradian, "AMC Chief Regrets C-17 Statement," *Air Force Times*, 23 May 1994, p 4.
[592] Minutes, AFPEO/TA, "C-17 CEO Forum," 6 September 1994; Article, Col Randy Davis, Lt Col Bill Phillips, and Lt Col Bud Vazquez, "The Phoenix Rises," *Acquisition Review Quarterly*, pp 417, 418; Article, Vago Muradian, "AMC Chief Regrets C-17 Statements," *Air Force Times*, 23 May 1994, p 4.
[593] Minutes, AFPEO/TA, "C-17 CEO Forum," 7 March 1994; Letter, John McDonnell to Sam Nunn, [C-17 business settlement], 29 April 1994.
[594] Article, Adam Goodman, "McDonnell Dynasty At An End," *St. Louis Post-Dispatch*, 27 September 1994, p 5C.
[595] Report, GAO, *Airlift Requirements: Commercial Freighters Can Help Meet Requirements At Greatly Reduced Cost*, July 1994, pp 3, 11.
[596] Report, GAO, Military Airlift: C-17 Settlement Is Not A Good Deal," April 1994, pp 2, 3, 4, 7, 9, 10, 11, 13, 14.
[597] Report, GAO, *Military Airlift: Comparison of C-5 and C-17 Airfield Availability*, July 1994; Statement, HQ AMC/PA, "Statement On GAO Airlift Report," 21 July 1994, pp 1-3; Interview, Allen, 28 October and 5 November 1998.
[598] Report, GAO, *C-17 Aircraft: Cost and Performance Issues*, January 1995, pp 2, 3, 32, 33, 37, 38, 45-49.
[599] Study, Jean R. Gebman, Loanne J. Batchelder, and Katherine M. Poehlmann, Rand Corporation, *Finding the Right Mix of Military and Civil Airlift, Issues and Implications*, vol I, 1994, p 11; Point Paper w/atchs, HQ AMC/XPPF, "Potential Hearing Questions on draft Rand Report," 16 May 1994.
[600] Hearings, House Armed Services, *National Defense Authorization Act For Fiscal Year 1995-S. 2182 (H.R. 4301) and Oversight Of Previously Authorized Programs*, 103d Cong., 2d sess, 10 February 1994, p 4.
[601] Point Paper, HQ AMC/XPQC, "HASC Meeting on C-17/NDAA," 4 May 1994.
[602] White Paper, OSD, *Department of Defense Airlift Acquisition Strategy*, May 1994, pp 12, 15.
[603] Point Paper, HQ AMC/XPQC, "Full Court Press for C-17," 13 May 1994; Letter, William J. Perry to Sam Nunn, [C-17 Support], 3 June 1994; Letter, John M. Deutch to Sam Nunn, [C-17 Support], 6 June 1994; Letter, Gen John M. Shalikasvili to Sam Nunn [C-17 Support], 17 May 1994; Letter Gen Gordon R. Sullivan to Sam Nunn, [C-17 Support], 17 May 1994; Letter Gen Joseph P. Hoar to Sam Nunn [C-17 Support], 3 June 1994; Letter, Derek J. Vander Schaff to Edward M. Kennedy, [C-17 Support], 3 June 1994; Letter Robert A.

Fuhrman to Sam Nunn, [C-17 Support], 3 June 1994; Letter, John M. Deutch and William J. Perry to Sam Nunn [C-17 Support], 21 June 1994.

[604] Letter, Derek J. Vander Schaff to Edward M. Kennedy, [C-17 Support], 3 June 1994.

[605] Letter, William J. Clinton to Thomas S. Foley, [C-17 Support], 23 May 1994; Letter, Charles E. Grassley, William V. Roth, and Alphonse M. D'Amato to Colleague, "GAO Says C-17 Settlement Agreement Is a 'Lousy Deal,'" 22 June 1994; Article, Brian Green, "Highlights of the 1995 Defense Bill," *Air Force Magazine*, October 1994, p 11; Report, HQ USAF, "C-17 Program Input for FY94/95 Annual Air Staff History," 20 November 1995.

[606] Report, HQ AMC/XPDIL, "Capitol Hill Update," 29 September 1994; Article, Brian Green, "Highlights of the 1995 Defense Bill," *Air Force Magazine*, October 1994, p 11; Minutes, AFPEO/TA, "C-17 CEO Forum," 6 September 1994.

[607] P-7**,** delivered on 26 August 1993, was actually 5 days early, but P-8-12 were still late although not the months late as P-1-6 were. AMC had a policy of having general officer and equivalents participate in aircraft deliveries as a way of ensuring the C-17 SPO remained committed to timely aircraft deliveries. Later, these DV deliveries built support for the program. See, Staff Summary, HQ AMC/XPQC, "General Officer Participation in C-17 Delivery," 18 February 1994.

[608] Minutes, AFPEO/TA, "C-17 CEO Forum," 10 June 1994; Minutes, AFPEO/TA, "C-17 CEO Forum," 6 September 1994; Minutes, AFPEO/TA, "C-17 CEO Forum," 12 January 1995; Article, James R. Carroll and Lindsay Chaney, "How The MD Program Was Saved," *Long-Beach Press-Telegram*, 23 October 1995, p 1A; Point Paper, SAF/AQQU, "Chronology on C-17 Program," 22 December 1995; List, HQ ASC/YCDB, "C-17 Aircraft Delivery Summary," 3 May 2001. Part of the delivery delays were the result of taking good trunnion collars from P-7, P-8, P-9 to replace the cracked collars on T-1, P-1, and P-2 as well as landing gear production problems which made deliveries challenges through P-12. See, Memorandum, HQ AMC/XPQC, "Landing Gear Production Delays," 18 January 1994.

[609] Interview, Fogleman, 28 January 2000.

[610] Ibid.

[611] Point Paper, HQ AMC/XPQC, "External Airflow Around Troop Doors (Parachute Entanglement)," 1 September 1994; Comment, Lawrence E. Fielding, July 2002.

[612] Point Paper, HQ AMC/TEA, "C-17 Paratrooper Entanglement," 22 January 1995; Point Paper, HQ AMC/TEA, "C-17 Jumper Entanglement," 14 February 1995.

[613] Memorandum, Gen Robert L. Rutherford to HQ USAF/CC, "C-17 Paratrooper Entanglement," 25 November 1994.

[614] Point Paper, HQ AMC/TEA, "C-17 Paratrooper Airdrop Operations-Developmental Testing Complete, Capability Released for Dedicated Initial Operational Test and Evaluation (DIOT&E)," 28 April 1995.

[615] Draft Letter, Lt Gen Howard W. Leaf to AFOTEC/CC, AMC/XP, and CDR/OPTEC, "C-17 Brigade Airdrop Test Demonstration," May 1995. Point Paper, AMC/TEA, "C-17 Personnel Formation Airdrop," 26 August 1996; Point Paper, HQ AMC/XPQA, "C-17 Personnel Airdrop-Developmental Through Initial Operational Testing," 4 November 1996.

[616] Article, Col Randy Davis, Lt Col Bill Phillips, and Lt Col Bud Vazquez, "The Phoenix Rises," *Acquisition Review Quarterly*, pp 421, 422; Minutes, AFPEO/TA, "C-17 CEO Forum," 6 September 1994; Minutes, AFPEO/TA, "C-17 CEO Forum," 12 January 1995; Minutes, AFPEO/TA, "C-17 CEO Forum," 1 May 1995; Minutes, AFPEO/TA, C-17 CEO Forum," 14 December 1995; Briefing, Maj Gen Ronald Kadish and Donald Kozlowski,

"C-17 Globemaster III Chief Executive Officer Forum," 14 December 1995; Letter, HQ AMC/CV to AFPEO/TA, "Low Cost Nacelle Proposal for C-17 Aircraft," 27 April 1995; Interview, Allen, 28 October and 5 November 1998.

[617] Seeking to minimize the firestorm of criticism, Major General Franklin desired a demonstration flight to prove the C-17's range and payload capabilities. On 30 January 1993, P-4 left Edwards Air Force Base loaded with six Marine Light Armored Vehicles, support equipment, and personnel for a total weight of 160,838 pounds. Landing at Eglin Air Force Base, Florida, with 21,000 pounds of fuel, the aircraft had flown a route covering a distance of 2,786 nautical miles, unrefueled. Remaining overnight, P-4 returned to Edwards the next day carrying the same cargo load and maintaining the same cruise speed and altitude—.74 Mach and 27,000 feet. The return flight charted 2,562 nautical miles. Letter, Kenneth L. Martin to HQ ASC/YC/YCT, "C-17 Range Demonstration," 2 November 1992; Letter w/atch, Lt Col Terry E. Tomeny and Col Donald M. Dessert, Jr., to HQ ASC/YCT, "Assessment of C-17A Payload/Range Capability Demonstration," 22 February 1993.

[618] Minutes, AFPEO/TA, "C-17 CEO Forum," 7 March 1994; Minutes, AFPEO/TA, "C-17 CEO Forum," 10 June 1994; Minutes, AFPEO/TA, "C-17 CEO Forum," 6 September 1994; Minutes, AFPEO/TA, "C-17 CEO Forum," 12 January 1995; Minutes, AFPEO/TA, "C-17 CEO Forum," 1 May 1995.

[619] Chronology, HQ AMC/HO, "The Air Mobility Command 1994 Historical Highlights," 1994; Staff Summary Sheet w/atchs, HQ AMC/XO, "C-17 at Rodeo," 7 April 1994; List, National Aeronautic Association, [World Records], June 1996; Briefing (classified), HQ AMC/XP, "Operator's Assessment," October 1995, information used is unclassified.

[620] Walter L. Kraus and Jose M. Matheson, *The C-141 Starlifter*, (Scott AFB, IL: Office of MAC History, 1973), pp 91, 93.

[621] Article, "New Planes Ruled Out For Aid Lift," *Start-Ledger* (McGuire AFB, NJ), 31 July 1994; Memo w/atch, HQ AMC/XPE to AMC Execs, [C-17 Rwanda], 4 August 1994; Article, Steven Watkins, "Will C-17 Aid Rwandan Effort?" *Air Force Times*, 8 August 1994, p 3.

[622] Interview, Fogleman, 28 January 2000.

[623] List, HQ ASC/YCDB, "C-17 Aircraft Delivery Summary," 3 May 2001; Point Paper, HQ AMC/XPQC, "C-17 Program Update," 29 December 1994.

[624] News Release, HQ AMC/PA, "First C-17 Squadron Declared Operational," 17 January 1995; Message, AMC/CC to SECDEF and others, "Declaration of C-17 Initial Operational Capability," 171409Z January 1995.

[625] Staff Summary Sheet w/atchs, HQ AFSC/XTXP, "Initial Operational Capability," 25 November 1987.

[626] Ibid.; Point Paper, HQ MAC/XPQC, "C-17 Initial Operational Capability," 22 March 1988.

[627] Point Paper, HQ MAC/XPQC, "C-17 Initial Operational Capability," 22 March 1988; Letter, Maj Gen Richard J. Trzaskoma to Gen Duane Cassidy, "C-17 Initial Operational Capability (IOC) Clarification," 7 April 1988. It should be noted that originally IOC was defined as 16 aircraft. See, Directive (PMD R-C 0020(1), Maj Gen Emil N. Block Jr., HQ USAF/RD-CX, "Implementation Of C-X Program," 10 December 1979.

[628] The exception was the 60,000-pound LAPES mission. Additionally, personnel airdrops were restricted to single door operations, pending resolution of paratrooper entanglement.

[629] Letter, Brig Gen Ronald T. Kadish to HQ AMC/CC, "C-17 Initial Operational Capability (IOC) Assessment," 22 December 1994; Maj Gen Walter Hogle to Gen Robert Rutherford,

"Initial Operational Capability (IOC) Status 437/315 Airlift Wings," 31 December 1994; Point Paper, HQ AMC/XPQC, "C-17 Program Update," 29 December 1994.

[630] Minutes, AFPEO/TA, "C-17 CEO Forum," 12 January 1995.

[631] Letter, Elizabeth Furse to Colleague, [C-17 termination], 11 January 1995; Article, Rod Hafemeister, "Senator Proposes Cuts To C-17 Plan," *Belleville News-Democrat*, 13 January 1995, p 1; Article, Michael Sperling, "Congressional Opponents To Launch New C-17 Attack," *Defense News*, 23-29 January 1995, p 14. Blocking Simon and Bumper in the Senate Armed Services Committee were Senators John Warner (R-VA) and Sam Nunn (D-GA), who supported the C-17.

[632] Point Paper, HQ AMC/XPQC, "C-17 Reliability, Maintainability, and Availability Evaluation (RM&AE) History (last 4 years)," 26 October 1994; Point Paper, HQ AMC/XPQC, "Chronology of the Reliability, Maintainability & Availability Evaluation (RM&AE) Plan," 21 February 1995.

[633] Interview, Johnson, 22 December 1999. Larry Fielding provided: "Never before at ASD [Aeronautical Systems Division] did a proposal include a sustainment section. The bidder usually provides only cost and technical performance volumes. On the C-X, a third volume, 'Supportability' was included. This volume detailed what type and how sustainment of the weapon system was to be provided. The SOW [statement of work] required a listing of organizational and intermediate [O&I] levels of support equipment [SE]—including SE needed for the 30-day surge period. The influence of the 'SE by Capability' acquisition philosophy paid huge benefits to the government in multiple ways: MD [McDonnell Douglas] was incentivized to select GFE [government furnished equipment] vice new SE development; MD had configuration control of the support package; and MD had to 'prove' the usefulness of the entire O&I level SE during the RM&AE exercise." Comment, Fielding, July 2002.

[634] Ibid.

[635] Briefing, USD (A&T), "RM&AE Review," 23 May 1994; Point Paper, HQ AMC/XPQC, "C-17 Reliability, Maintainability, and Availability Evaluation (RM&AE) History (last 4 years)," 26 October 1994; Point Paper, HQ AMC/XPQC, "Chronology of the Reliability, Maintainability & Availability Evaluation (RM&AE) Plan," 21 February 1995; Memorandum w/atch, Donald J. Yockey to Donald B. Rice, "C-17 Acquisition Program Baseline (APB)," 20 February 1992; Letter, J. P. Klaetsch to AFSC, "Contract F33657-81-C-2108, RM&A Evaluation Plan," 16 December 1992; Staff Summary Sheet, HQ AMC/XPDI, "UTE Rates for Weapon Systems," 8 October 1993; Staff Summary Sheet, HQ AMC/XPQC, "Delink of Initial Operational Capability (IOC) and Reliability, Maintainability, and Availability Evaluation (RM&AE)," 1 December 1994; White Paper, HQ AMC/XPQC, "The C-17 Reliability, Maintainability, and Availability Evaluation (RM&AE)," June 1995, pp 1-5; Letter w/atchs, John M. Deutch to John F. McDonnell, [Omnibus Agreement], 3 January 1994.

[636] Interview, Johnson, 22 December 1999.

[637] Point Paper, HQ AMC/XPQC, "C-17 Reliability, Maintainability, and Availability Evaluation (RM&AE) History (last 4 years)," 26 October 1994; Point Paper, HQ AMC/XPQC, "Chronology of the Reliability, Maintainability & Availability Evaluation (RM&AE) Plan," 21 February 1995; Briefing, OSD(A&T), "C-17 Reliability, Maintainability And Availability Issues," February 1995; Memorandum, HQ AMC/XP to HQ AMC/CV/CC, "Dr. Minneman's Concerns with C-17 RM&AE UTE Rates," circa November 1993; Interview, Allen, 28 October and 5 November 1998.

[638] Statement, John M. Deutch, "Statement of Mr. John Deutch Under Secretary of Defense for Acquisition and Technology Department of Defense to the Subcommittee on Military Acquisition House Armed Services Committee," 10 February 1994.
[639] Point Paper, HQ AMC/XPQC, "C-17 Reliability, Maintainability, and Availability Evaluation (RM&AE) History (last 4 years)," 26 October 1994; Point Paper, HQ AMC/XPQC, "Chronology of the Reliability, Maintainability & Availability Evaluation (RM&AE) Plan," 21 February 1995; Staff Summary Sheet w/atchs, HQ AMC/XPQC, "C-17 RM&AE-Senior Review Results," 25 April 1994; Letter, John A. Burt to Louis J. Rodrigues, [DOD Response to GAO Report], 11 June 1996.
[640] Interview, Hogle, 17 November 1999.
[641] Ibid.; Interview, Allen, 28 October and 5 November 1998.
[642] Interview, Hogle, 17 November 1999.
[643] Ibid.
[644] Ibid.
[645] Point Paper, HQ USTRANSCOM/TCJ5, "C-17 Reliability, Maintainability, and Availability Evaluation (RM&AE), and Initial Operational Capability (IOC)," 10 November 1994.
[646] Ibid.; Staff Summary Sheet, HQ AMC/XPQC, "C-17 RM&AE Background," 14 November 1994.
[647] Staff Summary Sheet, HQ AMC/XPQC, "C-17 Confidence Check," 16 February 1994; Point Paper, HQ AMC/XPQC, "C-17 Reliability, Maintainability, and Availability Evaluation (RM&AE) History (last 4 years)," 26 October 1994; Point Paper, 437th AW/C-17, "C-17 Readiness Review," 28 December 1994; Memorandum w/atch, 437th AW/CC to AMC/CC, "March 1995 C-17 Readiness Review—After Action Report," 28 March 1995; Memorandum, HQ AMC/XP to HQ ASC/YC, "May 95 Readiness Review Impact on C-17 Spares for RM&AE," 16 March 1995; Memorandum, HQ ASC/YC to HQ AMC/XP, "May 95 Readiness Review Impact on C-17 spares for RM&AE," 13 April 1995; Memorandum w/atch, 437th AW/CC to AMC/CC, "May 1995 C-17 Readiness Review—After Action Report," 15 May 1995.
[648] Of significance, the C-17 landing sink rate is 900 feet a minute (15 feet per second), flying a nominal 5-degree glide slope, where most of the other transports fly a 3-degree glide slope. The maximum landing sink rate for a C-130, C-141, or a C-5 is 540 feet a minute (9 feet per second). See, Interview, Allen, 28 October and 5 November 1998.
[649] Article, Tony Bartelme, "Against the Wind: The Story of the C-17, High Cost, Bungled Past Threaten Plane's Future," Part 1, *Post and Courier* (Charleston, South Carolina), 20 August 1995.
[650] White Paper, HQ AMC/XPQC, *The C-17 Reliability, Maintainability, and Availability Evaluation (RM&AE)*, June 1995, pp 1, 3, 4, 7.
[651] Briefing, HQ AMC/XPQC, "C-17 Reliability, Maintainability and Availability Evaluation (RM&AE)," 11 August 1995.
[652] Ibid.
[653] Report, GAO to Norman D. Dicks, *C-17 Aircraft: RM&A Evaluation Less Demanding Than Initially Planned*, July 1996, pp 3, 4, 6-8.
[654] Letter (draft), Gen Robert L. Rutherford to Norman D. Dicks, [RM&AE], June 1996. This letter was not sent.
[655] Interview, Walter S. Evans, 24 September 1998. Besides serving on the C-X Task Force, Colonel Evans was Headquarters AMC's representative at Charleston during the preparation for the RM&AE.

[656] Interview, Hogle, 17 November 1999.
[657] Ibid.; Interview, Walter S. Evans, 24 September 1998; Interview, Allen, 28 October and 5 November 1998.
[658] Interview, Allen, 28 October and 5 November 1998.
[659] Airlift forces were: 88 C-141s, 55 C-17s, 104 C-5s, 0-NDAAs, 37 KC-10s, and 26 KC-135s.
[660] Point Paper, HQ AMC/XPDIJ, "Mobility Requirements Study Bottom-Up Review Update (MRS BURU), 6 July 1995.
[661] To clarify, 49.4 MTM/D represented the capacity of 120 total active inventory C-17 equivalents with all C-141s retired. 51.8 MTM/D represented the capacity equal to 140 total active inventory C-17 equivalents. The range was dependent upon the amount of repositioning of resources needed.
[662] Specifically, Stage I passenger aircraft to approximately 45 wide-body equivalents (WBE), Stage II passenger to some 90 WBE, and preserving, at a minimum, the WBE cargo aircraft level of participation in the baseline fleet.
[663] Point Paper, HQ AMC/XPDIJ, "Mobility Requirements Study Bottom-Up Review Update (MRS BURU), 6 July 1995; Point Paper, HQ AMC/XPDIJ, "Mobility Requirements Study Bottom-Up Review Update (MRS BURU)," 30 April 1996.
[664] The SAFMA was a force mix capability analysis and not a force sizing analysis or a requirements analysis.
[665] Point Paper, HQ AMC/XPY, "C-5D Performance In The MASS Model," 15 August 1995. It should be mentioned that Cpt Gary Harvey was a "Whiz" kid, who General Fogleman personally credited with demonstrating the case for the C-17 during his sessions with Dr. Deutch. Through a computerized surface analysis tool, Harvey provided Deutch real time data as Deutch took in the presentations and asked for what ifs. It was the right approach. See, Interview, Fogleman, 28 January 2000.
[666] Study, HQAMC/SAF, *Strategic Airlift Force Mix Analysis (SAFMA)*, 1 November 1995.
[667] Ibid.
[668] Memorandum, R. Noel Longuemare to SECAF and others, "C-17/Non-Developmental Airlift Aircraft (NDAA) Acquisition Decision Memorandum (ADM)," 14 December 1994.
[669] Memorandum, Lt Gen Paul E. Blackwell to OSD/PA&E, "C-17 SAFMA/Military Unique Analyses," 13 April 1995; Memorandum w/atch, Gen Thomas S. Moorman Jr. to OSD/PA&E, "Integration of C-17 Analyses," 12 September 1995; Memorandum w/atch, Gen Ronald H. Griffith to OSD/PA&E, "Integration of C-17 Analyses," 12 October 1995.
[670] Article, "Tactical Utility Analysis Proved To Be Key Factor in DAB's C-17 Decision," *Inside The Pentagon*, 16 November 1995, pp 3-4.
[671] Responses were as follows: Aerospatiale offered the A-300 series; Air Cargo Management Group used 747-200Fs; Alenia used DC-10-30Fs; Boeing Defense and Space Group the 747-400F; Chrysler Technologies used DC-10-30Fs; CFM/Grumman/Aero Corporation an upgraded C-141B; E-Systems CLS contract; Lockheed Aeronautical Systems Company the C-5D; Lockheed Aircraft Services IL-96s, used L-1011s, and used 747-200Fs; McDonnell Douglas Corporation the MD-11F and MD-17; and Wolf International Airlines AN-124s. Briefing, Daniel L. Kugel, "NDAA," 5 October 1995.
[672] Ibid.; Point Paper, HQ AMC/XPQA, "Nondevelopmental Airlift Aircraft (NDAA)," 28 March 1995.
[673] Memorandum, Gen Gordon R. Sullivan to Gen Ronald R. Fogleman, "C-17/Non-Developmental Airlift Aircraft (NDAA)," 10 January 1995.

[674] Ibid.; Memorandum w/atch, Admiral William A. Owens to Paul G. Kaminiski, "Non-Developmental Airlift Aircraft (NDAA), 23 January 1995; Memorandum, Admiral William A. Owens to Gen Ronald R. Fogleman, "Non-Developmental Airlift Aircraft (NDAA)," 22 March 1995.
[675] Memo w/atch, Brig Gen Bobby Floyd to Gen Robert L. Rutherford, "Why buy NDAA vs CRAF Stage III?," 15 February 1995.
[676] Article, Tanya Bielski, "NDAA Proposal Would 'Decimate' CRAF Program," *Defense Daily*, 8 June 1995.
[677] Memorandum w/atch, Rudy de Leon, "Milestone III Steering Committee Minutes," 2 September 1995; Point Paper, HQ AMC/DOF, "Nondevelopmental Airlift Aircraft (NDAA) Impact On CRAF," 30 August 1995.
[678] Memo, Gen Robert L. Rutherford to HQ AMC/XP, 4 May 1995.
[679] Briefing, Brig Gen Bobby O. Floyd to Brig Gen James Childress, "Non-Developmental Airlift Aircraft (NDAA)," June 1995.
[680] Article, Brian Bretsch, "Perry Supports Fogleman's Stand For More Globemasters," Base News (Scott AFB, Illinois), 14 July 1994, p 1A; Article, Tony Capaccio, "Air Force, Deutch Slash Airlift Money For C-17 Alternative," *Defense Week*, 9 January 1995; Article, "Will NDAA Come to Fruition?" *Defense Daily*, 27 March 1995; Article, Kerry Glidea, "Boeing Seeks Support To Mix 747s Into Airlift Fleet," *Defense Daily*, 27 March 1995; Memorandum, HQ AMC/XPQ to HQ AMC/XP, "NDAA Leasing," 12 May 1995; Point Paper, HQ AMC/XPY, "C-5D Performance In The MASS Model," 15 August 1995. After his first flight on 29 March 1995, Secretary Perry openly stated he was very committed to the C-17 and wanted more than 40. Decent thrust reversers, according to Lt Col Allen, would have made the C-5D more of a real contender, addressing MOG issues. See, Interview, Allen, 28 October and 5 November 1998.
[681] By summer, McDonnell Douglas offered the Air Force a discount on the C-17s. The media reported unit costs for the three contenders as $190-200 million for the C-17, $150-168 million for the C-5, and $140 million for the B-747-400. See: Article, Imbert Matthee, "Sale Of Boeing Freighters To Air Force Not So Sure," *Seattle Post-Intelligencer*, 1 August 1995, p B1. McDonnell Douglas' unit cost reductions would come from higher aircraft production rates and redesigning parts, such as the main landing gear.
[682] Point Paper, HQ AMC/XPQA, "C-17 JROC Minutes, 12 Sep 95," 19 September 1995; Point Paper, HQ AMC/XPQA, "5 Oct 95 MSIII Steering Committee Minutes," ca October 1995; Briefing, Daniel L. Kugel, "NDAA," 5 October 1995; Article, "C-17s To Kuwait In Intrinsic Action," *Aerospace Daily*, 25 August 1995; Article, "C-17s Carry Comm Vans, Surveillance Radars To Kuwait," *Aerospace Daily*, 28 August 1995; Cpt Mike Doubleday, DOD News Briefing, 21 September 1995; Article, Vago Muradian, "Some C-17s Temporarily Were Grounded," *Air Force Times*, 2 October 1995, p 3. A potential flap also existed with the mission computer right before the DAB. In September 1995, some nine months after testing had ended, the Air Force Flight Test Center issued an evaluation on the mission computer, rating the system marginal. Fortunately, with the computer using software version 3.1, the report was very dated.
[683] Memorandum w/atch, Adm W. A. Owens to Paul G. Kaminski, "C-17 Program," 15 September 1995.
[684] Ibid.; Point Paper, HQ AMC/XPQA, "C-17 JROC Minutes, 12 Sep 95," 19 September 1995.
[685] Point Paper, HQ AMC/XPQA, "C-17 JROC Minutes, 12 Sep 95," 19 September 1995.

[686] Memorandum w/atch, Gen Thomas S. Moorman Jr. to OSD/PA&E, "Integration of C-17 Analyses," 12 September 1995.
[687] Memorandum w/atch, Gen Ronald H. Griffith to OSD/PA&E, "Integration of C-17 Analyses," 12 October 1995.
[688] Article, Elaine M. Grossman, "Joint Chiefs Of Staff Poised To Back All C-17 Airlifter Force, Reject NDAA," *Inside The Pentagon*, 12 October 1995.
[689] E-Mail, Maj Gen Walter S. Hogle to Gen Robert L. Rutherford, "C-17 OIPT Meeting 20 Oct," 21 October 1995.
[690] Originally, the Air Force assumed and programmed funding for Boeing spreading the non-recurring engineering cost over the entire aircraft buy profile. Boeing was unwilling to do so without termination liability coverage, thus, the non-recurring engineering variant, which delayed procuring the first aircraft until fiscal year 1997 as non-recurring engineering was completed. Briefing, Daniel L. Kugel, "NDAA," 5 October 1995.
[691] Ibid.; Memorandum w/atch, Ronald E. Mutzelburg, "C-17/Non-Developmental Airlift Aircraft (NDAA) Defense Acquisition Board (DAB) Overarching Integrated Product Team (OUPT) Meeting-Report Coordination," 23 October 1995.
[692] Report, Rachel Schmidt, Victoria Fraider, and JoAnn Vines, CBO, *Options For Strategic Airlift*, October 1995.
[693] Memorandum, Paul G. Kaminski to SECAF, "C-17/Non-Developmental Airlift Aircraft (NDAA) Acquisition Decision Memorandum," 3 November 1995.
[694] Oral History, James K. Matthews and Robert T. Cossaboom, *General Walter Kross: Commander In Chief United States Transportation Command and Commander Air Mobility Command* (Scott AFB, IL: Research Center, October 1999), pp 64, 65. Gen Kross described the session as a "giant love-in," except for Lynn.
[695] Article, HQ AMC/PA, "Defense Acquisition Board Announces Decision to Buy 80 More Globemaster IIIs," November 1995; Article, "Tactical Utility Analysis Proved To Be Key Factor in DAB's C-17 Decision," *Inside the Pentagon*, 16 November 1995, pp 3-4; Staff Summary Sheet, HQ AMC/XPQA, "C-17/NDAA Acquisition Decision Memorandum (ADM)," 20 November 1995; Media Release, HQ AMC/PA, [General Rutherford Prepared Remarks Closing RM&AE Ceremonies], 5 August 1995. As to McDonnell Douglas' improved performance, hours of rework and repairs on completed aircraft had decreased from 660,000 hours for P-1 to 115,000 hours for P-22, delivered on 29 September 1995. The calendar days to assemble one aircraft went from 1,151 days to 554. See, Article, James R. Carroll and Lindsay Chaney, "How The MD Program Was Saved," *Long Beach Press-Telegram*, 23 October 1995, p 1A.
[696] Memorandum, Paul G. Kaminski to SECAF, "C-17 Multi-Year Procurement (MYP) Acquisition Decision Memorandum (ADM)," 1 February 1996; Point Paper, HQ AMC/XPQC, "C-17 Multi-Year Procurement," February 1996; Memo w/atch, HQ AMC/XP to AMC/CC, "C-17 CEO Meeting," 22 March 1996.
[697] News Release, DOD/PA, "Air Force Awards C-17 Multi-Year Contracts," 31 May 1996. With C-17 performing well in Bosnia, Congress was supportive of the multi-year contracts and generally did not give much notice to a GAO report (*C-17 Aircraft: Cost of Spare Parts Higher Than Justified*, April 1996) that disclosed the Air Force had paid more for C-17 spare parts than it should have when the program was behind. The media attempted to compare the C-17's thousand of dollars for spare door hinges and hooks with the C-5's high-priced toilet seats and coffee pots. Congress' handling of the report was another indication that the C-17's trials were over. McDonnell readily repaid the Air Force $187,000.

See, Article, Christopher Carey, "MAC Says Critics Won't Kill C-17*,"* *St. Louis Post-Dispatch*, 18 February 1996, p 1E.
[698] Article, James R. Carroll, "Air Force General, Report See Need," *Long Beach Press-Telegram*, 7 March 1997; Letter w/atchs, AMC/CV to USTRANSCOM/TCDC, "CINC's Quarterly Letter to SECDEF," November 1997.
[699] Notes, Lt Col Bud Vazquez, HQ USAF PEO/TA, "C-17 Chief Executive Officer Meeting 29 Nov 93—Minutes," ca November 1993.
[700] Interview, Maj Gen Charles H. Coolidge Jr. with Sgt Richard E. Rice, circa 1996; Article, David Hughes, "Heavy Jets Key To Airlift," *Aviation Week & Space Technology*, 15 January 1996, p 46.
[701] Point Paper, HQ AMC/XPQC, "C-17 in JOINT ENDEAVOR," 2 May 1996.
[702] Point Paper, HQ AMC/XPY, "JOINT ENDEAVOR Airlift Operations," 22 February 1996.
[703] Interview, Maj Gen Charles H. Coolidge Jr. with Sgt Richard E. Rice, circa 1996.
[704] Article, "Endorsed At The Top," *Aviation Week & Space Technology*, 19 August 1996, pp S6, S7; Article, SrAm Kari Olson, HQ AMC News Service, "C-17 Becomes Air Force One For Tuzla Trip," January 1996.
[705] Point Paper, HQ AMC/XPQC, "C-17 in JOINT ENDEAVOR," 2 May 1996; Article, Maj Chris King, "Proving Its Worth," *Citizen Airman* (Charleston AFB, SC), April 1996, p 16.
[706] Article, James R. Carroll, "The Mighty Moose Is An Agile Bird," *Press-Telegram* (Long Beach), 7 February 1996, p 1.
[707] Ibid.; Point Paper, HQ AMC/XPQC, "C-17 in JOINT ENDEAVOR," 2 May 1996; Point Paper, HQ AMC/XPRA, "C-17 Shortfield Performance," 5 March 1997; Article, "Making The Grade In Bosnia," *Aviation Week & Space Technology*," 19 August 1996, p S3; Article, "The C-17 Comes of Age in Bosnia," *Janes Defense Weekly*, 14 February 1996, p 26.
[708] Point Paper, HQ AMC/XPQC, "C-17 in JOINT ENDEAVOR," 2 May 1996; Article, Maj Chris King, "Proving Its Worth," *Citizen Airman* (Charleston), April 1996, p 16; Article, David Hughes, "Night Flight To Tuzla," *Aviation Week & Space Technology*, 15 January 1996, p 48; Point Paper, HQ AMC/XPRA, "C-17 Performance, Operation JOINT ENDEAVOR vs RM&AE," 17 January 1997; Interview, Maj Gen Charles H. Coolidge Jr. with Sgt Richard E. Rice, circa 1996; Point Paper, HQ AMC/XPQCC, "C-17 Aircrew Armor," 10 January 1996; Point Paper, HQ AMC/XPQCC, "C-17 Defensive System (DS) Status," 10 January 1996; Article, HQ AMC News Service, "C-17 Flies Nonstop From Travis To Bosnia," February 1996; Interview, Walter S. Evans, 24 September 1998.
[709] Point Paper, HQ AMC/XPQL, "C-17 Anti-Ice/Engine Bleed Air Systems," 11 January 1996; Point Paper, HQ AMC/XPQC, "C-17 SATCOM," 11 January 1996; Briefing, Maj Gen Ronald Kadish, "C-17 Balkan Journey," 29 January 1996; Article, "The C-17 Comes of Age in Bosnia," *Janes Defense Weekly*, 14 February 1996, p 26.
[710] Article, "Making The Grade In Bosnia," *Aviation Week & Space Technology*," 19 August 1996, p S2.
[711] Briefing, HQ AMC TACC/XOMB, "AMC Operations Summary," 15 September 1997; News Release, USACOM/PA, "Exercise CENTRAZBAT '97," ca 15 September 1997; Interview, Lt Col Thomas Svisco with Betty R. Kennedy, 3 May 2000.
[712] Statement, Gen Charles T. Robertson Jr., CINCTRANS/AMC CC, Before The Military Readiness Subcommittee Of The House Armed Services Committee, 106th Cong., 1st sess., 26 October 1999; Article, Lt Gen William J. Begert, "Kosovo and Theater Air Mobility," *Aerospace Power Journal*, Winter 1999, p 15.

[713] Ibid., p 15; Article, 437th AW/PA, "C-17s Give Apache Helicopters A Lift," 19 April 1999; Article, Otto Kreisher, "Globemaster Ideal For Small Albanian Airport; Transport Once Was Nearly Canceled," Copley News Service, 21 April 1999; Report, Lt Col Erikson, 15th AS, JULLS (82541-62962): "24 Hour Precision Approach Capability," 24 November 1999.

[714] Article, 437th AW/PA, "C-17s Give Apache Helicopters A Lift," 19 April 1999; Briefing, Maj Martin Beard, USAFE/AMOCC, "Allied Force: Intra-Theater Air Mobility," September 1999; Article, Otto Kreisher, "Globemaster Ideal For Small Albanian Airport; Transport Once Was Nearly Canceled," Copley News Service, 21 April 1999; Report, Maj Daley, 637th AGS, JULLS (82629-54903), "C-17 Austere Field Operations," 24 November 1999.

[715] Article, Lt Gen William J. Begert, "Kosovo and Theater Air Mobility," *Aerospace Power Journal*, Winter 1999, p 16; Briefing, Maj Martin Beard, USAFE/AMOCC, "Allied Force: Intra-Theater Air Mobility," September 1999; Article, Terry Joyce, "Charleston Crews Airlift Peacekeepers," *Post and Courier* (Charleston), 12 June 1999; Article, Jon R. Anderson, "Relief Is In Sight," *European Stars & Stripes*, 17 June 1999; Article, Chuck Roberts, "Globemasters To Complete Mission," 24 June 1999; Report, Lt Col Erikson, 15th AS, JULLS (82551-60013): "Proven Airlifter: The C-17," 24 November 1999.

[716] Point Paper, HQ ASC/YCL, "C-17 Kosovo Reconstitution Efforts," 16 July 1999; Report, Maj Daley, 637th AGS, JULLS (82552-48306): "Contractor Support," 24 November 1999; Report, Maj Daley, 637th AGS, JULLS (82551-70916): "Forward Supply Location (FSL)," 24 November 1999; Report, Cpt Hardy, HQ AMC/LGFA, JULLS (72626-76881): "Development of C-17 Deployable Maintenance Kit Needed," 24 November 1999; Report, Cpt Hardy, HQ AMC/LGFA, JULLS (72626-89283): "Logistics Support of 'Chopped' AMC Mobility Aircraft Needs Clarification," 24 November 1999; Report, Maj Daley, 637th AGS, JULLS (82629-54903), "C-17 Austere Field Operations," 24 November 1999.

[717] Point Paper, HQ ASC/YCL, "C-17 Kosovo Reconstitution Efforts," 16 July 1999; Report, Maj Kasberg, HQ AMC/DOK, JULLS (71926-24059): "Inadequate Defensive Systems on Mobility Air Forces (MAF) Aircraft," 24 November 1999; Point Paper, HQ AMC/XPRS, "Defensive Systems For Mobility Aircraft," 1 April 1999; Report, Lt Col Erikson, 15th AS, JULLS (82554-35382): "C-17 SATCOM Unreliable," 24 November 1999.

[718] Article, Jeffrey Denny, "The C-17's Uncertain Future," *Military Logistics Forum*, January/February 1985, pp 60, 61.

[719] Report, Maj Kasberg, JULLS (71926-09587): AMC Must Have Access To ATO, SPINS, ACP, and Comm Plan During Contingencies," 24 November 1999; Interview, Hogle, 17 November 1999.

[720] Interview, Walter S. Evans, 24 September 1998.

[721] Paper, Maj James N. Soligan, Air Command and Staff College, *Direct Delivery*, April 1985, p xi.

[722] Interview, Hogle, 17 November 1999; Interview, Svisco, 3 May 2000; Author's views.

[723] Paper, Maj Creighton W. Cook Jr., AFIT, *Integrating C-17 Direct Delivery Airlift Into Traditional Air Force Doctrine*, June 1998, pp vii, 25-37; Paper, Maj M. Shane Hershman, AFIT, *Employment Of The C-17 In Support Of National Objectives*, May 1997, pp viii, 17-27.

[724] Somewhat confusing, the Air Mobility Command is also calling missions direct delivery that stop in Germany for crew changes and then continue on to the Middle East. Thus, there exists direct delivery between theaters and there is CONUS to any theater/region nonstop, direct delivery.

[725] Generals Ronald Fogleman and Walter Kross were especially effective in bridging service differences and fostering working relationships. Both generals bonded well with the Army and Marine Corps. Besides being a fighter pilot and rated parachutist, Fogleman had flown as a forward air controller during Vietnam and had attended the Army War College. In the early 1990s, Fogleman had worked closely with the Army in Korea. Before assuming command of the United States Transportation and Air Mobility Commands, Kross had been the director of the joint staff and was highly regarded. Kross was into quality and process improvements, and this readily came across. He could look beyond the Air Force's interests. Serving as the director of operations and logistics for all defense transportation requirements in the Gulf War, he had gotten the big picture. Biography Sheet, HQ USAF/PA, "General Ronald R. Fogleman," August 1997; Biography Sheet, HQ USAF/PA, "General Walter Kross," August 1996; Author's knowledge.
[726] Staff Summary Sheet, HQ AMC/XPQC, "23 Apr 96 General Officer Review After Action Report," 25 April 1996; Point Paper, HQ AMC/XPQA, "C-17 Personnel Airdrop," 4 November 1996; Point Paper, HQ AMC/XPRA, "Universal Static Line (USL)," 24 November 1998.
[727] Report, 33d Flight Test Squadron, "C-17 Personnel Formation Airdrop," October 1997; Point Paper, HQ AMC/XPRA, "C-17 Airdrop Capability," 5 March 1997.
[728] Information Paper, Lt Col Henry J. Salice, "C-17 Issues," 21 January 1997; Conversation, Lt Col Thomas Svisco with Betty R. Kennedy, 2 February 2001.
[729] Staff Summary Sheet, HQ AMC/XPQA, [C-17 Issues], 29 January 1996; Memorandum w/atchs, Lt Gen John M. Keane, "Minutes of the 17th General Officer Airborne In-Process Review (IPR)," circa May 1996; Point Paper, HQ AMC/XPQ, "17th General Officers Airborne In-Process Review," 2 May 1996.
[730] E-Mail, Maj Gen Walter S. Hogle, Jr., to Lt Gen John B. Sams, Jr., "Brigade Airdrop," 5 December 1996; Staff Summary Sheet w/atch, HQ AMC/XPRA, "CSA Query on C-17," 2 April 1997; Point Paper, HQ AMC/XPRA, "Universal Static Line (USL)," 24 November 1998; Point Paper, HQ AMC/XPRA, "C-17 Strategic Brigade Airdrop Issues," 11 January 1999; Message, CDRXVIII ABNCORPS to CDRFORSCOM, "C-17 Operations with the 15-Foot Static Line," 282029Z April 1998; Conversation, MSgt Dwayne Adkins with Betty R. Kennedy, 27 February 2002. Assigned as the Air Force's liaison and chief project officer at Natick, MSgt Adkins interfaced with the Army on all aerial delivery projects and tests. He had over 25 years experience as a loadmaster.
[731] Information Paper, Lt Col Henry J. Salice, "C-17 Issues," 21 January 1997; Information Paper w/atch, Col Peck, "Strategic Brigade Airdrop (SBA) Update," 21 November 1998; Point Paper, HQ AMC/XPRA, "C-17 Strategic Brigade Airdrop Issues," 11 January 1999; Point Paper, HQ AMC/XPRA, "C-17 Strategic Brigade Airdrop Issues," 13 September 1999; Interview, Chester S. Haines, Lt Col Peter R. Livingston, and Lt Col Scott L. Wymore, with Betty R. Kennedy, 14 December 1999. See, also: Paper, Lt Col Peter R. Livingston, US Air Force Air War College, "Testing The C-17 For The Strategic Brigade Airdrop Role: When Will It End?" December 2000; Paper, Maj David A. Kasberg, Air Command and Staff College, "From Paper To Practice: Making Strategic Brigade Airdrop A Credible Force Employment Option," April 2001. Maj Kasberg worked strategic brigade airdrop issues while on the operations staff at Headquarters Air Mobility Command, 1997-2000.
[732] Although the Army revised its load requirements, C-17 sorties remained the same, namely 53 C-17s for airdrop and 46 C-17s for the airland portion. See, Briefing, XVIII Airborne Corps/G3Air, "Strategic Brigade Airdrop C-17 Requirement," June 2002.

[733] Thesis, Maj Hans J. Petry, Air Force Institute of Technology, "An Objective Oriented Simulation Of The C-17 Wingtip Vortices In The Airdrop Environment," March 1997; Point Paper, HQ AMC/XPRA, "C-17 Strategic Brigade Airdrop Issues," 11 January 1999, Article, "Top Army Official Ready to Reduce C-17 SBA Formation Geometry To 28,000 Feet," *Inside the Air Force*, 11 December 1998; Conversation, Lt Col Thomas Svisco with Betty R. Kennedy, 2 February 2001.
[734] Point Paper, HQ AMC/XPRA, "C-17 Strategic Brigade Airdrop Issues," 13 September 1999; Briefing, Col Michael Billings, HQ AMC/DXP, "AMC Modernization Phoenix Rally," December 1999; Article, Danita L. Hunter, HQ AMC/PA, "AMC C-17s Deliver a Brigade in 30 Minutes or Less," 18 February 2000; Conversation, MSgt Dwayne Adkins with Betty R. Kennedy, 27 February 2002.
[735] Upon his retirement, General Robertson became vice president of Boeing's Business Development for Military Aerospace Support.
[736] Article, "USAF Study Says C-17 Airdrop Goals Can Be Met; Army Still Concerned," *Army Times*, 7 February 2000, p 1; Article, "Air Force, Army Seeking More Flexibility In Strategic Airdrop Missions," 10 March 2000, p 1; Memo, Gen Charles Robertson to Whitten F. Peters, "C-17 Formation Airdrop Testing," 4 January 2000; Point Paper, HQ AMC/A58A and C-17 SPO, "C-17 Traffic Alert and Collision Avoidance System Overlay (TCASO)," 16 June 2004.
[737] Interview, Lt Gen John M. Keane with Cynthia L. Hayden, "End Of Tour Interview," 9 February 1998. This interview was on General Keane's tenure as Commander of XVIIIth Airborne Corps and Fort Bragg, North Carolina, and was conducted by the command historian.
[738] Interview, Hogle, 17 November 1999.
[739] Interview, Svisco, 3 May 2000.
[740] Hearings, Senate Appropriations Committee, *Department of Defense Appropriations for Fiscal Year 1977*, Part 5, 94th Cong., 2d sess, 1976, pp 410-413.
[741] Plan, HQ USAF, *US Air Force Airlift Master Plan*, 29 September 1983, p III-5.
[742] Ibid., p V-4.
[743] Document, HQ AF/RD, "C-X Preliminary System Operational Concept," 22 January 1980, p 8.
[744] Ibid., p 15.
[745] Letter w/atch, Lt Gen Lawrence A. Skantze to The Boeing Co., McDonnell Douglas Corp., and Lockheed Corp., "C-X Acquisition Program Request for Proposal (RFP)," 15 October 1980, Appendix 2 and Section J.
[746] Document, HQ MAC/XPQ, "C-X System Operational Concept," March 1981, p 9.
[747] Interview, Hunter, Jamieson, and Davis, 29 March 1999.
[748] Ibid.; Interview Svisco, 3 May 2000.
[749] Article, McDonnell Douglas C-17 News, "C-17 Displays Austere Airfield Capabilities," January 1995.
[750] Article, McDonnell Douglas C-17 Team News, "Globemaster III Shines In Desert Tests," 12 May 1995.
[751] Briefing, Maj Gen Walter Hogle to Mobility Air Forces Conference, March 1997; Information Paper, Lt Col Henry J. Salice, "C-17 Issues," 21 January 1997; Report, C-17 SPO, "C-17 SPO Sep 97 Monthly Activity Report," September 1997; Interview, Haines, Livingston, and Wymore, 14 December 1999.
[752] Oral History, James K. Matthews and Robert T. Cossaboom, *General Walter Kross: Commander In Chief United States Transportation Command and Commander Air Mobility*

*Command* (Scott AFB, IL:  Research Center, October 1999), p 64.
[753] Ibid., p 63.
[754] Information Paper, Cpt Haywood, "1997 Warfighter Due Out Status Report," 23 November 1998.
[755] Point Paper, HQ AMC/XPRA, "C-17 Strategic Brigade Airdrop Issues," 13 September 1999.
[756] Ibid.
[757] Staff Summary Sheet w/atch, HQ AF/XOOB, "Additional Congressional Notification of C-17 Beddown," 9 November 1995.
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