



**STRATEGY  
RESEARCH  
PROJECT**

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**THE ACQUISITION OF STRATEGIC AIRLIFT**

**BY**

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United States Army**

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**THE ACQUISITION OF STRATEGIC AIRLIFT**

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**ABSTRACT:**

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The Force Projection component of our Post-Cold War National Military Strategy relies significantly upon increased airlift and sealift assets. The US Air Force C-17 Globemaster is an important enabling airlift resource now in mid-procurement. Despite its capabilities, now being demonstrated across the globe, this major system almost didn't come into being. This study looks at the details of the C-17 acquisition program and discusses the key factors that enabled its transformation from a business debacle to an overall success.



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The United States has projected Army forces abroad on a grand scale since World War I. The enormous launch of US heavy forces to European and Pacific theaters in World War II, and later large scale, extended deployments to Korea and Vietnam, have relied primarily upon sealift. However, throughout the Cold War period, a growing threat and continuing evolution of modern warfighting demanded an ever shorter response time for US light and heavy forces.

Our Cold War National Security Strategy relied principally upon forward basing of troops, reinforced by power projection. In the early 1980s, the concept of a Rapid Deployment Force - Army (RDF-A) was demonstrated, chiefly by elements of the XVIIIth Airborne Corps, in periodic exercises to the Middle East such as Bright Star, and battle proven in Operations Urgent Fury, Just Cause, and Desert Shield/Storm. The RDF-A augmented our forwarded deployed elements in operations plan (OPLAN) theaters and enabled early entry into smaller, more isolated areas. However, in 1981, one light infantry battalion of the 82d Airborne Division required approximately ninety-five C-141 Starlifter aircraft to transport its full complement of Table of Organization (TO&E) men and equipment. The 82d's deployment to Grenada in 1983(almost the entire division) severely strained the US Air Force's operational lift capacity. It became apparent there was a shortfall in strategic airlift, even for small contingencies.<sup>1</sup>

Peacetime air projection of Army vehicles and heavy equipment has since been largely borne by US Air Force's Air Mobility Command (AMC) fleet of C-5 Galaxies and C-141s, with extensive contingency augmentation by contracted carriers (Civil Reserve Air Fleet) for wartime troop lift. Mobilization plans also relied upon federal use of commercial aircraft in a national emergency, given warning time from a presumed gradual increase in hostilities prior to armed conflict, such as in Desert Shield/Storm.



Since the end of the Cold War, Force Projection as an element of our National Military Strategy has ascended, as our forward presence in potential theaters overseas has diminished. We recognize that the timely arrival of main and reserve forces is crucial to what happens afterward. But the time available in future conflicts may pre-empt ship-borne build-up. The conflict intensity might as well, making transport ships and commercial aircraft vulnerable targets of high value to the enemy. The threat of more than one Major Regional Conflict (MRC) magnifies the problem. The Army's very relevance may well depend upon a vast increase in strategic military airlift, both for initial entry and follow-on theater logistical support. Fortunately, the United States Air Force (USAF) identified the required operational capabilities of the C-17 in the 1970s as the means for future force projection. It's one of few major systems that can really provide strategic means to political ends.

Materiel acquisition is the business of providing warfighting capabilities to our forces. Accomplishing the development and procurement of a major system "new start" (a ground-up design of an aircraft to military specifications) entails many complex processes involving key players of Clausewitz's Trinity (the people, its military, and their government).

## **OVERVIEW**

What follows is a discussion of the C-17 Globemaster acquisition program, analyzing the critical programmatic (technical performance, cost and schedule and political) obstacles encountered in this major system development, deriving the management lessons learned, and recommendations for their prevention in the future. The C-17 story unfolds as a tragic investment failure and emerges a flag-bearer for acquisition reform. As the reader will see, the strategic needs

for this transport aircraft, after a long saga, were eventually transformed into a long-term U.S. capability in a world with increasing propensity for regional conflicts. But the campaign to win this prize was long and hard-fought.

### BACKGROUND - CURRENT AND NEEDED LIFT CAPABILITIES

The current airlift aircraft in the USAF inventory include the C-5, C-141 and C-130. Each performs different specific missions. A capabilities matrix is shown below.

	Large Payloads, International Ranges	Outsize Cargo	Direct Delivery	Airdrop	Low Altitude Parachute Extraction Systems	Combat Offload	Air Refueling	Crew Size (Airdrop)	Main Operating Bases	Small Assault Airfields	
C-5	✓	✓	Limited			✓	6(8)	✓			Strategic Lift
Commercial Freighter	✓						3(N/A)	✓			
C-141	✓	✓	✓			✓	6	✓			
C-17	✓	✓	✓	✓	✓	✓	3(3)	✓	✓	✓	Theater Lift
C-130			✓	✓	✓		5(6)	✓	✓		

Airlift Capabilities Matrix

The current legacy airlift fleet is becoming old. The average age today of the C-141B is twenty-nine years; the C-5A's average age is twenty-three years, and the C-5B's is seven years.<sup>2</sup> To the frustration of mobilization planners in the 1980s, it seemed the Department of Defense (DOD) priority for procurement of weapon systems was typified by the purchase of "killing systems" over logistical needs, however critical. The Air Force wanted to augment and boost its lift capacity with a flexible capability to accomplish multiple missions with one airframe. It would be

able to land on short runways, like the C-130, but carry more payload than the C-141 and even carry “outsized” loads like the C-5.

The C-17 transport is today a four engine aircraft designed to carry a payload of 130,000 pounds for a distance of 5,200 nautical miles without aerial refueling, and is designed to carry Army combat units to small, sparsely furnished airstrips at trouble spots around the world.<sup>3</sup> Similar to the C-5 Galaxy, it has a huge cargo belly that can carry outsize items, such as M-1 tanks, Apache helicopters, Patriot anti-aircraft/missile batteries and Bradley armored troop carriers, which are too bulky for most other cargo planes. In contrast to commercial wide-body jets, the C-17 and C-5 have a low-slung fuselage from which vehicles can quickly be driven on and off. The C-17 is smaller than the C-5 and is more agile on the ground. A fleet of C-17s can thus deliver more cargo faster and closer to the action, making use of runways too short to accommodate the C-5.<sup>4</sup>

### **THE ACQUISITION PROGRAM - ANALYSIS OF A TURNAROUND**

Schedule delays, technical problems, and cost overruns have become particularly critical circumstances in the 1990s era of shrinking DOD budgets. The C-17 acquisition program, however, has survived for sixteen years (and is now thriving) despite a myriad of cost, operational performance and schedule problems which plagued it. Major issues along the way included excessive lag time in the first four years of the program (mostly due to lack of government funding), Air Force-driven configuration changes, software management problems, and insufficient preparedness by the prime contractor (McDonnell Douglas), when the development program finally accelerated in 1985. The C-17's troubled history also included significant design problems, test failures, and uncontrolled cost growth (to \$1.1 billion total at the end of the development effort).

The Air Force continued to alter the aircraft's configuration well into the manufacturing and development process, when the design should already have been frozen.

Mid-program, critics judged, "the C-17 transport is a good example of what happens when the challenges of a major military acquisition program are underestimated and the development phase of the program lags on for too many years (since 1980)."<sup>5</sup> Remarkably, the program has since been able to rebound from its long list of problems, which culminated in a bitter General Accounting Office (GAO) Report in late 1993. The GAO harshly criticized a contract dispute settlement proposed between government and contractor, citing that the Air Force had not quantified cost, schedule, and performance criteria when evaluating McDonnell Douglas's contract performance. And the GAO went on to dispute any need for Air Force aircraft purchases exceeding forty, placing the cost-effectiveness, and very life of the program in question. In the time since the report, the government eventually developed a partnership with McDonnell Douglas that has resulted in a vastly improved "concurrent engineering" process and put the C-17 program back on a promising road for all parties.

What went wrong with the C-17? And how has it survived the formidable defense acquisition and Milestone Decision Review (MDR) process to arrive healthy and in full production? A careful examination of the program's history will give us insight into the mistakes and successes that bring us to the present.

### **THE C-17 SAGA**

Many of the program's evolutionary difficulties can be attributed to time lags and indecisiveness in the C-17's primordial development phase in the early 1980s. The program started

as a low-risk one in which proven technology from other state-of-the-art aircraft would be integrated to provide a new military transport with increased size, range and versatility. However, the scope was clearly much greater and costlier than McDonnell Douglas and the Air Force originally negotiated.

Subsequent to the 1980 contract to build the C-17, Congress also authorized the acquisition of two other planes, the KC-10 and the Lockheed C-5B (an upgrade to the C-5A), creating a macro-level challenge of cost conflict among three aircraft. The question of best procurement "mix" placed the C-17 program virtually on hold between 1981 and 1985, with Congress appropriating less than \$30 million per year on average for low-level development and testing only. The prime contractor had expected to commence major design and prototype-build work in 1981, after the successful development and flight test of the YC-15 Advanced Medium Short Take-Off and Landing Transport (AMST) aircraft in the mid-1970s. However, McDonnell Douglas had to wait until December, 1985 before receiving a \$3.4 billion fixed price incentive contract for full-scale development of the C-17.

McDonnell Douglas was initially focused upon the effort and well-staffed to get the program off and running. However, during the four-year lag between contract award and receipt of full development funding, disturbing events put the C-17's future on dangerous footing. First, many engineers, managers, and production floor workers, feeling the C-17 program was in limbo, left McDonnell Douglas to accept jobs with defense programs at competing companies. Internally at McDonnell Douglas, technicians had also been assigned to other aircraft programs competing for management's attention. During this period (the early Reagan years), there was a sharp surge in commercial aircraft orders as well as military aero-systems procurements. Thus, when McDonnell

Douglas received the go-ahead for full development in December of 1985, the contractor experienced great difficulty gaining back personnel with requisite expertise.

By that time, the Air Force's initial plan to administer the program as a streamlined, commercial-like non-development process faded as government advocates of that concept departed their positions. As such, the management approach became a more conventional contractor-government customer arrangement, complete with accompanying oversight processes. Other defense budget pressures also arose and Congressional support for the transport program dissipated, placing an additional cost squeeze on McDonnell Douglas for concessions to "keep the program afloat."<sup>6</sup> Lastly, as the next four years (1985-89) progressed, decisions were made to add new capabilities to the aircraft, including an electronic flight control and satellite communications systems, without anticipation of potential cost overruns as a future result.

Meanwhile, government managers were overseeing the minute details of engineering and manufacturing development. For example, the Air Force required that the contractor utilize "off-the-shelf" software (for perceived savings potential), making it more difficult to achieve standardized and compatible systems to accomplish the C-17's multiple functions. "In addition, the management control system (Cost/Schedule Control Systems Criteria (CSCSC)) imposed by the Air Force was excessively harsh. The controls, which required detailed breakdowns on spending for comparisons to cost targets, were expensive to implement and maintain, and focused excessively on program detail, according to a former McDonnell Douglas official, who added that some managers, as a result, 'lost sight of the big picture.'"<sup>7</sup>

With the aircraft nearly four years into full scale development, there was next an abrupt

implementation of Total Quality Management (TQM) at McDonnell Douglas, and a complete streamlining of the entire company without adequate preparation. It was disruptive to initial production work which was beginning on the C-17 wing. Personnel turnover became commonplace as many people moved into new positions, sometimes without proper technical qualification. Although the number of new McDonnell Douglas employees was growing rapidly, ninety-one percent of 900 structural mechanics assigned to the C-17 in the first year of production had a significant lack of experience, resulting in forty percent rework rates, adding four percent to the cost of each aircraft.<sup>8</sup>

Under severe pressure to reverse its declining profit margins, McDonnell Douglas was greatly relieved by the Air Force's "rushed" approval of a contracting milestone which authorized "assembly complete" status for its T-1 (first test flight) aircraft. This softened the contractor's financial crunch and eliminated more than \$1.6 billion in test liabilities before the end of FY1990. The Air Force later refuted any charge of ethical impropriety for relieving McDonnell Douglas's financial burdens, asserting that this was "perfectly appropriate" because neither law, regulations or sound management principles were violated.<sup>9</sup> However, during the same period, the Air Force had to investigate an estimate that the cost of the C-17 development contract, which included the first six production aircraft, would incur a cost overrun of over \$300 million (to \$7.75 billion) and that the total cost of the 120-aircraft target procurement program would overrun by \$2-\$3 billion beyond the \$35.8 billion current estimate. McDonnell Douglas was presumably liable for development costs beyond the development (fixed price) contract ceiling price of \$6.6 billion. Auditors criticized that the "T-1 assembly complete" decision was among a sequence of moves

intended to speed up C-17 payments to McDonnell Douglas and was a public relations gimmick to create improper vision of success.<sup>10</sup>

In another negative episode, C-17 test planes were required to fly with “interim restrictions” on control surface loads after Grumman Corporation, the subcontractor for the plane’s control surfaces, located flaws in ailerons and elevators. These deficiencies could have potentially reduced the aircraft’s durability and strength, with major safety implications.<sup>11</sup> Furthermore, the majority of the C-17’s flight controls rely on computer systems.<sup>12</sup> Looking back, the GAO in 1993 criticized the Air Force for disregarding Pentagon software development guidelines, giving McDonnell Douglas too much leverage in software development, and allowing a proliferation of computer languages (six) in C-17 software, including three languages alone in the flight control computer.

The C-17 contains fifty-seven subsystems requiring 970,000 lines of software code. The Mission Computer, considered to be the “center” of the C-17’s avionics, posed a significant technical challenge. This system was too slow and wasn’t meeting capacity requirements. Both the Air Force and the contractor agreed that this system was inadequate.<sup>13</sup> “The Air Force assumed that software was a low-risk part of the C-17 program and did little to either manage its development or to oversee the contractor’s performance. McDonnell Douglas took a number of shortcuts that have substantially increased the risk of not successfully completing software development and testing and may result in substantially higher software maintenance costs when the C-17 is eventually fielded.”<sup>14</sup>

Despite a DOD requirement to write software packages in a standardized and traceable common language called “Ada”, the Air Force felt exempted because McDonnell Douglas was



already functioning with a different language at the inception of the rule. The GAO recommended that the Air Force convert to Ada when major software changes would later occur, citing the excessive software maintenance costs inherent with language diversity. "While this conversion is likely to increase software costs initially, substantial savings could result over the C-17's 25-year life."<sup>15</sup>

Another critical issue in 1990-91 was the numerous fuel leaks found on the inaugural C-17 (T-1) after its delivery for flight testing. The second flight vehicle off the production line (designated P-1) was delayed almost one month so that technicians could locate and assess leaks and fix the wing tank seals. Although leaks plagued the first three test aircraft, McDonnell Douglas fixed the problems with modifications and better detection procedures during build-up.<sup>16</sup>

The program suffered perhaps its most significant setback when both wings of the transport failed during static tests in October, 1992. The tests simulated weight, altitude, and wind gust conditions at 150 percent of the plane's maximum potential load, and represented the lower stress threshold. The wings failed at 124 percent of maximum load. Failure of the wing structure during static testing occurred midway between the inboard and outboard engines on both wings, resulting in a skin fracture visible on the top of each wing. Production and flight test schedules sustained minor impact, while specialists ruled out any connection with over and under-expanded rivets in the wings. Previously, major wing assemblies had been tested to a load factor of 150 percent without failure. However, McDonnell Douglas had employed an improper method to determine compression stress. By April 1993, top priority was being given to redesign, test and retrofit a new wing design. The cost of modifications for this mistake totaled \$50 million. Other wing tests

uncovered further difficulties: the left wing failed in two areas right before and after it reached the 150 percent benchmark.

Meanwhile, with cost and performance problems mounting and the C-17 teetering on the edge of termination in 1991-93, a revolution was slowly taking place. A major reengineering effort conceived by McDonnell Douglas quietly catapulted the ailing transport program onto the road to recovery -- even while more political problems brewed. McDonnell Douglas's initiative hoped for results that would silence numerous dissenters in the DOD and Congress and ensure the program's survivability. Guided by Total Quality Management (TQM) and "concurrent engineering" principles, the organizational reengineering was geared toward restoring quality, schedule predictability, and cost compliance. McDonnell Douglas predicated its project on "process variable reduction" (PVR), a protocol developed to reduce production time and product defects. The areas targeted included, fuel system and the wing assembly sections which utilized Drivmatic<sup>TM</sup> riveting machines. The Drivmatic integrated product process team (IPPT), composed of wingspan, statistical process control, and proof of process teams, produced in-depth analyses which initiated performance charts, defect analyses, new goals, improved product schedules and innovative task measurement techniques.<sup>17</sup>

Industrial technologist John Gaffney headed up the PVR development team and faced significant implementation dilemmas, including the time required for new strategy formulation. He successfully molded a cohesive work team competent in troubleshooting, and convinced his troops of the PVR concept's advantages over traditional methods. Although the PVR process meant more work, a steep learning curve, and employee resistance in the short-run, it would prove to be worth the growing pains, revising detailed assembly and defects analysis processes and establishing task

timetables with clear target dates. Total employee hours and rework hours would soon decline without a significant reduction in the work force. Continuous improvement, cost avoidance and savings were becoming the new corporate catch phrases.

During this quiet revolution in quality management, McDonnell Douglas was continuing to troubleshoot and correct important engineering problems and, with strict fiscal responsibility and timely fixes, felt they could withstand public scrutiny in light of the aircraft's long-term strategic need. The major technical problems that still lay ahead included insufficient lower nose-gear retraction speed, inability to use reverse thrust and full flaps (due to McDonnell Douglas's miscalculation of engine exhaust effect), flight restrictions resulting from failed wing tests, and ever-present software problems.

### **AN UNFAVORABLE GAO REPORT**

Despite the gradual performance and software advances being made by McDonnell Douglas in mid-1993, the aircraft's future was caught up in a sea of Congressional criticism over cost and schedule management. The costs for procuring a total of 120 C-17s projected in 1993 President's Budget (\$43B) exceeded that planned for purchasing 210 aircraft in the 1991 Budget (\$41B). In addition, the program was blasted for slipping delivery schedules, attainment of reliability and maintainability levels that would not yield a total life cycle cost advantage, and agitating technical problems, including inadequate built-in test capability and a series of unsatisfactory airdrop missions.<sup>18</sup>

These problems reached a zenith at the end of 1993, culminating in a GAO Report that

struck down the merits of a tentative agreement between McDonnell Douglas and the Air Force and stated that C-17 procurement was no longer in the government's best interests. The report was also influenced heavily by the results of a special Defense Acquisition Board (DAB) convened from August to December 1993, which reviewed the program's requirements, cost, operational effectiveness, and affordability. Noting the revised aircraft buy estimates, the DAB froze C-17 production at forty aircraft, less than twenty percent of total buy originally planned in 1985. The Under Secretary of Defense for Acquisition and Technology, Dr. John M. Deutch, convened the Defense Science Board (DSB) to evaluate the C-17 program and to report back to the DAB concerning what had to be done technically to put the program on solid footing.

### **MORE CONTROVERSY**

Nevertheless, McDonnell Douglas continued to apply their quality initiatives to significantly improve reliability and productivity and developed a partnership with DOD aimed at attaining a settlement for the cost growth from a combination of "out of scope" (government add-on) contract changes as well as less-than-optimum contractor execution. Under the tentative agreement, the Air Force and McDonnell Douglas abandoned pending and prospective legal claims against each other and agreed to invest \$348 million and \$456 million respectively in the program. In January 1994, the Pentagon also compromised on a slight reduction in the original range and payload requirements and agreed to buy a total of fourteen C-17s in fiscal years 1995 and 1996 to bring the total number of operational planes to forty. DOD said it would decide on how many more transports to budget for based on McDonnell Douglas's success in meeting future cost, performance and schedule parameters. The Air Force and McDonnell Douglas were seeking more quantities in

future production, with the Air Force needing seventy-to-eighty planes for a viable fleet and McDonnell Douglas asserting it must sell eighty-to-one hundred transports to break even. The upcoming November, 1994 DAB decision would be critical to both sides' needs.

Meanwhile, McDonnell Douglas and DOD tackled affordability hurdles by instituting cost-evaluation teams to consider further cost-reduction techniques in systems engineering. McDonnell Douglas reported that a ten percent reduction was achieved through direct labor pools and better building maintenance and scheduling.

The GAO sharply criticized the C-17 program, deeming further production to be cost adverse, and fueled additional attacks from Congress, the Congressional Budget Office (CBO) and the Rand Corporation. "The C-17 program has been a troubled program almost since its inception and has fallen far short of original cost, schedule and performance expectations. Total program costs continue to grow."<sup>19</sup> It also found that the average target unit price the government negotiated with McDonnell Douglas rose by \$33 million per aircraft between production lots three and five. Meanwhile, delivery schedules continued to fall behind and production aircraft No.7 through 10 were delivered with increasing degrees of unfinished work or known deficiencies.

GAO charged that the Air Force waived potential claims against McDonnell Douglas without quantifying those claims and conducted a "blanket resolution" of filed and un-filed contractor claims by adding \$237 million to the contract price. GAO said DOD never established specific cost and schedule criteria in the settlement, merely requiring McDonnell Douglas to demonstrate "ability" to deliver aircraft on schedule and at cost. Examining McDonnell Douglas, GAO stated that the contractor's "out-of-pocket" costs were really \$46 million for the settlement, not \$454 million as claimed, and questioned the validity of \$1.25 billion in potential delays and

disruptions. In addition, GAO believed that \$171 million for non-recurring engineering should be excluded, because full-scale engineering and development costs had been allocated improperly by the contractor to current and future production contracts. The report emphasized that unsettled claims and late delivery of aircraft were major hindrances to the program's survival. GAO also charged that contract specifications were relaxed on payload weight and fuel consumption rates at the expense of originally-specified airlift capability.<sup>20</sup>

An additional controversy surfaced over the introduction of the Non-developmental Airlift Aircraft (NDAA) project, which was conceived as a safety net if the C-17 program failed. This project was lauded by the CBO and placed additional pressure on C-17 players to perform flawlessly before the November 1994 DAB decision on future production. In March 1994, the Air Force expressed willingness to accept a mix of fewer C-17s and more commercial aircraft, much to the satisfaction of CBO. This would cancel the Administration's commitment to purchase 14 additional C-17s for FY 1995, and replace 12 of them with the Boeing 747-400F version of McDonnell Douglas's MD-11 freighter. If this were done, the Air Force would have a comparable airlift capability at a saving of \$1.9 billion in 1995 and about \$3.5 billion from 1995-1999, based on calculations relative to CBO's estimate of the Administration's plan. The CBO also indicated serious doubt as to the C-17's ability to meet even lower performance thresholds given its previous difficulties meeting these criteria (i.e. 1992 wing failures).<sup>21</sup>

Representative Ronald Dellums (Democrat-California), with McDonnell Douglas as a constituent, surprisingly defended the House Armed Services Committee's (HASC) agreement with the GAO report and recommendation for the alternative cargo airlift program, arguing that only a limited part of the cargo necessary in a regional war is outsized and requires the C-17's unique

capacity. With C-17 procurement appropriated at \$2.5 billion for 1994 (barely enough for six C-17s), Dellums believed that cargo capacity would be maximized with a mix of four C-17s and several less expensive commercial-body jets. "The issue is not the C-17. The issue is airlift... how to provide enough overall airlift capability and specialized C-17 capabilities within a realistic spending level."<sup>22</sup>

Of course, the counter argument is that there are problems with accepting commercial aircraft with significantly less capability in the military theater, opposing any justification for halting C-17 production. Much more versatile, the C-17 can carry "outsized" cargo, including an M-1 Tank or Apache helicopter, making it a much more effective transport vehicle in wartime. In addition, the C-17 is built to better survive military use, and has superior maneuverability, enemy detection and evasion capability. Furthermore, the C-17 is built for severe environments that do not require long runways and special equipment for loading and unloading. In light of the Administration's objective to deploy sufficient forces to successfully wage two major regional conflicts at once, freight capacity limitations at major international airports would severely hamper national interest and security, if commercial transport were utilized.<sup>23</sup> Finally, total force airlift capabilities would likely drop below standards from the commercial buy, mainly due to significant maintenance problems with the older C-141 workhorses. This would likely necessitate the purchase of additional C-17s before the year 2000, reducing the savings envisioned by CBO. The airlift fleet is comprised of aging legacy aircraft, making it even more critical to fully integrate a C-17 fleet which could perform to the requirements of each other aircraft type.<sup>24</sup>

## THE TURNAROUND

The rest of 1994 was tumultuous as other critical issues continued to threaten the life of the program, despite renewed government-contractor cooperation, mechanical refinements, and “concurrent engineering” and quality advances. They included the nagging software incompatibilities, unresolved cost excesses, the alleged life-cycle cost advantage of the procuring NDAA aircraft, and a growing alignment of negative public opinion fueled by Congress, a Rand study and the residual effects of the GAO Report. Intense competition between parties with vested interests in the future of the program, including Congress, GAO, Rand Corporation, the Services, DOD, Pentagon insiders, contractors, and NDAA supporters, was giving the C-17 highest visibility. However, Dr. John M. Deutch, now the Deputy Secretary of Defense (DEPSECDEF) strove to reestablish the Globemaster vision and support for the C-17, lauding the transport as still “the most efficient solution” to the cargo transportation problem.<sup>25</sup> But on 7 May 1994, the House Armed Services Committee approved four C-17s instead of the six Dr. Deutch requested. It also wrote language instructing the Air Force to begin buying the NDAA in FY1995.<sup>26</sup>

Air Force officials further lobbied DEPSECDEF Deutch on behalf of the program. Dr. Deutch was convinced that the GAO and Rand Corporation reports based their conclusions on faulty assumptions and went before Congress on 17 May. Air Force officials also felt that the Rand report was flawed due to the nature of the information gathered: the Rand study was based upon data gathered during the Persian Gulf War where 90 percent of the airlift was accomplished by commercial planes landing on long, improved Saudi Arabian runways. The Air Force contended that current and future Air Mobility requirements aren’t met on remote, short airstrips in worldwide contingencies with an aging fleet of C-5s and C-141s. On 21 May 1994, the House debated the



future of the C-17 and President Clinton's requested funding for six of the planes. The HASC was considering an amendment to kill the entire program as well as another to fully fund the six.<sup>27</sup>

By 28 May 1994, the Pentagon and McDonnell Douglas struck a tentative agreement to resolve their disputes. President Clinton asked Congress for legislation to waive any provisions of law that would obstruct the deal between the two parties. Dr. Deutch was adamant in his support for the program, making reference to the C-17's reduction of airstrip limitations: "Getting that equipment in the early stages of a conflict is the most important way to minimize casualties and to reduce the length of a conflict to ensure military success," and, "We are not here discussing the transport of cargo....from Dulles Airport to Frankfurt."<sup>28</sup> Thirty-three of the fifty-six Congressional Armed Services Committee members signed a letter endorsing the President's request for six additional C-17s.

The House approved production of six C-17s on 11 June and appropriated \$105 million to research a supplemental cargo plane to augment the C-17 during mobility requirements.<sup>29</sup> On 25 June 1994, the Senate reaffirmed the President's proposal to revise the contract with McDonnell Douglas by a vote of 66 to 32.<sup>30</sup> Both chambers approved the procurement of six planes. However, only the Senate approved the provision authorizing a legal settlement that was previously negotiated to settle the disputes between the contractor and the government.<sup>31</sup> The House withheld the endorsement of the proposed contract settlement until passage of the Defense Bill on 1 October 1994. It included the authorization to purchase an additional six C-17s and approved the contract dispute settlement. The language targeted \$190 million to continue flight-testing and an additional \$190 million for components to be used in eight planes (Long Lead-Time Item procurement) slated for funding in FY 96.<sup>32</sup>

Dr. Deutch, dual-hatted as Chairman, Defense Resources Planning Board, announced 5 November that the Air Force would not purchase more than forty C-17s unless the manufacturer solved its cost overruns and scheduling problems. Based on Dr. Deutch's announcement, the Air Force faced a difficult year of testing in 1995 that would determine the fate of the C-17 program. A November 1995, DOD (Defense Acquisition Board - DAB) decision would announce whether or not the Air Force could continue the procurement of C-17s.

Since the early 1994 agreement between the Pentagon and McDonnell Douglas and throughout the suspense-filled summer committee marks to the FY1995 Defense legislation, the contractor continued to make significant improvements in the production of the C-17. According to the terms of the bilateral settlement, McDonnell Douglas was required to upgrade computer-assisted design and manufacture (CAD/CAM) systems, create an Management of Information Systems (MIS) department, and implement an advanced quality system. "By late summer 1994, company officials were boasting of better quality and rapidly improving delivery schedules."<sup>33</sup>

Another key factor contributing to factory progress was the addition of Mr. Kozlowski as McDonnell Douglas's Program Manager. In late 1993, he was transferred from St. Louis to Long Beach, CA to replace David Swain, a McDonnell Douglas executive vice president and the C-17 program manager who was blamed as the source of conflict with the Air Force.<sup>34</sup> To ensure a direct line of communication and responsibility, "The Air Force demanded that Mr. Kozlowski report directly to John McDonnell, Chairman and Chief Executive Officer of the corporation."<sup>35</sup>

The Air Force had also wanted to perform Level Three (depot-level) maintenance at Kelly AFB, Texas but instead elected Interim Contractor Support (ICS) at McDonnell Douglas's plant in

Long Beach. This became another opportunity for McDonnell Douglas to enhance profitability, in exchange for comparatively small business risk.

On the government side, President Clinton signed the Federal Acquisition Streamlining Act (FASTA) in October 1994, which provided sweeping reforms in the materiel acquisition process. FASTA freed program managers from having to use military specifications for hardware and software unless absolutely required (including CSCSC specifications); promoted the use of commercial products; encouraged a TQM-inspired, empowered teaming concept called “Integrated Product Process Teams” (IPPT) which Defense Secretary Perry immediately began implementing within the Office of the Secretary of Defense (OSD) bureaucracy; lowered procurement dollar thresholds for small administrative purchases; and reduced paper by encouraging electronic commerce initiatives like “paperless” proposals. In short, it reduced the government’s “policing” aspects of contractor and program oversight and improved management’s decision-making ability.

Together these factors enabled and enhanced the quiet quality revolution at both McDonnell Douglas and within the government. Support was back on the rise for the C-17 in Congress from demonstrated improvements in cost and aircraft performance throughout the remainder of 1994. On 11 February 1995, the Administration indicated that its plan for Pentagon procurement in FY 96 included \$2.4 billion for eight C-17s. The “Defense Hardware” issue arose in Congress on 8 April 95, recommending the purchase of Boeing’s 747 as an alternative to the C-17. Proponents claimed that the 747 was cheaper, but acknowledged that it had landing and payload restrictions.<sup>36</sup> On 10 June, the bill was submitted to authorize eight additional C-17s in FY1996 and Long Lead Time Item (LLTI) parts to continue production into the following fiscal year, FY97. Many skeptics

had been persuaded that the C-17 was finally on track, and the Air Force was expected to buy more of the cargo planes.<sup>37</sup>

(The \$105 million in FY1995 to research commercial and existing military aircraft as possible alternatives to the C-17, as might have been expected, was held by the Air Force pending the November 1995 DAB decision on the program.<sup>38</sup> Once appropriated, Research Development Test & Evaluation (RDT&E) funds have a two-year life span and can thus be spent elsewhere in the following year, given Congressional approval.)

The long-awaited C-17 is now rolling off the production line in some significant numbers (26 deliveries thus far, and Congress recently approved an unprecedented multi-year contract for 80 more over the next 10 years). A total buy of 120 is planned.

### **OBSERVATIONS & CONCLUSIONS**

The C-17 was born from an Air Force *want*, derived of course from anticipated airlift needs. In the late 1970s, the Air Force sought to improve air transport. They wanted an aircraft that could carry "outsized" loads. The fairly new (at the time) C-5 had this capability but required runways over 3,000 feet long. The aircraft that the Air Force sought to fulfill this requirement was called the C-X, and eventually became the C-17 Globemaster.

From its beginning in 1981, the C-17 was in development longer than any plane in history and also has the distinction of being the world's third most expensive aircraft, behind the B-2 Stealth Bomber and the E-3 Airborne Warning and Control System (AWACS). As the development of the C-17 dragged on through the entire decade of the 1980s, the world around this project changed dramatically. A "new world order" of fewer US bases and an aging legacy

air transport fleet transformed the operational requirements of the C-17 from *an individual service requirement* into *a truly joint service need*: versatile strategic force projection.

Lessons learned from this difficult and controversial program are: contract types (in this case Firm Fixed Price for research & development) don't necessarily alleviate government cost risk; American business has limited funds to invest on programs without government support; a like limit exists on commercial manpower; real economies can be gained in development when bureaucracy is removed from contract scope of work; and that, while all DOD programs must compete for priority and resources in the planning, programming and budgeting process, at least once in a while, overwhelming user need can outweigh affordability despite a severely declining defense budget.

## **RECOMMENDATIONS**

The US government must select and maintain a long term acquisition strategy for military capabilities. The C-17 actually benefited from the major political and funding changes that happened during the development, since our global military strategy evolved to actually heighten the need for the C-17.

Strategies that have been adopted by a service and properly presented to the public and Congress should be properly funded. The C-17 program suffered for several years as a good idea without funding, and lack of initial funds rippled into and exacerbated problems in other areas, including staffing at McDonnell Douglas and management from the Project Manager.

The US government must maintain its rigorous contracting process for major acquisitions, including careful requirement determination, procurement request, solicitation,

selection, etc. However, once the contract has been awarded, the contractor must be allowed to do his job with minimal interference. The C-17 program was severely hampered by management control systems imposed by the Air Force, including detailed breakdowns on spending for comparisons to cost targets and other expensive micro-managing tools that added apparently little value to the product.

The first C-17s produced have rendered highly successful service to the Bosnian peacekeeping mission as the world watched, and future production is virtually assured by the unprecedented multi-year contract to purchase eight C-17s per year for the next ten years.<sup>39</sup> The total purchase quantity and deployment of C-17s does not necessarily guarantee enough strategic airlift for the timely arrival of all US forces to two nearly simultaneous Major Regional Conflicts. However, the C-17's arrival into the aging and retiring airlift fleet is timely indeed.



## ENDNOTES

<sup>1</sup>John McCloud, "McDonnell-Douglas Saves Over \$1,000,000 per Plane with Reengineering Effort," Industrial Engineering, (Oct 1993): 27.

<sup>2</sup>David M. North, "C-17 Should Fulfill USAF Airlift Mission," Aviation Week and Space Technology, 10 May 1993, 42.

<sup>3</sup>Congress of the United States, Congressional Budget Office, "Reducing the Deficit: Spending and Revenue Options," A Report to the Senate and House Committees on the Budget, January 1994, p. 54.

<sup>4</sup>Pat Towell, "House Approves Full Request for C-17 Planes," Congressional Quarterly Weekly Report, 28 May 1994, 1400.

<sup>5</sup>Bruce A. Smith, "Management Miscues, Delays Snarl C-17 Program," Aviation Week and Space Technology, 12 April 1993, 30.

<sup>6</sup>Ibid., p.31.

<sup>7</sup>Ibid.

<sup>8</sup>Ibid.

<sup>9</sup>David F. Bond, "Rushed Approval of C-17 Milestone Aided Contractor Financial Crunch," Aviation Week and Space Technology, 18 May 1992, 30.

<sup>10</sup>Ibid., p. 31.

<sup>11</sup>Ibid.

<sup>12</sup>David J. Lynch, "Airlift's Year of Decision," Air Force Magazine, (November 1994): 28.

<sup>13</sup>Ibid.

<sup>14</sup>David F. Bond, "C-17 Program Faces Problems in Manufacturing Software," Aviation Week and Space Technology, 18 May 1992, 32.

<sup>15</sup>Ibid.

<sup>16</sup>Bruce A. Smith, "Douglas Improves C-17 Costs and Quality, Adds Fuel Leak Fixes to Initial Transports," Aviation Week and Space Technology, 10 May 1994, 56.



<sup>17</sup>T. Digges and Michael Meadows, "The C-17 Saga," Principles of Program Management, (August 1995): 2-20.

<sup>18</sup>Frank C. Conahan, "Military Airlift: C-17 Settlement Is Not a Good Deal," GAO Report to Congressional Committees, April 1994, p. 3-4.

<sup>19</sup>Ibid.

<sup>20</sup>Ibid., 5-6.

<sup>21</sup>Congressional Budget Office, "Reducing the Deficit: Spending and Revenue Options," A Report to the Senate and House Committees on the Budget, March 1994, p. 1.

<sup>22</sup>Ibid., 2.

<sup>23</sup>Pat Towell, "House approves full request for C-17 planes," Congressional Quarterly Weekly Review, 28 May 1994, 1400.

<sup>24</sup>Congressional Budget Office, "Reducing the Deficit: Spending and Revenue Options," A Report to the Senate and House Committees on the Budget, March 1994, p. 2.

<sup>25</sup>Ibid.

<sup>26</sup>Elizabeth A. Palmer, "Requested But Not Popular," Congressional Quarterly Weekly Review, 12 Feb 1994, 338.

<sup>27</sup>Pat Towell, "Panel Makes Few Big Changes But Raps Clinton's Plans," Congressional Quarterly Weekly Report, 7 May 1994, 1132.

<sup>28</sup>Pat Towell, "House Coalition Repels Efforts To Cut Military Further," Congressional Quarterly Weekly Report, 21 May 1994, 1320.

<sup>29</sup>Pat Towell, "House Approves Full Request For C-17 Planes," Congressional Quarterly Weekly Report, 28 May 1994, 1401.

<sup>30</sup>Pat Towell, "Senate Panel Gives Clinton B-2 Funds He Didn't Seek," Congressional Quarterly Weekly Report, 11 June 1994, 1537.

<sup>31</sup>Pat Towell, "Clinton Program Stays Intact In Senate - For Now," Congressional Quarterly Weekly Report, 25 June 1994, 1725.

<sup>32</sup>Pat Towell, "Defense Debate Pivots On Bombers, Weapons," Congressional Quarterly Weekly Report, 23 July 1994, 1192.

<sup>33</sup>Ibid., 1193.

<sup>34</sup>David J. Lynch, "Airlift's Year Of Decision," Air Force Magazine, (November 1994):  
26.

<sup>35</sup>Ibid., 27.

<sup>36</sup>Ibid., 27.

<sup>37</sup>Pat Towell, "The Next 100 days," Congressional Quarterly Weekly Report, 8 April  
1995, 985.

<sup>38</sup>Ibid., 986.

<sup>39</sup>Katherine McIntire Peters, "It Flies!" Government Executive, (June 1996): 10-17.



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