

THE PHOENIX RISES

**Col Randy Davis, USAF, LTC Bill Phillips, USA,
and Lt Col Bud Vazquez, USAF**

The story of how this acquisition program rebounded from the brink of extinction to a model of reduced-cost and ahead-of-schedule production illustrates how determination, the use of integrated product teams, the program executive officer system, and the process approach to manufacturing can produce results.

Truth is a function of time.

—Brig Gen Ron Kadish
C-17 System Program Director
1993

Secretary of the Air Force, Dr. Sheila Widnall, used to joke that the phrase, “the troubled C-17 program” was really all one word. Accordingly, there are many accounts describing how the C-17 “Globemaster III” airlifter program got into trouble. Surprisingly, no one has tried to capture the specifics of the even more remarkable story of how the C-17 program got out of trouble. This article will tell that story.

We will begin with a short description of the aircraft and the requirement for it. Then, to put the ultimate success of this major acquisition program in proper context, we provide a brief review of the program’s troubled past. Following this review, we’ll cover the salient events—in the Pentagon, program offices, and the

McDonnell Douglas plant—that substantially contributed to the remarkable turnaround. We conclude with an in-depth look at lessons learned that could benefit other programs.

THE AIRCRAFT AND THE REQUIREMENT FOR IT

The C-17 aircraft program is the U.S. Air Force’s effort to develop a modern airlifter capable of meeting the worldwide air mobility needs of the Department of Defense (DoD). In the late 1970s, and after the cancellation of the YC-14 and YC-15 programs, the need for an aircraft capable of carrying large payloads to aus-

tere fields remained. The formal requirement for the C-17 was thus identified in 1980. The aircraft was specifically designed to carry modern combat weapons of U.S. ground forces directly into airfields near the conflict. This capability is known as “direct delivery”: a strategic airlifter is able to deliver to tactical assembly areas without an intermediate stop. Perhaps most important, the C-17 will also provide a way to move “outsize” cargo (very large equipment like the M-1A Abrams tank, or the Multiple Launch Rocket System—equipment that cannot fit on today’s C-141s or C-130s) for inter- and intra-theater airlift. The direct delivery dimension with an outsize airdrop capability will serve to significantly enhance airlift support to combat forces in the field and improve the mobility of general purpose forces.

The aircraft is a high-wing, T-tailed airlift aircraft. It is powered by four Pratt and Whitney PW-2040 engines with the military designation F-117. The engines are high bypass ratio fan jets very similar to those that have been used on Boeing 757 aircraft for years. The C-17 is the first modern, fully integrated, all electronic cargo aircraft. The design includes a quad-redundant electronic flight control system and fully automatic electronic monitoring of all systems to enable the aircraft to be fully supported by an aircrew of three

people: two pilots and one loadmaster.

Technologically, the heart of the C-17 is its propulsive lift system, which uses engine exhaust to augment lift generation. By directing engine exhaust onto large flaps extended into the exhaust stream, the C-17 is capable of flying steep approaches at remarkably slow landing speeds. This equates to the aircraft’s ability to land payloads as large as 160,000 pounds on runways as short as 3000 feet.

Once on the ground, its ability to turn in a small radius, combined with its backing capability, allows the C-17 to maneuver into and out of tight parking spots as well as turn around on narrow runways. This ground maneuverability in tight quarters enables this aircraft to deliver more cargo to small airfields with limited parking space in a shorter time, increasing “throughput.”

Finally, throughout its design, the contractor—McDonnell Douglas Transport Aircraft Division in Long Beach, CA—placed major emphasis on reliability and maintainability, which paid dividends in reduced maintenance manpower and spares requirements. The aircraft was designed with the maintainer in mind, and not as an afterthought. These reduced support costs, combined with the three-person crew and greater airlift productivity, serve to yield low life-cycle costs.

Col Davis is currently serving at the U.S. Special Operations Command Program Executive Office (USSOCOM PEO) for Fixed Wing Aviation, USSOCOM Headquarters, MacDill Air Force Base, FL.

LTC(P) Phillips is currently serving as the Director of Information Management & Assessment for the Secretary of the Army for Research, Development and Acquisition, Falls Church, VA.

Lt Col Vazquez is currently the Director, Program Execution Office, Office of the Commander, Air Force Electronic Systems Division, Hanscom Air Force Base, MA.

TROUBLED TIMES—A BRIEF REVIEW

I have decided to put you on the C-17 program...say your prayers.

—Note from the Air Force program executive officer to one of the authors, June 1993

Just how did the C-17 program get into trouble? As one might suspect, there are many reasons. Most notable of all is that the contractor, McDonnell Douglas Corporation's Transport Aircraft Division (located in Long Beach, CA), throughout the late 1980s and early 1990s, was consistently behind schedule and over budget on the program.

The first C-17 scheduled to fly (known as "T-1") became airborne nearly 18 months after the date indicated in the contract. Thanks in part to the fixed-price development contract, and due to the sting of the A-12 program cancellation, the company was suffering financially. In fact, there was considerable concern within the Pentagon's acquisition and contracting communities about the company's viability. These tight purse-strings constrained the ability of corporate managers to invest in much-needed process and equipment improvements. To compound these woes, the company had a tumultuous experience implementing a total quality management system (TQMS), wherein a large number of experienced managers were laid off. To make matters worse, in hearings before the House Sub-Committee on Government Operations, the Air Force was accused of making improper progress payments to McDonnell Douglas that, in effect, were "bailing out" the struggling corporation. The Air Force was even accused of ac-

cepting the aircraft with structurally weak or "unsafe" wings.

After T-1 finally flew on its maiden voyage in September 1991, it had a series of fuel leaks, resulting in a highly publicized grounding (for about three weeks). The aircraft's aluminum-lithium alloy flooring had many problems associated with cracks. The failure to initially use a computer-aided design and manufacturing (CAD/CAM) system to design the aircraft caused both design and production problems.

All of this culminated in the Congressional decision to reduce the number of aircraft purchased (to 4 from an original 6 in 1993, and to 8 from an original 12 in 1994). These actions helped to drive a deeper wedge between the program office and the contractor. McDonnell Douglas found itself in a position of reduced buys, and therefore cut personnel to compensate for the reduced revenue. This action inhibited its ability to take advantage of learning curve efficiencies, made it tougher for the company to attract and retain quality subcontractors, and resulted in greatly reduced morale and increased chaos. The program was dangerously close to cancellation.

THE TURNAROUND

The C-17 program's incredible turnaround truly began in late 1993—but the year did not exactly begin well for it. In another well-publicized maneuver, Secretary of Defense Les Aspin forced former program director Maj. Gen. Mike Butchko to retire, and punished two other general officers and a senior civilian over the

“bailout” controversy. The DoD’s senior acquisition leaders recognized the dilemma the program faced. Relations between the contractor and the government were strained to the limit. The Air Force blamed McDonnell Douglas for failure to perform up to the standards of the contract. McDonnell Douglas blamed the government for “requirements creep,” and for expensive constructive changes to the contract. Thus, the contractor had staked a series of contractual claims worth over a billion dollars against the government. The program had reached an impasse.

Hunting for a way out of the logjam, Under Secretary of Defense for Acquisition and Technology (USD[A&T]) John Deutch commissioned a Defense Science Board task force to study the program and to make recommendations. The leaders for

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this effort were Air Force Lt. Gen. Jim Fain, who was serving as the commander of the Aeronautical Systems Center in Dayton, OH, and Robert A. Fuhrman, the respected and retired chief operating officer

of Lockheed Corporation. The program’s landscape was littered with three major land mines, and it was these three that the task force had to negotiate through and around:

- The fixed-price contract did not account for the unknowns of a development program, and led to incessant

contractual and legal bickering over who was to pay.

- Congressional changes laid in a four-year gap between when McDonnell Douglas “won” the C–X competition, and when development would be fully funded. This gap also saw legislation forcing the Air Force to buy 50 C–5Bs and 44 KC–10s.
- Last, and certainly not least, poor performance by McDonnell Douglas was apparent in all aspects of the program.

THE SETTLEMENT

In order to effect change, the task force knew that both parties would have to agree to substantive concessions. To make a very long story very short, McDonnell Douglas was persuaded to drop all its current and pending claims against the government, and they agreed to invest more than \$100 million into improved manufacturing processes and equipment, a modern management information system, CAD/CAM, an ISO-based advanced quality system, and a host of other small but needed changes. As the government’s portion of the settlement, the Air Force increased the contract ceiling price by \$237 million (effectively paying that amount to the contractor), and relaxed a number of specification requirements to reflect the change to a post-Cold War world.

In the late summer of 1993, there was a concerted and highly guarded effort to develop a way to wipe the slate clean for both government and contractor. It was one of the better-kept secrets in the infamously leaky halls of the Pentagon. Specifications were rewritten to account for shortfalls and to represent actual opera-

tional requirements,¹ various government and contractor legal claims were added up, and vigorous debates on the appropriate (money, consideration, additional investment, etc.) relief ensued. On January 6, 1994, at least five months later than the Office of the Secretary of Defense (OSD) and Air Force staffs had originally anticipated, the settlement was approved and signed by John Deutch and John McDonnell.

If there is one truth about the turnaround of this program it is that one can hardly underestimate the importance of the settlement. The settlement provided all involved the *tabula rasa* needed to continue building the aircraft, moving the program focus back to customers, managers, and engineers, and away from the lawyers and contracting officials.

Knowing the value of a goodwill gesture in the never-ending legislative branch debate, McDonnell Douglas began to make much-needed investments even before the agreement was formally signed. The new management teams could move forward as teammates, rather than as adversaries. Furthermore, the settlement gave everyone involved in the program a sense of optimism that had been long gone. Things were looking up! At this point, it was in the labyrinth of the Pentagon where the road to recovery began to build upon the settlement's optimistic momentum.

MEANWHILE, BACK AT THE PENTAGON

On November 8, 1993, the fifth meeting of Defense Acquisition Board (DAB),

which had begun in August 1993, concluded. John Deutch left room 3D1019, and called an executive session in his office. Shortly thereafter, as the generals and senior civilians scurried back to their offices, the respective staffs were hastily assembled to begin what would become a concentrated effort to turn the C-17 program around.

The decision that rumbled through the Pentagon was hardly a surprise to those close to the program and its turbid history. Rather than the planned 120 aircraft, DoD would commit to buying no more than 40 C-17's, with subsequent buys predicated on improved C-17 performance, quality, and a marked reduction in price. The time pressures were immense: the acquisition community had 24 months to do it or buy a different airlift aircraft. At the DAB meeting, data presented

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by the Institute for Defense Analyses (IDA) showed that if the Globemaster III did not perform up to specifications, mixed buys of C-17s and Boeing 747-400 freighters might be a cost-effective option to the previously planned 120 C-17s. Deutch, who was soon to become the Deputy Secretary of Defense, delegated the responsibility for turning this concept into reality over to Rudy deLeon, the Under Secretary of the Air Force. The Air Force's acquisition community and C-17 program brain trust—Deputy Assistant Secretary Darleen Druyun, the incoming Program Executive Officer (PEO) Brig. Gen. Jim Childress, Airlift Directorate

Brig. Gen. Jim Richards, and Program Director Brig. Gen. Ron Kadish—had a huge task before them.

Work began immediately on three priorities. First, efforts to turn the C-17 program from a disaster into a viable program had to be continued at an ever-heightened pace. Second, a competitive alternative to the C-17, primarily in the form of a slightly modified Boeing 747-400 freighter, and revitalized C-5 (to become known as the C-5D), had to be ready to be executed by the scheduled November 1995 DAB meeting—no small task considering there weren't even people assigned to these projects yet. Third, a process had to be devised that pulled all the constituencies, personalities, and details together for another DAB meeting not later than November 1995.

Most of these issues fell squarely into the lap of the new Air Force program executive officer for tactical and airlift

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(AFPEO/TA), then Brig. Gen. Jim Childress. Having arrived from the F-15 System Program Director (SPD) position at Warner Robins Air Force Base in the summer of 1993, Childress was assigned as

SAF/AQX, or the Directorate of Management Policy and Program Integration. He was thrust into the PEO position when Lt. Gen. Ed Franklin left to take command of Hanscom Air Force Base's Electronic Systems Center. He and his C-17 SPD, Brig.

Gen. Ron Kadish, and the new McDonnell Douglas program manager, Don Kozlowski, had the monumental task of working to make good on the myriad of demands and promises. Given the long-lead time to “cut-in” production line improvements in order to see tangible results within 24 months, they were already behind schedule.

THE CHILDRESS PLAN

Brigadier General Childress immediately and correctly recognized that a detailed plan had to be built, coordinated, and executed, and that this plan would require the “buy-in” of all of the key people in the Pentagon. This plan, and its many evolving parts, captured the key events and the process by which the Air Force proposed to bring the salient parts together by November 1995. There were a few key components of the plan.

Childress envisioned continuing the highly successful chief executive officer (CEO) meetings started by his predecessor, Lt. Gen. Ed Franklin. These small and confidential meetings between the Secretary of the Air Force and John McDonnell (and including a small group of the most senior Air Force and Army leaders) kept issues squarely in the limelight for immediate decisions. They continued quarterly for the next two years.

He created and implemented what became known as the “Milestone III Steering Committee.” This was another quarterly gathering aimed at managing the inevitable process issues that were certain to appear on the way to the DAB. The group was chaired by Rudy deLeon, the Under Secretary of the Air Force. Unlike the CEO meetings, this forum had wide membership, and included OSD represen-

tation. It was an integrated process team (IPT) at its best and at the Pentagon staff's highest level.

In addition, given the complex process needed to force all the disparate pieces to come together by November 1995, the acquisition community could not afford disagreement with the process used to get there. Accordingly, General Childress proposed a major briefing to the DAB principals a full year ahead of time, in November 1994. This evolved into a full-blown DAB meeting (affectionately known by many as a "practice DAB") wherein the plan to get to the Milestone decision in November 1995 was approved. This was another stroke of genius. The PEO had substantially lowered the risk that there would be disagreement over the approach at the Milestone DAB meeting, when it would be too late to do much about it.

These initiatives were applauded and supported up and down the chain of command. General Childress had gained the planning "high ground" in the Pentagon. It was now his plan, and suggestions to change it went to him—rather than the PEO having to get it issued from "on high." There were three main "annexes" to the attack plan. Figure 1 shows a simplified process plan used to integrate the nondevelopmental airlift aircraft (NDAA) competition with the C-17 program. Figure 2 shows the overall management plan for managing the process through 1994 and 1995. Figure 3 shows the detailed plan for the last 180 days before the DAB meeting—the period when pre-DAB activity reaches a crescendo.

SURPRISE! THE CUT TO FOUR

Early in 1994, and just after the settlement was finalized, DoD and the Air Force

prepared for their annual Congressional testimony. As expected, Air Force airlift testimony supported Deutch's decisions and made the continued signs of C-17 technical progress prominent. Nonetheless, the key professional staffer for the House Armed Services Committee (HASC), Bruce MacDonald, was nonplused, to say the least. A strong advocate of using commercial airlifters like the Boeing 747 in the years preceding the Deutch-led DAB session, in late April

MacDonald convinced the HASC members to recommend a cut from the plan of six C-17s for the sixth production lot, down to four. The legislation would then use the "savings" to begin buying commercial airlifters.

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This recommended cut would be disastrous to DoD plans. It would not allow the Deutch plan to unfold, it would not give McDonnell Douglas time to make improvements, and it would not provide any major near-term benefits to U.S. strategic mobility capabilities. Just as McDonnell Douglas was making progress, the reduction would increase the price of the airplane, probably cause layoffs, and wreck the program. Something had to be done—and quickly.

Rudy deLeon called the Air Force brain trust together that Friday evening to develop the plan that would counter this legislative threat. It called for a full-court press to save the C-17. Senior leaders

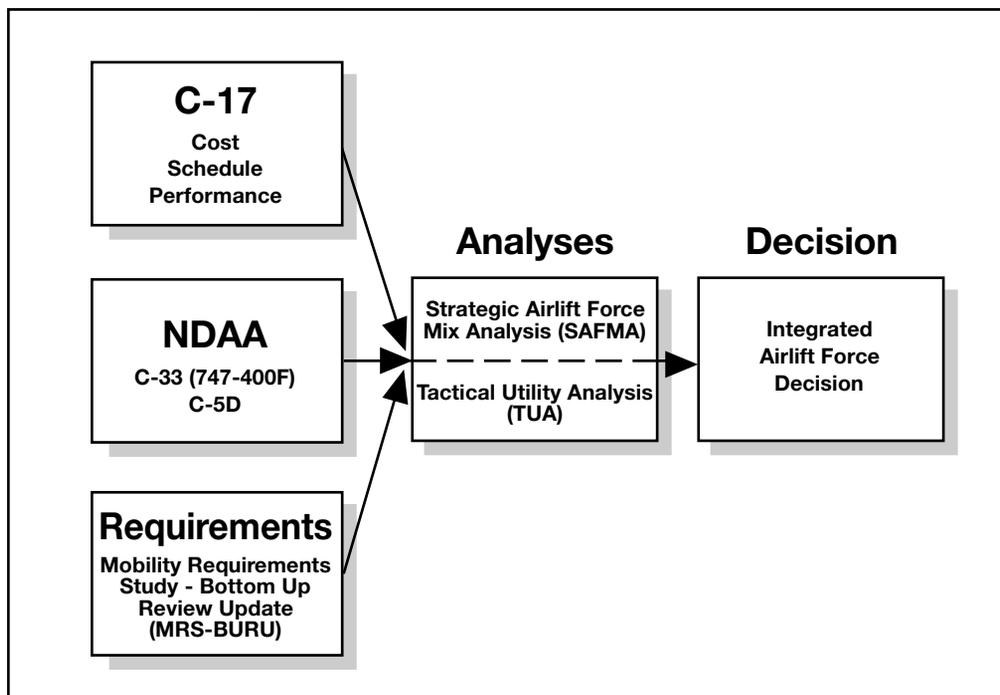


Figure 1. Decision Process

throughout the Air Force and DoD would be mobilized to meet with, write to, or call key members of Congress. A bipartisan alliance of Democrats and Republicans formed the nucleus of the effort. A “white paper” making the case for restoring the cuts and allowing the Deutch plan to unfold was needed. And it would have to be built over the weekend by a small team of Pentagon action officers, division chiefs, and OSD lawyers. The White Paper made a convincing case of all the reasons the cut would be counterproductive and was a remarkable success. As a result, in an unprecedented move, the cuts recommended by the HASC were overturned in a vote on the floor of the House of Representatives. The C-17 was saved, at least temporarily.

JOINTNESS AND THE TEAM EFFORT TO SAVE THE C-17

A prime lesson for those in the Pentagon was that jointness is goodness. Without the vigorous, vocal, and continual support of the U.S. Army, the C-17 would likely be a relic of the past, rather than the core airlifter of the future. In the Army’s Concepts, Doctrine & Force Policy Division (DAMO/FDQ), then-Brig. Gen. John Riggs and his action officer, then-Maj. John Burns, were assigned to stay actively engaged in the program. Lt. Cmdr. Dan Page’s role as the Army liaison to the program office in Dayton took on heightened importance. The Air Force acquisition community welcomed this participation and did its best to keep the Army informed, involved, and working issues that needed Army help. For instance, at one time the

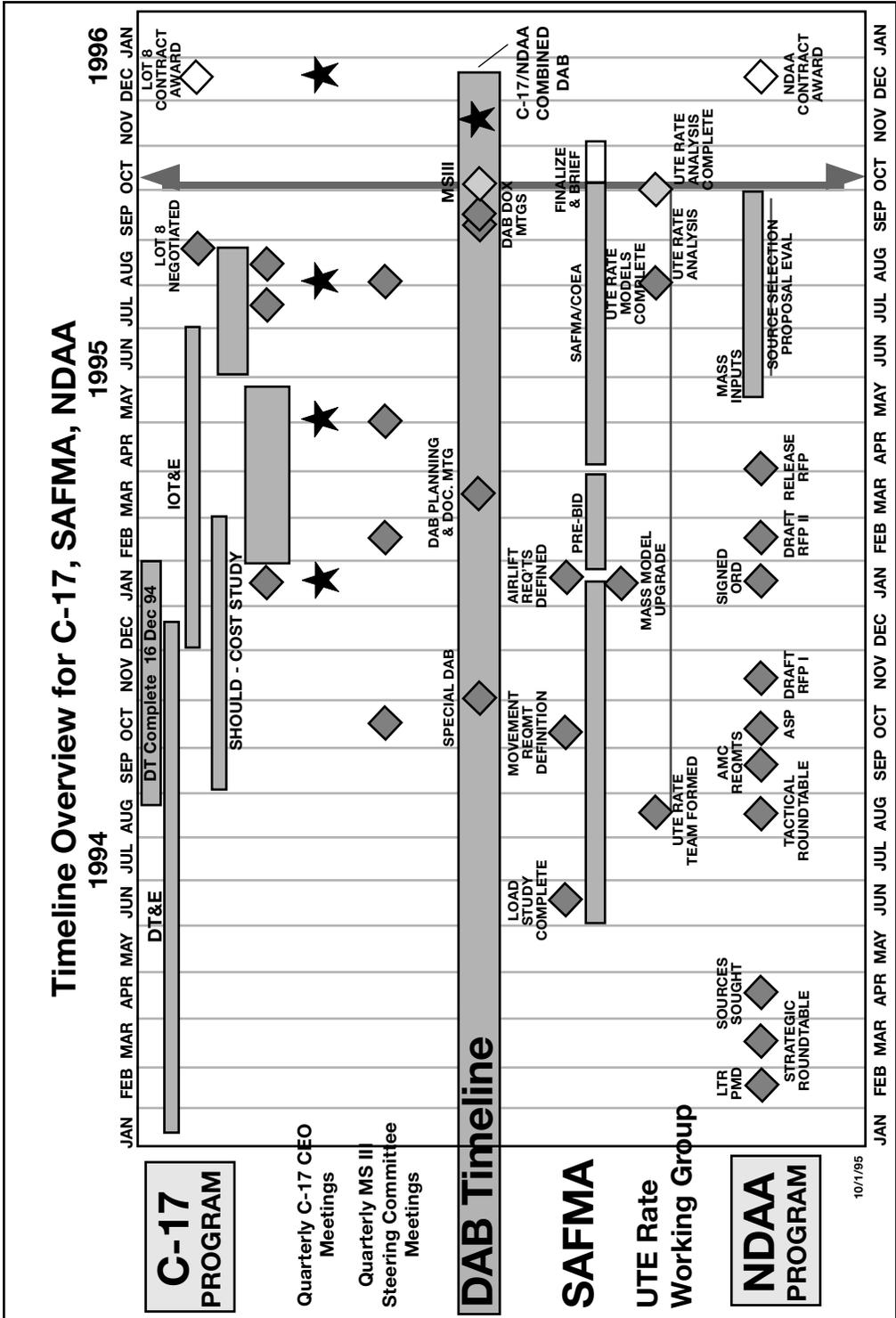


Figure 2. Timeline Overview for C-17, SAFMA, NDAA

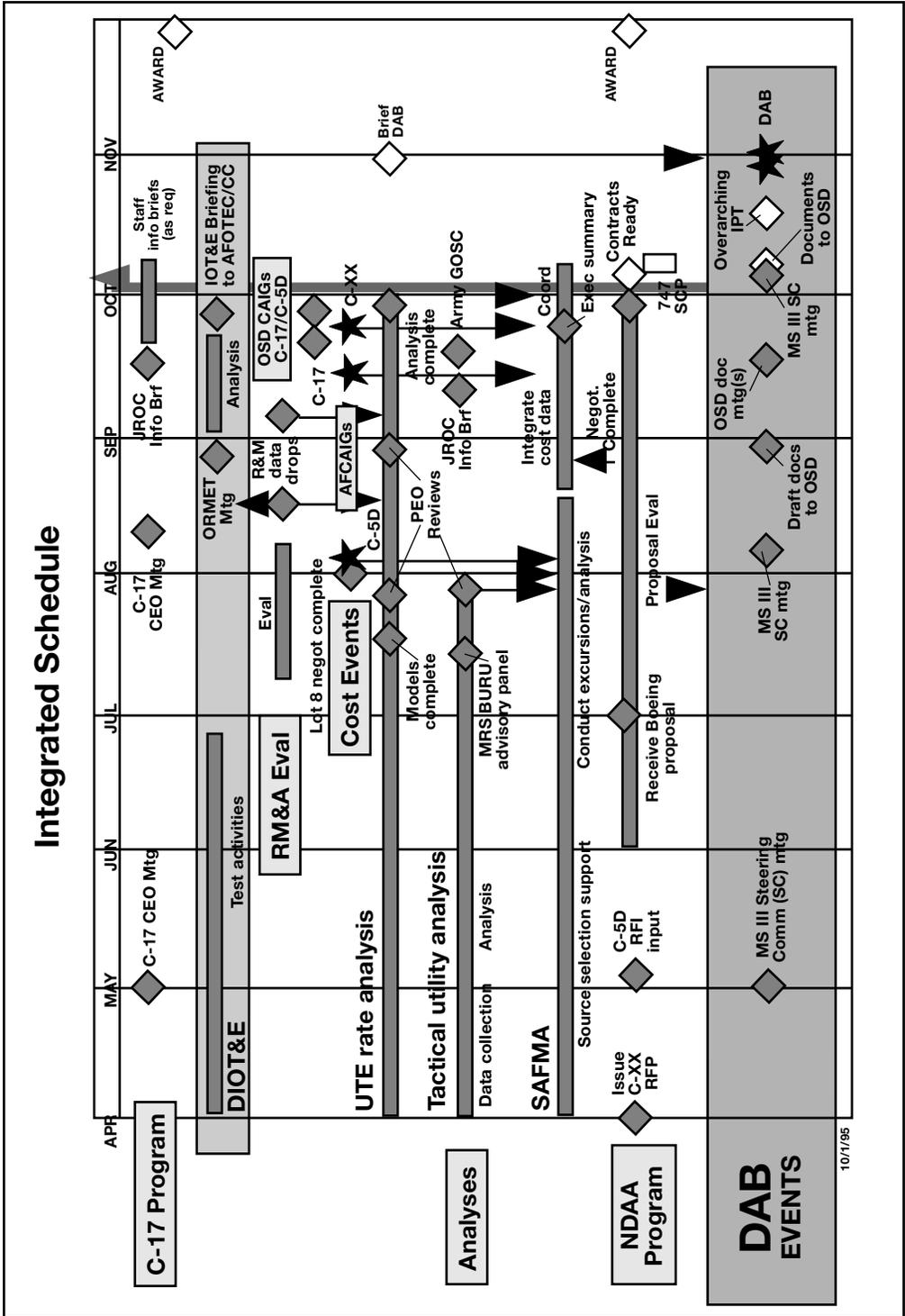


Figure 3. Integrated Schedule

Joint Staff alleged that there were no plans for strategic brigade airdrop. John Burns' research found no less than 6 historical examples and 10 active plans that program proponents used to counter-punch our way to advantage. When the Army's plans for Direct Delivery proved to be more a concept than an operational plan, Riggs and Burns helped motivate several tactical analyses, that rightly accounted for the C-17's ability to deliver outsize equipment to tactical assembly areas, and that would greatly help prove the C-17's worth. The cooperative approach would work out tremendously.

THE ARMY—AN INVALUABLE PARTNER

The U.S. Army was considered by the Air Force to be ultimate user of the aircraft; and therefore a highly valued customer. The Pentagon, company, and the system program office (SPO) worked together to ensure that the Army was a full member of the team as the program turned the corner. An example of the high spirit of jointness exhibited under General Kadish's leadership was the joint effort to approve the C-17 for airdrop missions. After many fits and starts, new procedures and equipment were used to better meet the Army's needs. In a brigade airdrop "slice" demonstration in the spring of 1995, six C-17's successfully dropped more than 200 Army paratroopers and a large compliment of heavy equipment with absolute precision. This demonstration took place in front of a host of DoD distinguished visitors, including the DoD director of operational test and evaluation.

The strategic importance of the C-17 was quickly demonstrated in real life by the superb support the aircraft provided Operation Joint Endeavor. Having just

been designated as operationally capable, the aircraft was called upon to provide both strategic and operational lift for the NATO Implementation Force (IFOR) move into Bosnia. The aircraft demonstrated its superb mission flexibility in support of the IFOR Savo River crossing. When flooding caused a need for additional bridging sections, innovative people discovered these "outsize" sections could be loaded onto flatbed trailers and driven right on and off the aircraft. The sections were delivered by C-17 and driven to the river. The time savings for this outstanding example of direct delivery was measured in hours rather than days. Further, within the first six months, the C-17 had flown almost half the tonnage in only one quarter of the missions. This equates to 508 missions; 4108 passengers (27% of all passengers); and 12,610 tons of cargo (48% of all cargo carried into the region). The aircraft's performance has been, and continues to be, truly exceptional and critical to the successful sustainment of Operation Joint Endeavor. The C-17 has proven its worth in its very first test.

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THE "SHOULD COST"

We mentioned a key objective was to lower the cost of buying C-17s. A direct impact of the decision to temporarily cap the program at 40 was to greatly inflate the cost of each C-17. During the Congressional reporting cycle in December of 1993, the total program cost (research, development, production, and mainte-

nance) divided by 40 worked out to well over \$500 million per aircraft. The acquisition community could hardly endure these headlines and expect a 41st aircraft. At the suggestion of DoD Inspector General Derek Vander Schaaf, and with the concurrence of deLeon, the Air Force was asked to perform a top-to-bottom cost

“The strategic importance of the C-17 was quickly demonstrated in real life by the superb support the aircraft provided.”

“scrub” aimed at reducing program cost. After some initial pause (several of these studies had occurred with little to show), a new

and high-powered approach took shape. Lt. Gen. Dick Scofield, General Fain’s replacement at Wright-Patterson Air Force Base, OH, would lead an effort aimed not at identifying “potential” savings (as was common in past attempts), but at implementable savings.

This minor shift was tremendously important. The focus was now on realistic and realizable savings, and under Darleen Druyun’s leadership at the Pentagon, the group worked miracles. Using the investment monies from the settlement and the corporate coffers, the team searched for the high-payback items with great success. Of great import, and precisely because the aim was on implementation, the contractual vehicles performed in parallel so that time (and the associated opportunity for payback) would not be wasted. In addition, all the stakeholders—the auditors, the contractors, and the government—agreed to a single cost model. By the summer of 1995, the team identified cost savings that brought down the cost of the C-17 to little more than that of a Boeing 747-400. The

C-17 now cost \$172 million in “flyaway cost” per aircraft in constant 1995 dollars. This was a number many Pentagon bureaucrats thought impossible to reach, and this achievement gave rise to more optimism.

Occurring almost simultaneously with events in the Pentagon, and shortly after the settlement, was another watershed event vital to the turnaround. Senior leadership at both the SPO and McDonnell Douglas changed. Brig. Gen. Ron Kadish transitioned from his position as F-16 program director to the directorship of the C-17 program. McDonnell Douglas put Don Kozlowski, a McAir veteran program manager from St. Louis, MO, in charge in Long Beach. These two leaders shared common goals: turn the program around, make it successful, and do it post haste.

THE PROGRAM OFFICE-CONTRACT OR PARTNERSHIP

Perpetual optimism is a force multiplier.

—Gen. Colin Powell

The first steps the new leadership took involved personnel and organizational structure. They jointly formed “mirror image” integrated product teams (IPTs) to help them to manage the program as partners. These IPTs were consciously organized around C-17 product-related areas, and in the long run proved massively successful for program execution. General Kadish and Kozlowski empowered these IPTs. Each team received talent from all of the key functional areas of expertise, and the team leaders had the trust and confidence of the program leadership to the

extent that they made decisions for program execution. The initiation of IPTs facilitated joint decision making, and promulgated full and open communication. They allowed program managers on both sides to focus on program events, as they jointly worked the issues. The government and the contractor jointly developed an integrated master plan that included lower level integrated schedules.

Integrated program management also resulted in the following: joint configuration management control; quarterly joint executive program management reviews; and a program reporting system that consolidates issues and tracks actions. All of this fostered the feeling that both the contractor and the SPO shared a common destiny. Perhaps the best way to describe what integrated product development brought to this program is to contrast the old way of doing C-17 business with the way things worked once IPTs formed. The old way is best characterized this way: different organizations, functional process focus, us versus them, slow and guarded communications, plans integrated at program level, multiple schedules, and functional budgets. The new way of doing business included: aligned organization, product focus, we, rapid and open communications, team planning, an integrated master schedule, and team budgets.

Communication was another key to success. Any problems, potential problems, or obstacles in the way of progress were dealt with openly. General Kadish's motto "bad news doesn't get better with age" was clear guidance to communicate openly and honestly, without fear of retribution.

Kozlowski brought a renewed sense of purpose to the McDonnell Douglas C-17

team. He implemented major organizational changes and installed proven performers in key team positions. Most important, he essentially reinvented senior management's relationship with the employees. Among his key leadership achievements were: a fresh focus on team solutions and accountability, 75 percent reduction in lost work days due to accidents on the production floor, employee involvement and gain sharing, a renewed

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relationship by objectives with the UAW union, employee recognition programs, increased emphasis on skills training, and an 80 percent reduction in grievances.

General Kadish and Kozlowski set up three definitive goals at the outset, with a relatively near-term focus. These goals were: to achieve initial operating capability (IOC) in January 1995, to successfully complete the reliability, maintainability, and availability evaluation (RM&AE) in July 1995, and to successfully complete the DAB review in November 1995. To ensure consistency, each of these three goals had joint integrated master plans and integrated master schedules associated with them. Each IPT aggressively managed its portion of all three goals.

The first goal, IOC, involved delivering the 12th operational C-17 to the 437th Air Wing at Charleston Air Force Base, SC. All 12 aircraft had to be fully supportable, and we needed 48 fully qualified aircrews for IOC to be declared. The planning and scheduling "drills" just discussed

Table 1.
RM&AE Results for the C-17

Parameter	Actual Percent	Req. Percent	What's Good
On-time departure reliability	99.20	n/a	n/a
Mission completion success probability (MCSP)	97.50	86.00	Higher
Mean time between maintenance (inherent) MTBM(I)	3.94	1.31	Higher
Mean time between maintenance [corrective] MTBM(C)	1.81	0.63	Higher
Mean time between removal (MTBR)	8.47	2.26	Higher
Maintenance man hours per flight hour (MMH/FH)	3.45	27.7	Lower
Mean man hours to repair (MMTR)	2.50	8.16	Lower
Mission capable (MC) rate	90.70	80.80	Higher
Fully mission capable (FMC) rate	85.10	73.00	Higher

Note: Requirements and goals above are based on growth curves leading to mature values.

1. RM&AE numbers based on 15,000 hr (est).
2. Mature numbers based on 100,000 hr.

had uncovered major disconnects in time for us to fix them. The Air Mobility Command commander declared IOC on January 17, 1995.

The second goal, successful completion of the RM&AE, involved flying all 12 of the 437th's C-17s at an up-tempo pace for 30 consecutive days. The plan called for C-17 operations at small austere airfields, transatlantic long-haul missions, and constant "quick turnarounds." The evaluation called for collecting extensive sortie generation rate data, mean time between failure data, mean time to repair data, and on-time takeoff data. In addition, mission completion success rates were monitored closely. This exercise took place during July and August 1995, and the C-17 per-

formed magnificently. Key results are shown in Table 1.

The third and final goal, successful completion of the combined C-17 and NDAA DAB session, was reached early in November 1995. Certainly the successful achievement of the first two goals contributed mightily to this outcome. It will go down in acquisition history as one of the smoothest and least controversial DAB meetings ever. The ultimate decision, announced by Deputy Secretary of Defense John P. White, was for a total buy of 120 C-17s, and a discontinuance of the NDAA program.

Having cleared the initial three program goals with flying colors, General Kadish and Kozlowski refocused the C-17 team

on three new goals: deliver and sustain a quality C-17 fleet, improve the weapon system's capability and support, and lower the life cycle cost. They developed an innovative way to separate C-17 contracts to provide better visibility into cost performance. The result was a scheme to orchestrate three discernible contracts: the production contract to correctly isolate flyaway cost to the production contract; the performance enhancement and product improvement (PE/PI) contract to directly manage the enhancement process; and the field support contract to directly manage the field support expense. Clearly, there was a need to reduce the cost of the C-17. Therefore, the SPO and McDonnell Douglas embarked on a journey to make the aircraft more affordable. This effort would soon intensify with a major effort in 1994 and 1995 to enhance affordability.

There were two basic ways to cut costs: through greater efficiency or through design changes. To achieve greater efficiency, the focus was on lowering indirect costs, lean aircraft initiative concepts, high-speed machining, outsourcing, low-cost suppliers, production span time reductions, and modern assembly techniques. On the design change side of the equation, the focus areas were design for manufacturing and assembly, avionics technology upgrades, and commercially available, highly reliable microcircuits. The company began to focus on these ideas, and it began to pay off almost immediately. The ultimate results of all of these cost reduction efforts were impressive and irrefutable. McDonnell Douglas' investment into the program, combined with nearly \$4 billion in cost reduction initiatives, resulted in lowering the flyaway cost of a C-17 from approximately \$275

million to \$172 million (CY\$95).

In addition, General Kadish initiated a unique award fee concept. His award fee plan focused on program benefits, with an eye toward initiatives to further reduce the cost of the C-17, and toward encouraging management responsiveness and program integration. This served as a highly effective motivator, as significant progress was made in all areas.

BUILDING SUCCESS IN LONG BEACH

A partnership is fragile—it must not be taken for granted!

—Col. Gene Kluter
Commander, DCMC
McDonnell Douglas, 1995

The Defense Contract Management Command (DCMC) at McDonnell Douglas in Long Beach played a major role in the C-17's turnaround. The Defense Contract Management Command (formerly known as The Defense Plant Representative Office, or DPRO) provides contract administration services support for the C-17 SPO by ensuring that McDonnell Douglas complies with contractual requirements. The SPO is the primary DCMC customer. The DCMC maintained active involvement with every aspect of contractor operations, providing a variety of services including pricing and negotiation, technical support, engineering and production surveillance, property management, quality assurance and flight acceptance of aircraft.

Prior to 1993 an adversarial relationship existed between DCMC Long Beach and McDonnell Douglas. As previously

mentioned, McDonnell Douglas was behind schedule while contract costs continued to escalate. This relationship resulted in significant distrust between government and contractor personnel, each blaming the other for failure to meet contractual requirements.

In August 1992, Air Force Col. Gene

“One of the most challenging and far-reaching DCMC initiatives involved a transition from functionally oriented government oversight to product- and process-focused oversight.”

Kluter reported as the commander, DCMC McDonnell Douglas, Long Beach. The assignments of Brigadier General Kadish, Kozlowski, and Colonel Kluter completed the tripartite leader-

ship (SPO, McDonnell Douglas, and DCMC) that was essential to establishing a path toward success for the C-17 program. Colonel Kluter quickly established a positive, effective relationship with Kozlowski, which fostered a new era of partnership built upon trust. Furthermore, Kluter made a commitment to Kadish that DCMC would provide world class support for the C-17 Program. This partnership, built upon trust, cooperation, and a firm commitment to program excellence, then began its march toward reversing the disasters of the C-17 program.

DCMC CULTURAL CHANGE

One of the most challenging and far-reaching DCMC initiatives involved a transition from functionally oriented government oversight to product- and process-focused oversight. In 1994, DCMC began

to realign its functionally oriented divisions (engineering, contracts, and quality) into product- and process-focused teams. Implementation of this approach to contract administration reflected a significant cultural change for the DCMC workforce. The previous functional structure resulted in stove-piped organizations that inhibited open communication and cooperation. It promoted an adversarial relationship with McDonnell Douglas through application of an inspection and detection approach to determining nonconformances that were often subjective in nature. The functional approach did not facilitate determination of the root cause of a nonconformance; and most often resulted in temporary improvement and isolated solutions.

Conversely, the product- and process-focused teams created an efficient, cooperative approach to contract administration that focused on prevention of nonconformances and the design of quality into the product. The results were objective, continuous product improvements and systematic solutions to nonconformances. Furthermore, this approach fostered a synergy among DCMC team members (in engineering, contracts, and quality assurance), who shared their professional knowledge and skills.

Process-based management proved to be a critical component for eliminating production bottlenecks, as well as reducing costs and cycle time.

—Randy Mizer, Vice President
for Program Integration
McDonnell Douglas
Transport Aircraft, 1997

PROCESS-BASED MANAGEMENT

Probably the most significant enhancements to C-17 manufacturing process improvement, production efficiency, and cost reductions resulted from McDonnell Douglas' implementation of process-based management (PBM). PBM is a proprietary "management approach that defines an organization as a collection of processes and that focuses on customer satisfaction and waste reduction by defining, measuring, stabilizing, and improving processes."² It is a formal, seven-step process that results in disciplined systems and processes. It closely resembles the DCMC's Process Oriented Contract Administrative Services (PROCAS), a program designed to improve customer satisfaction, reduce contract costs, and reduce the cost of government oversight. Process-based management forms one major cornerstone for total quality management (TQM) at McDonnell Douglas. It is a proactive way to manage a process, prevent process nonconformances, and anticipate and implement process improvements.

McDonnell Douglas implemented PBM in full partnership with the DCMC and SPO, consummated by the signing of a formal teaming agreement. The Defense Contract Audit Agency (DCAA) was an active PBM participant as well. McDonnell Douglas and DCMC identified critical processes and designated "process owners" (MDC personnel) and "process specialists" (DCMC personnel). Process owners and specialists were empowered to manage the process and establish metrics (e.g., defects, timeliness, efficiency, and cycle time) to provide a balanced view of process health. McDonnell Douglas and government per-

sonnel shared the metrics' results and process health reports.

The successful results achieved from PBM implementation had an extremely positive impact on program execution. For instance, defects were reduced by 92 percent from P-16 (production aircraft) to P-22, while mandatory government in-

spection hours were reduced approximately 70 percent. Ramp span time was reduced by 61 days (46 percent) from P-7 to P-22. Timely execution of "root cause analysis" and resultant process improvements directly resulted in a 59 percent reduction of scrap, rework, and repair. Process improvements resulted in the elimination of fuel leaks on production aircraft that saved \$660,000 per aircraft. Production span time improved from 505 days for P-9 to 373 days for P-23, a 26 percent reduction.

Considering current trends, McDonnell Douglas expects to achieve another 48 percent reduction in production span time for aircraft P-40, scheduled for delivery in June 1998. Furthermore, based upon the government's confidence in PBM, DCMC reduced mandatory government inspection hours by 73 percent (which equates to 16 DCMC personnel), and a 500 hour-per-month reduction in Material Review Board hours. Greater reliance on PBM will lead to great contractor self-governance, which translates directly into cost avoid-

"One of the most challenging and far-reaching DCMC initiatives involved a transition from functionally oriented government oversight to product- and process-focused oversight."

ance to the taxpayer (from oversight to insight).

Process variability reduction (PVR) achieved tremendous success due to the implementation of PBM, coupled with investments in production tooling resulting from the settlement agreement. McDonnell Douglas implemented a total of 48 process variability reduction projects and 38 settlement-induced projects that resulted in significant cost savings. For example, the main landing gear pod was redesigned for easier manufacturing and assembly. The number of detail parts and fasteners were reduced from 1,792 to 37, resulting in 8,400 installation hours saved and \$103 million of cost savings for the remaining aircraft.

Furthermore, more efficient and effective production tooling was installed to reduce production bottlenecks. An auto-

mated rivet gauging tool referred to as "Genesis" was installed, which significantly reduced variability and rework costs. State-of-the-art fuselage alignment tools were also installed. New information systems that realigned daily work schedules to maximize production efficiency were employed. What's the bottom line, you ask? Effective implementation of process-based management and process variability reduction directly resulted in a better product, faster delivery at reduced costs, and much greater customer satisfaction.

STREAMLINING MILITARY SPECIFICATIONS AND STANDARDS

Few would argue with the premise that military specifications and standards add significant costs to government programs. In some cases these contractual require-



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ments do add value and are necessary to ensure that the product meets government needs. However, in many cases they do not add value, a trend recognized by leadership within the DoD. On June 29, 1994, Secretary of Defense William J. Perry issued a memorandum on specifications and standards. The memorandum “directed the use of performance specifications to the maximum extent practicable, and the development of a streamlined procurement process to modify existing contracts to encourage contractors to propose nongovernment specifications and industry-wide practices that meet the intent of military specifications and standards which impose government-unique management and manufacturing requirements.”

Considering DoD guidance, McDonnell Douglas and DCMC performed a thorough review of contractual military specifications and standards. The mission was to “challenge the requirement” and retain essential performance requirements or tailor them to the C-17 program. During full-scale development of the C-17 aircraft, there were 243 contractual military specifications and standards. During Lot VII production, these were reduced to 30. The review further resulted in the current requirement of 5 military specifications and standards—a significant reduction. A few of the deleted specifications and standards are Mil-Std-1567A (work measurement), Mil-Std-965 (parts control program), Mil-Std-980C (foreign object debris prevention), Mil-Std-483 (configuration management), and Mil-Q-9858A (quality system). These requirements were replaced by commercial practices employed by McDonnell Douglas, and thus the cost associated with maintaining two sys-

tems—one for the government and one for the company—was reduced.

The deletion of Mil-Q-9858A occurred after McDonnell Douglas’ successful implementation of an ISO 9000 compliant advanced quality system (AQS). Obtaining ISO 9000 compliance was not an easy task by any means. McDonnell Douglas, in partnership with DCMC, established a detailed implementation plan that included support of external consultants well versed in ISO 9000. Company and DCMC personnel underwent a rigorous training program, and numerous assessments were performed.

“The AQS resulted in improved process metrics, reduced cycle time to implement corrective action, increased focus on designing and building in quality, and continuous reduced process variability.”

In October 1995, DCMC issued a “Statement of the Qualification.” The AQS resulted in improved process metrics, reduced cycle time to implement corrective action, increased focus on designing and building in quality, and continuous reduced process variability. Most important, the AQS is compatible with commercial quality systems; it thus reduces costs to the government by avoiding duplicate systems. In the June 1996 “Milspec Reform” publication, the USD[A&T] singled out the C-17 program’s implementation of an ISO 9000 system as a success, resulting in “advanced schedule deliveries, cost savings of approximately \$100,000 per aircraft, and a 40 percent reduction in government quality inspection work force.”

COMMUNICATION— A “VISION” FOR SUCCESS

Timely communication that clearly articulated the issues, concerns, and problems proved essential to the C-17 program’s turnaround. This was a monumental task, considering the number of major and minor subcontractors, as well as the myriad of parts suppliers supporting the program. The DCMC tackled this problem by expanding the “partnership” to include all the major and minor suppliers.

“Timely communication that clearly articulated the issues, concerns, and problems proved essential to the C-17 program’s turnaround.”

A customer service center was established at Long Beach to “maintain communications and teamwork on the part of all of the suppliers and government organizations managing the C-17 program.” This included institutionalizing a formal structure for reporting issues, problems, required actions, and successes. The reports were consolidated into a keystone document called *Vision—C-17 Employed Around the World*.

The report provided a detailed, extensive look into the program’s status from a manufacturing and program integration view. It included a “quick look” (executive summary) section followed by contract performance, product team performance, subcontracting management, and system program integration (SPI) sections. The executive summary provided a quick program overview to include major issues relating to cost, schedule, and perfor-

mance. The contract performance section provided a detailed look at cost and schedule, estimate at completion, progress payments, contract modifications, safety/foreign object debris, and the health of business and technical systems. The product team performance section provided extensive insight into aircraft systems (avionics, flight controls, mission equipment, and airframe), flight operations, air vehicle integration, and PBM. The subcontract management section provided a brief overview of the status of major suppliers to include component descriptions, issues, and delivery and quality ratings (red = unsatisfactory; yellow = marginal; green = satisfactory). The SPI section provided an extremely thorough analysis of program status at 38 major suppliers, to include cost, delivery, quality, and program rating. Most important, the report identified the key issues affecting performance that required action.

The customer service center prepared the *Vision* report monthly. The document was forwarded to key agencies for review and action as required. The center tracked the issues to ensure timely resolution, and thus ensured the elimination of roadblocks to program execution and greater customer satisfaction.

LESSONS LEARNED

The story of the C-17 program’s remarkable turnaround highlights lessons learned that could benefit other programs. Among the most important of these are:

Never count on divine intervention. The settlement between McDonnell Douglas and the Air Force allowed the con-

tractor to begin with a clean slate. It was the major catalyst that fostered better communication and teamwork between the SPO and McDonnell Douglas. Nonetheless, it required an extraordinary lining up of the Congressional, OSD, and service “planets” that was extremely rare and unlikely to happen again.

Integrated product teams and the PEO system work. The teamwork that IPTs fostered proved invaluable, in part due to the fact that they were genuinely empowered by Kadish and Kozlowski. The teams aggressively attacked and achieved the program goals that the leadership laid out. Major General Childress and his staff did a masterful job conducting the DAB process, and “running top cover” in Washington, enabling the SPO to concentrate its effort on program execution. His savvy development of an executable NDAA alternative put the weight of competition onto McDonnell Douglas, and tangibly helped them get their act together.

Other lessons are:

- Enlist the vocal support of your customer. Keeping the Army well informed and deeply involved proved vital to program success.
- Assign action officers to orchestrate a Milestone III DAB at least one year in advance. This proactive approach served to get “buy-in” from key OSD participants early on, and gave them a sense of ownership in the success of the C-17 program.
- A process approach to manufacturing is extremely valuable; it allows problems to be fixed at their source. Root

cause analysis helped participants to focus on the problem’s source, eliminating bottlenecks to program progress.

- Concentrate on a series of challenging yet achievable goals, and harness the energy of the combined contractor-SPO team to attain them. Once attained, establish a new set of goals. Program goals and objectives must flow down into integrated plans and schedules. Hold IPT leaders accountable for achieve-

“Ultimately, all improvement boils down to the contractor’s ability to perform.”

ment of their part of each goal. A well-functioning team will include four tiers of members. First-order members are the contractor, plant representatives, and SPO; second-order members are the SPO, PEO/mission area director, and service staffs; third-order members are the OSD; and the fourth order is Congress.

- Use the public affairs office to develop a plan to disseminate the good news. It proved useful to get VIPs involved, allow them to fly on the C-17, and to let them hear the opinions of the people actually using the aircraft—both AMC aircrews and maintainers and Army soldiers.

Ultimately, all improvement boils down to the contractor’s ability to perform. McDonnell Douglas’ performance improved at a rapid rate throughout the recovery cycle of the program. The company began to routinely deliver high-quality

ity C-17s ahead of schedule. Take charge! Seize the high ground on every issue. This includes issues other than just the ones you think you own. Finally, a brief array of Gen. Colin Powell's "rules" apply in the

C-17's case: "It ain't as bad as you think." "It will look better in the morning." "It can be done." "Check small things." "Share credit." "Have a vision." "Be demanding."

Col Randy Davis, USAF, LTC Bill Phillips, USA, and Lt Col Bud Vazquez, USAF, wrote this paper as part of their course work for the Senior Acquisition Course (SAC), a highly selective part of the National Defense University's Industrial College of the Armed Forces (ICAF) curriculum. At the time of their experiences, Colonel (select) Davis led an Integrated Product Team at Wright-Patterson AFB's C-17 Program Office, LTC Phillips commanded the DCMC McDonnell Douglas Huntington Beach, CA, facility (plant representative office), and Lt Col Vazquez was the director of airlift programs for the Air Force's Program Executive Officer for Tactical and Airlift programs in the Pentagon.

ENDNOTES

1. The original contract specifications were written to capture the C-17 performance proposed by McDonnell Douglas during the source selection. However, these were very much in excess of actual Air Force requirements stated at the time.
2. PBM is a management system proprietary to McDonnell Douglas. Permission was granted for use in this article. For further information about PBM, contact McDonnell Douglas.

