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AIR WAR COLLEGE
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The Making of the Weakest Link

by

Stephen C. German

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REPORT SUBMITTED IN TO THE FACULTY
IN
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REQUIREMENT

Advisor: Dr. David Blair

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PROLOGUE

It seems like only yesterday that the light came on. I remember it quite vividly. We were on a routine training mission, having just completed refueling with the SR-71. The light was an indication that something terrible had gone wrong. The light belonged to a new piece of equipment installed on our KC-135Q. It was called a wing crack detector warning system -- we called it the "you are about to die light." This system was installed as an interim device to help crews survive the KC-135 wing re-skinning program that was advancing towards completion like a herd of turtles. After running the system checklist, we had arrived at the most ominous conclusion: **Land at the nearest available airfield -- wing failure could be imminent.**

This incident is indicative of life at the tail end of the food chain in military aviation. Fortunately the situation has improved quite a bit since the '70s. Flying a KC-135R seems like flying a new airplane, especially if you were raised in the KC-135A. Unfortunately, many at the top of Air Force leadership really do consider the KC-135R a *new* airplane! It is far from it. And events are unfolding that may very well put the aircraft back where it was 20 years ago.

This paper will examine two factors that could be instrumental in this giant leap backwards. The first is the **lack of understanding** of the role the tanker plays in past and future strategies. The importance and impact of that role was best described by General Lee Butler when he reflected on the role the Strategic Air Command played in Operation Desert Storm. People were astounded that he would "chop" his B-52s to a theater CINC, why this was pure heresy for a CINCSAC, never been done before. He smiled and quipped, "If I had wanted to

have a real impact on the conduct of that war, I would have **recalled the tankers!**"¹

The other factor is the **acquisition bow wave** developing between the year 2000 through 2020. As defense acquisition struggles with terms like build-down, budget cuts, and peace dividends, the tanker will be passing into its twilight years without so much as a whimper from the war fighting CINCs who are preoccupied with C-17s and F-22s.

The tanker has been described as a force multiplier. What it has really been is a **time machine**. It has flown far beyond its expected life span, enabling this nation to prosecute its wars and other operations on its own terms. It has provided fighters with more time on target, test aircraft with more time pushing the envelope, and everyone in the world the legs to get there, wherever there might be in half the time. In return it has demanded very little other than meticulous care in the maintenance of its place in the launch stream. This paper will provide the insight as to the why time is no longer on the side of the tanker...yet everyone seems to think time is still on the tanker's side.

¹Butler, General George Lee, General, USAF. Address to the Strategic Air Command Squadron Commander's Conference, Offutt AFB, NE, Fall 1991.

INTRODUCTION

"Air strategy begins with airplane ranges. Airplane ranges determine the location of bases. The proximity to the target of the bases under ones control fixes the weight and rhythm of the attack."

"Tooey" Spaatz²

On March 2, 1949 a B-50A Superfortress, Lucky Lady II of the 43rd Bomb Group, completed the first nonstop around-the-world flight, covering 23,452 miles (37,523km) in 94 hours, 1 minute.³ This first demonstration of Global Power, Global Reach gives little mention to the "other resources" employed in making this demonstration possible. It is these "other resources" this paper will address.

We finish refueling and now, for practice, the copilot tries the mating dance. Twice under Tom's careful coaching he brings the huge plane forward. Each time he fails to make secure contact. As yet he lacks the piloting skills to bring off this complex maneuver.

This symbolic relationship of bomber and tanker is a concise illustration of the need to think about defense not in terms of weapons but at the very least in terms of weapon systems, to realize why Tooth and

²Military Air Power, The CADRE Digest of Air Power Opinion and Thoughts, Lt Col Charles M. Westenhoff, USAF, Air University Press, October 1990, p 41.

³Robert F. Dorr. Boeing KC-135 Stratotanker, Ian Allan Ltd., 1987, p 22.

Tail are one fighting unit, as in any effective dragon. The bomber is useless without the tanker. It cannot make it to the target. It does no good to spend millions on bombers and not have sufficient tankers, as the British found in the Falklands.⁴

As American "shooters" become more expensive and complex, it is readily apparent to even the most casual observer that these resources will never be exposed to the perils of front line basing. The absolute star of the Gulf War was the Stealth Fighter, a misnomer if there ever was one in that this exotic craft carries only bombs — not a single round or missile for the fighter role. Yet the typical mission of this "silver bullet" required two air refuelings on its nightly excursions to downtown Baghdad. It was inconceivable that this aircraft would be based close to the fighting where it might become vulnerable to Scud attack or overrun by enemy forces early in the conflict. In fact, some 60 percent of all DESERT STORM attack sorties *required* air refueling.⁵ Even in a limited theater such as the Kuwait Theater of Operations (KTO), the distances between coalition main operating bases and their targets routinely required at least two air refuelings. As cataloged in the Gulf War Air Power Survey Summary Report, a list of representative aircraft and target areas shows the extent of this dependence:

<u>Aircraft</u>	<u>Combat Radius</u>	<u>Target Distance</u>
F-117	550 nm	to Baghdad - 905 nm
F-15E	475 nm	to Western Scud areas - 680 nm
F/A-18	434 nm	Red Sea Carrier to Kuwait City - 695 nm
B-52G	2177 nm	Diego Garcia to Kuwait - 2500 nm ⁶

⁴Arthur T. Hadley. The Straw Giant, Random House, Inc., 1987, p 214.

⁵Thomas A Keaney and Eliot A. Cohen. Gulf War Air Power Survey Summary Report, Air University, 1994, p 190.

⁶*Ibid*, p 228.

As a prologue to the future US Strategic Plan -- **Global Reach - Global Power** -- B-52s launched from Barksdale Air Force Base, Louisiana, on January 16, 1991 enroute to targets in the KTO.⁷ A 14,000 mile, 35-hour plus round-trip mission, with four scheduled air refuelings (the fog and friction of war caused this requirement to be increased), would highlight the global capabilities of the US military, while also demonstrating the inherent options of a recallable force.⁸ The National Command Authority's capability to reach out and touch someone using this option is only available through the use of air refueling.

It is this capability that will provide US forward presence in the future. Where the US once relied on forward basing, the concept of Global Power - Global Reach, at least for the Air Force, will rely more and more on power projection from bases in the US. The Air Force Chief of Staff, General Merrill A. McPeak, eloquently described this presence capability in an address to the Forum Club and the Houston Military Affairs Committee in April of 1994: "Moreover, our unmatched mobility combined with air refueling means we can get anywhere very quickly, take off anywhere, attack anywhere and return anywhere, without landing en route. No spot on the globe is more than 20 hours flying time from combat aircraft stationed in the United States."⁹

⁷Bob Woodward. The Commanders, Simon & Schuster, 1991, p 369.

⁸John Tirpak. The Secret Squirrels, *Air Force Magazine*, Vol. 77, No. 4, April 1994, p 56.

⁹Gen. Merrill A. McPeak. Americans could do with a better understanding of our military presence, *Houston Chronicle*, April 10, 1994, p 4E.

THE HOSTILE TAKEOVER

"Time is necessary to both belligerents, ...the only question is: which of the two, judging by his position, has most reason to expect special advantages from time?"

Clausewitz¹⁰

In the course of transferring control of the tanker weapon system to Air Mobility Command, the truly important employment features of the KC-135 were lost on the new owners of this national resource. Like many a wing commander who boasts his wing "can be there tomorrow," the 48 hours it required to set the air bridge seemed to be lost somewhere in the translation. Many trials and tribulations immediately beset the world of tankers when the airlift community, which as a major command (Military Airlift Command) possessed the least understanding of the air refueling mission, found itself owner of one of the truly unique air arms in world military aviation.

The differences between the air refueling community and the airlift community were immense. But no greater clash occurred than plans surfaced to use the KC-135 as a target of opportunity to fill holes in a woefully abused, and in the words of USCINCCENT, a "broken" airlift capability.¹¹ The "warriors" from the Strategic Air Command (SAC) were aghast at the "hostile takeover" mentality and new mission roles they were now assigned. As the opening words of Karen

¹⁰*Military Air Power, The CADRE Digest of Air Power Opinion and Thoughts*, Lt Col Charles M. Westenhoff, USAF, Air University Press, October 1990, p 62.

¹¹Hoar, General Joseph P., USMC, *Eyes on the World's Likeliest Flashpoint*, *Defense 93*, American Forces Information Service, Issue 3/4, 1993, p 11.

Bemowski's article in Quality Progress states so eloquently, "The Air Mobility Command (AMC) is not in the warrior business; it is in the **support business**."¹²

¹²*Quality Progress*, Vol. 25, No. 7, July 1992, p 27. Copyright 1992 American Society for Quality Control.

TARGET OF OPPORTUNITY

"All the numerous applications of physics, chemistry, engineering, etc., which make up the modern arsenal are in fact at the mercy of humans, the soldiers who use or direct them."

S. T. Das¹³

It wasn't long before the superior performance and reliability of the tankers, and the "core tanker" (KC-135) in particular, over all other AMC resources became quite clear. The KC-135, as operated in SAC, was clearly cared for and operated in the manner unknown to the C-5, C-141, and C-130 fleet in Military Airlift Command (MAC). This performance and reliability was even more remarkable considering the first order for the KC-135 was placed with Boeing on July 11, 1954.¹⁴ This outstanding record however, has led directly to misuse that will spell disaster for the health of the airframe and the readiness and capability of its air crews to perform its primary mission, that of air refueling.

AMC has levied upon the KC-135 a new airlift mission (euphemistically referred to as Roller Derby) that will invariably reduce the service life of the airframe. The KC-135, which was designed to fly only 375 hours a year is not the old C-135 Military Air Transport Service (MATs) used to operate.¹⁵ Currently, AMC is exceeding this timeline by tasking the Stratotanker in an airlift

¹³Military Air Power, The CADRE Digest of Air Power Opinion and Thoughts, Lt Col Charles M. Westenhoff, USAF, Air University Press, October 1990, p 60. S. T. Das is the Indian author of An Introduction to the Art of War.

¹⁴Robert F. Dorr. Boeing KC-135 Stratotanker, Ian Allan Ltd., 1987, p 25.

¹⁵Alic, Branscomb, Brooks, Carter, Epstein. Beyond Spinoff, Harvard Business School Press, 1992, p 70.

role competing against well-known commercial express companies. This is an effort ill-advised vis-à-vis the structural demands on the aircraft and certainly an uneconomical concept in that initial estimates showed operations resulting in a loss of about one million dollars a month during the test phase of the program.

AMC is also testing an internally conceived snap-on roller system fashioned from cannibalized C-5 rollers in the cargo area of the KC-135. Boeing, manufacturer of the -135 series aircraft, has neither studied nor approved this system for use in the KC-135. While no weight limits are being exceeded, the movement of the pallets through the cargo area is without engineered protection for the aircraft structure. This point was made by Boeing representatives when presenting a similar unsolicited capability at HQ AMC in 1993.

This airlift role is also detrimental to the true mission capability of the crews who fly the KC-135. The AC-130 and B-52 can carry limited amounts of cargo -- but we don't utilize these aircraft as airlifters because their flying time is too valuable to use in this role. The same applies to the KC-135 and its crew force. By definition the KC-135 is "...a four engine, swept wing, long range, high altitude, high speed airplane that is primarily a tanker but may also be used as a cargo carrier or troop transport."¹⁶ However, significant changes in the employment of this aircraft have evolved since this definition was authored by Boeing in the 1950s.

Tankers had traditionally been linked to the Single Integrated Operational Plan (SIOP) and mated with the bomber force. Although they are still responsible for this mission, they no longer perform alert duty on a 24-hour basis

¹⁶ Flight Manual USAF Series KC-135R Aircraft, T.O. 1C-135(K)R-1, 1 May 1984, p 1-3, Change 18.

in response to the SIOP. This fact led to the misconception that the tanker community was in need of a mission. Nothing could be further from the truth.

One example that illustrates this misconception would be the situation faced by the 19th Air Refueling Wing (19 ARW), Robins Air Force Base, Georgia, immediately after the stand-down from SIOP alert. A number of their SIOP sorties had been "dual tasked" against other "national missions." In succinct terms, in 1993, the 19th ARW had more crews still in "alert" status than they would have had following the previous fiscal year's SIOP revision which was never implemented due to the end of the cold war.

Complicating this commitment is the tanker weapon system crew ratio of 1.27.¹⁷ When required to operate under old MAC alerting and utilization rules, AMC tanker units could not comply with these regulations and meet mission taskings because the crew ratio was insufficient to do so. Consequently, new exceptions specifically addressing KC-135 crews had to be implemented and published in AMC regulations. Even with this relief, the resulting operations tempo is producing declines in maintenance and crew morale, training time, retention, and quality issues throughout the tanker community.

With the demise of the SIOP alert, the race was on to find a meaningful way to insert the tanker community into the revenue producing world of airlift. Lost in this race was the fact that the tanker has a valuable role to play outside the airlift world which was overlooked by some in AMC. In old MAC, air refueling was not a requirement for its wartime mission. In fact, MAC considered air refueling such an insignificant event in its business, it only had a goal to qualify 50 per cent of their aircraft commanders in the tactic! During Operation Restore Hope, planners found that of those 50 per cent, only around 30 per cent

¹⁷Air Mobility Master Plan. HQ AMC, 1993, atch 5.

were actually current in this tactic at any given time. This complicated the scheduling of non-stop missions to Mogadishu, Somalia to the point that two staging bases were set up on the east coast of the US -- one for direct missions and one for staged missions to Cairo West, Egypt. This state of readiness was not lost on General Fogleman, AMC Commander. He immediately took steps to set a new goal for AMC pilots flying air refuelable (receptacle equipped) aircraft at 100 per cent.

Lessons learned sometimes seem to be lost in those aircraft which play "minor" roles in successful operations. Operation Eldorado Canyon is one significant event that is replete with errors in the employment of tankers. Criticism was unfairly heaped on the tanker crews and staff during that operation. Criticism that should have been laid squarely on the shoulders of other communities, because those other communities made decisions they were either unqualified to make or failed to fully grasp the full employment considerations of the tanker weapon system. One case in point was the selection, by non-tanker planners, of the KC-10 to lead the strike cells. Bad choice. Not because the KC-10s or crews are not capable, but for the reason that KC-10s are seldom utilized in large air refueling formations. The KC-10 then, and even more so today, is used primarily in the airlift/deployment role rather than a tactical role. This is a daily training issue, not a capability issue. A large formation for a KC-10 crew too often consists of 50 minutes refueling with another tanker on an overhead air refueling track with two or three crews of pilots jockeying for air refueling time on each aircraft. Today, the acceptance of this inadequacy in training time continues with little effort in curing this readiness issue -- a problem that is spreading. Where this was and is still a problem for the KC-10, the KC-135 is now getting the same dose of medicine as crews are denied the necessary quality training time to remain current and qualified in their

primary mission. This effects not only the tanker crews, but the receiver pilots as well, because the availability of tanker missions declines with every hour used doing the job commercial companies like Federal Express can and should do. Federal Express has not only proven it can do the job, but do it more efficiently and economically than AMC's KC-135s. By its own numbers, AMC documents a shortfall in air refueling requirements versus capability in its notional Defense Planning Guidance war fighting scenario through 2015.¹⁸ In this context alone, one can only question the wisdom of levying an additional "outside" missions against a weapon system that is always a major participant early in a wartime contingency.

¹⁸HQ AMC. Air Force Modernization Planning, Air Refueling Mission Area Plan, AMC/XPD, 15 Oct 93, p 8.

MISSED OPPORTUNITIES

***"A wise man learns from experience;
a wiser man learns from the experience of others."***

Confucius¹⁹

In the Air Force learning centers dedicated to imparting this knowledge upon its service members and others as well, the subject of tanker employment continues to be absent. At the Air Force's junior (Squadron Officer School), and mid-level (Air Command and Staff College) executive development courses, wargaming exercises continue to operate under the ubiquitous "assume unlimited tanker availability" parameters. But the real oxymoron approach comes at the senior officer level course (Air War College) where the following statement appears in its premier wargaming exercise called CAMPEX: "Air refueling,...assumed to be present in adequate supply. Our experience in testing CAMPEX with previous classes showed that the addition of these assets increased the complexity of the simulation without contributing to the outcome."²⁰ A surprising position considering air refueling is highlighted as one of the five technologies that worked best in the Gulf War.²¹

Even at the AMC-run United States Air Force Air Mobility School, as late as 1993, introduction to the tanker weapon system was allocated just two hours of instruction during the two week course with little, if any, application during the

¹⁹*Military Air Power, The CADRE Digest of Air Power Opinion and Thoughts*, Lt Col Charles M. Westenhoff, USAF, Air University Press, October 1990, p 11

²⁰Air War College, *Campaign Planning, CAMPEX 94*, Air University, Maxwell AFB, AL, p 5-1.

²¹Thomas A Keaney and Eliot A. Cohen. *Gulf War Air Power Survey Summary Report*, Air University, Maxwell AFB, AL, 1994, p 223.

course's air mobility exercise.²² Surprising again since over 80 per cent of those attending this course had never been exposed to the air refueling mission.

With these missed educational opportunities, it is not difficult to see why there appears to be a lack of knowledge regarding tanker employment. To mirror Stanley Baldwin's famous quote, "the bomber will always get through,"²³ the leadership of the USAF seems to prescribe to the theory that the "tanker will always be there." Given the cavalier attitude this same leadership has in regard to operating this resource as the core tanker beyond 2030, it is currently setting the stage for the proverbial "train wreck" in the future. An aircraft that has lived at the bottom of the priority list for so long is a catastrophic event waiting to happen. After all, this is the same aircraft the French Air Force sent to Operation Daguet (designation for US's Operation Desert Shield/Storm) with threat warning capability and the USAF had to execute an emergency modification program to install VHF radios.

²²USAF Air Mobility School Learning Guide, USAF AMS/DTC, December, 1992, p ii-v.

²³Military Air Power, The CADRE Digest of Air Power Opinion and Thoughts, Lt Col Charles M. Westenhoff, USAF, Air University Press, October 1990, p 51. Stanley Baldwin was Prime Minister of Great Britain from 1923-31 and 1935-37.

CONSEQUENCES

"We know from even the most casual study of military history how fallible man is in matters concerning war and how difficult it has been for him, mostly because of the discontinuity of wars, to adjust to new weapons. Yet compared to the changes we consider now, those of the past, when measured from one war to the next, were almost trivial. And almost always in the past there was time even after hostilities began for the significance of technological changes to be learned and appreciated."

Bernard Brodie²⁴

Continued tasking of the KC-135 in an airlift role will reduce the projected service life of the core tanker. It is important to note that while the KC-135 is projected to be used as a channel low volume - high priority cargo carrier in peacetime, it is not to be dedicated to wartime airlift and is consequently not included in computing wartime airlift requirements.²⁵ As the member of a command that boasted of doing its wartime mission everyday, the tanker community is left wondering where AMC is taking them.

Previous to the new airlift mission stresses, the KC-135 was projected to be in service until 2030. And if that isn't incredible enough, based upon calculations using a predicted service life of 43,200 hours (structural data only), the Stratotanker has 100 additional years of service life left -- good until 2193.²⁶ In reality however, acquisition for a new core tanker is to begin with studies projected to start sometime around the year 2000.²⁷ The Air Mobility Command

²⁴*Military Air Power, The CADRE Digest of Air Power Opinion and Thoughts*, Lt Col Charles M. Westenhoff, USAF, Air University Press, October 1990, p 90.

²⁵*Air Mobility Master Plan*. HQ AMC, 1993, p 4-20.

²⁶*Ibid*, p 4-23.

²⁷*Ibid*, p 4-23.

Master Plan allows for 17 years from Mile Stone Zero (MS 0) to Initial Operational Capability (IOC) for Full Military Development and Acquisition scenario for a new tanker.²⁸ If concept exploration were to begin in 2000, then the earliest AMC forces could expect to see a new tanker on the ramp would be around the year 2018. This means today's KC-135 will be required to remain in service until the aircraft is 65 years old -- minimum!

Anyone who could possibly debate the need to replace a 65 year old aircraft, needs to think in terms of today's Air Force having sent the Wright brothers' original Kitty Hawk flyer to the bone yard on the same day, astronaut's Borman, Lovell and Anders became the first humans to orbit the moon on Apollo 8! Even with consideration for this revelation, there are storm clouds on the course towards a replacement program for a new core tanker.

²⁸Ibid, p 4-7.

ACQUISITION BOW WAVE

Why can't they just buy one airplane and take turns flying it?

Calvin Coolidge²⁹

The first thunder cloud on the horizon is the "acquisition bow wave." This obstacle can be seen developing today as the services experience the "build down" in defense. There are very few major force programs that are not being delayed for funding or in some other management crisis. Two cases in particular are the C-17 and the F-22.³⁰

The C-17 acquisition, the aircraft projected as AMC's core airlifter to replace the C-141 fleet is in dire straights. Many experts offer the opinion that the US can no longer afford to subsidize the sick and wounded in its defense industrial base. The McDonnell Douglas C-17 program is being run by a defense contractor who the Department of Defense has failed to require it maintain the most rudimentary quality improvements that other contractors (foreign as well as domestic) have been forced to develop in order to successfully compete in the commercial marketplace. For instance, McDonnell Douglas Chief John F. McDonnell finally bowed to Pentagon demands on the C-17 program, and dropped roughly \$1.7 billion in claims and agreed to sweeping management changes on January 6, 1994. This settlement, requiring Congressional approval, orders the company to install a host of new

²⁹*Military Air Power, The CADRE Digest of Air Power Opinion and Thoughts*, Lt Col Charles M. Westenhoff, USAF, Air University Press, October 1990, p 23.

³⁰*Air Power Journal, A New Defense Industrial Strategy*, USAF, Vol. VII, No. 3, Fall 1993, p 16-33.

management tools, including computer-aided design and manufacturing systems. Unfortunately, the government will relax several performance specifications for the C-17 as an incentive for this contractor to improve its manufacturing performance and the flight test program will be extended from 80 to 152 "aircraft months."³¹ As the C-17 slips further in the acquisition process with increased costs, it puts additional pressure on the bow wave developing in the KC-135 replacement window, and also converges on the end of the C-141 service life (retirements began in 1993 and end in 2015 (extended from an original date of 2005)).³² This situation will only make matters worse for supported CINCs as General Hoar, USCINCENT fears. Additionally, costs continue to escalate as delays trigger unexpected outlays like ones the Air Force awarded to McDonnell Douglas. This was a \$63 million face-value increase to a fixed-price incentive firm contract for continuation of long-lead funding for Lot VI C-17 aircraft.³³

Fighting for funding during the same time frame, adding to the financial bow wave effect, will be the F-22. The F-22 program has slipped (again) into the next century. Funding issues impact this important program in several ways. Although Congress fully authorized the \$2.2 billion request for development, it trimmed the appropriation by \$163 million, thus causing the program to be rephased. A consequence of this move required the Air Force to award Pratt & Whitney a \$15 million face-value increase to a cost plus award fee contract for the F-22 program due to this extension of the total program until March 2001.³⁴ Even with this extension, the Air Force now plans to reduce the overall buy of

³¹*Aviation Week and Space Technology*, Vol. 140, No. 2, McGraw-Hill, January 10, 1994, p 21.

³²*Air Mobility Command Master Plan*. HQ AMC, 1993, p 4-10.

³³*Air Force Magazine*, Vol. 77, No. 1, The Air Force Association, January 1994, p 20.

³⁴*Aviation Week and Space Technology*, Vol. 140, No. 2, McGraw-Hill, January 10, 1994, p 20.

F-22s from 648 to 442 aircraft. Total program costs are now estimated at \$71.6 billion in 1994 dollars. Each F-22 will now cost \$99 million as a flyaway cost, but unit cost will be \$162 million when research and development, military construction, and total production costs are factored in.³⁵

This is not a question of whether the US can afford the F-22. If the US is to maintain its technological edge with superior combat aircraft, the F-22 is a necessity. As briefed by British Aerospace Military Aircraft executives to the USAF Air War College European Defense Studies Group in February 1994, analyses showed the relative engagement success rates of current and developmental aircraft against the Soviet Su-35. The F-15C when engaged head-to-head with the Su-35 only attained a 20 per cent success rate, whereas the EuroFighter 2000 attained an 80 per cent success rate. Other aircraft on the S-graph included the F/A-18 Plus at 15 per cent, the French Rafael at 55 per cent, and the F-22 at 95 per cent plus, with its stealth qualities accounting for the plus factor. Based upon this data, with the EuroFighter 2000 slated for initial operational capability (IOC) in 2002, the US will find itself in the unenviable position of second-class status in the fighter aircraft arena until the F-22 reaches IOC. But as expressed in the figures earlier, one might consider the EuroFighter 2000 as the only **affordable** answer for the export market to counter the threat posed by the Su-35. It could very well be that the US has developed another "silver bullet" only it can afford. Without a foreign military sales market to help share the overall costs, it will be a very expensive bullet indeed.

³⁵*Air Force Magazine*, Vol. 77, No. 4, The Air Force Association, April 1994, p 18.

TECHNOLOGY WINDOW

***"An educated guess is just as accurate
and far faster than compiled errors."***

George Patton³⁶

Because the KC-135 was derived from Boeing's Model 367-80, the prototype for the tanker and the progenitor of the Boeing 707, many mistakenly feel the replacement for the -135 can be done in minimum time in the same manner — use an existing airliner with modifications (like the KC-10). This is a road fraught with pitfalls that need to be addressed before real options evaporate.

Today's newest commercial airliners reflect the prerequisites outlined by the commercial carriers. There aren't many commercial air refueling companies beating down the door at Boeing for the latest in tanker technology. Today's airliners are built for economy and not for the rigors of combat situations. They capitalize on the **fewest engines** possible, a **super critical wing**, and **contracted maintenance** when and wherever possible. These commercial factors are important disconnects when looking at military options for a new tanker.

On the subject of **two engines versus three or four**, the US Air Force need not spend a dime on researching this question. The French Air Force has already done it. When looking to expand its air refueling fleet, the French Air Force was under extreme pressure to buy an Airbus platform. They have

³⁶*Military Air Power, The CADRE Digest of Air Power Opinion and Thoughts*, Lt Col Charles M. Westenhoff, USAF, Air University Press, October 1990, pg 108.

instead curiously pursued buying or leasing used US Air Force KC-135s previously slated to be placed in the bone yard. Several factors led to this approach, but the most important issue was the number of engines available on the aircraft of choice. The French are also upgrading their entire fleet with air refueling wing pods which make it possible to air refuel both probe and drogue, and receptacle equipped aircraft on the same flight.³⁷ (A capability the USAF has decided to forgo.) In the fog and friction of war, a single engine (one engine shut down) Airbus (or B-757/767), leads to mission degradation of unacceptable parameters. Whereas a KC-135R with one (or two engines for that matter) shut down still guarantees a capability to continue the mission. In the US Air Force's case, it too seems unlikely to accept such a linchpin in the employment of an F-117, B-2 or other "special mission" aircraft.

The issue of the **super critical wing** is one of mission capability. In searching for the most economically sound platform for its operations the airlines have demanded a wing that meets their requirements. They maximize operations in two speed ranges -- cruise, and approach and landing. The military tanker aircraft has these two considerations also, but where the airlines "make money" in the cruise phase, the tanker mission "makes its money" in the air refueling envelope. This envelope ranges from 180 knots indicated airspeed (KIAS) to 355 KIAS and at altitudes from 500 feet above ground level to over 30,000 feet.

³⁷Aviation Week and Space Technology, Vol. 139, No. 18, McGraw-Hill, November 1, 1993, p 31.

In the development of commercial airfoils, three major areas are considered:

- 1) economical high speed performance in cruise configuration,
- 2) airfield performance within acceptable limits, and
- 3) give structural engineers a "reasonable" task.³⁸

As the design engineers work toward the airfoil solution, they must masterfully compromise between all the conflicting qualities of seven main factors in selection of the wing planform and the performance of that planform. These factors include:

- 1) Area,
- 2) Aspect ratio,
- 3) Sweep,
- 4) Taper ratio,
- 5) Section,
- 6) Twist and Camber, and
- 7) Thickness/Cord Ratio.³⁹

In a civil transport, no one parameter can be allowed to become dominant at the expense of the other. In military aircraft however, parameters dominate based upon the mission. In the case of the tanker, a wide speed range in the air refueling envelope takes precedence in the final wing selection along with the requirement to maximize the efficiency of carrying large quantities of fuel. Fuel is most efficiently carried when it "flies" in the airfoil (wing) rather than "riding" as weight in the fuselage area of the aircraft. Commercial transports have diverged from this military requirement significantly in this area. (Note the absence of the

³⁸D.P. Davies. Handling the Big Jets, 3rd Edition, Daniel Greenaway and Sons Ltd., 1979, p 83.

³⁹*ibid*, p 83.

Boeing 707 from the world's major air carriers today.) No better example of this principle can be seen in the way Boeing has decided to cure its range problems with the B-747-400.⁴⁰ By installing fuel cells in the vertical and horizontal stabilizers, the additional fuel will "fly" instead of "ride," thereby limiting the economic impacts of carrying the additional fuel weight. This difference in commercial and military requirements underscores the probability that a new tanker will most likely be a Full Military Development and Acquisition (17-years to IOC) Milestone scenario versus the Commercial Buy Options (13- and 9-years to IOC).⁴¹

In the past, one of the attractive items in acquiring modified commercial aircraft for the military has been to utilize **commercial maintenance** rather than building a like military support structure. The KC-10 is a graphic example of such a system buy. Where this approach fails the military, is the requirement to submit itself to the time tables of the commercial sector. As delineated in the Air Mobility Master Plan, the replacement studies for the KC-10 are projected to begin in the same year as the KC-135, even though the last KC-10 was delivered to the Air Force on April 4, 1990.⁴² This is because the KC-10, linked to the commercial infrastructure of the DC-10, sees that infrastructure phasing out in 2010 when DC-10s are programmed to go out of service in the commercial arena.⁴³ The benefits of not having this linkage is clear when the KC-135's "blue suit" maintenance, systems and spares support capability is viewed over a 40-year service life.

⁴⁰*Aviation Week and Space Technology*, McGraw-Hill, October 4, 1993, p 17.

⁴¹*Air Mobility Master Plan*, HQ AMC, 15 Oct 93, p 4-7.

⁴²*Air Force Magazine*, Up From Kitty Hawk, Air Force Association, December 1993, p 37.

⁴³*Air Mobility Master Plan*, HQ AMC, 15 Oct 93, p 4-25.

CONCLUSION

"A nation may have every other element of air power but still lag behind if its government has no real urge to insure its future development. The attitude and actions of government will fully determine the size of our military establishment, and greatly affect the efficiency of our civil air establishment, our aeronautical industry and facilities - hence our air power in being."

John C. Cooper⁴⁴

History has chronicled the demise of many a species as it lapses into endangered status. This road to ruin is often told after the fact, when it becomes apparent that things went wrong, and there was little responsible parties could do but watch. It was too late. Often times it is a situation that need not have developed, but for a little forethought and attention given to the matter at hand.

This is a similar story. A story outlining the twilight of a national resource, in fact, a world resource. It is an example of misplaced priorities complicating accomplishment of an important mission. Put in the context of today's shrinking defense budgets, and the demands over and above the programmed uses of defense resources, this misuse, neglect, and lack of realistic future vision could result in failure of US military forces in the accomplishment of its new strategy -- Global Power, Global Reach.

⁴⁴Military Air Power, The CADRE Digest of Air Power Opinion and Thoughts, Lt Col Charles M. Westenhoff, USAF, Air University Press, October 1990, p 27. John C. Cooper was a USN Commander in W.W.I; aviation scholar and activist; Author of The Right to Fly (1948) and The Fundamentals of Air Power (1948).

There appears to be an absence of advocacy in the future maintenance of this resource and the unique capabilities it brings to US and allied military forces. As this author has been told over and over again in the course of instruction at the Air War College -- "It's about choices, hard choices." If the Air Force mission is "to defend the United States through control and exploitation of air and space," and attain its vision of "...building the world's most respected air and space force..." then the right advocate(s) need to be coming forward now. As the Chief of Staff of the Air Force has said, "There are no easy answers, but at least we should have the presence of mind to ask the right questions, debate the right issues and do what's right for America."⁴⁵

⁴⁵General Merrill A. McPeak. Americans could do with a better understanding of our military presence, *Houston Chronicle*, April 10, 1994, p 4E.

BIBLIOGRAPHY

- Air Force Magazine*, Purchases, Arlington, VA, The Air Force Association, Vol. 77, No. 1, January 1994.
- Air Force Magazine*, USAF Reduces F-22 Buy, Arlington, VA, The Air Force Association, Vol. 77, No. 4, April 1994.
- Air Force Modernization Planning, Scott AFB IL, AMC/XPD, 15 Oct 93.
- Air Mobility Command Flight Plan, Scott AFB IL, US Government Printing Office, 1993.
- Air Mobility Master Plan, Scott AFB IL, HQ AMC, 1993.
- Air Power Journal*, A New Defense Industrial Strategy, USAF, Vol. VII. No. 3, Fall 1993.
- Alic, John A., Branscomb, Lewis M., Brooks, Harvey, Carter, Ashton B., Epstein, Gerald L. Beyond Spinoff, Boston, MA, Harvard Business School Press, 1992.
- Aviation Week and Space Technology*, Air Force Gets A310s, New York, McGraw-Hill, Vol. 139, No. 22, November 29, 1993.
- Aviation Week and Space Technology*, McDonnell Caves, New York, McGraw-Hill, Vol. 140, No. 2, January 10, 1994.
- Aviation Week and Space Technology*, Probe and Parry, New York, McGraw-Hill, July 26, 1993.
- Aviation Week and Space Technology*, Shoring Up "Bottom-Up", New York, McGraw-Hill, October 4, 1993.
- Aviation Week and Space Technology*, 747-400 Range Increase, New York, McGraw-Hill, October 4, 1993.
- Butler, General George Lee, USAF, Address to the Strategic Air Command Squadron Commander's Conference, Offutt AFB NE, Fall 1991.
- Bemowski, Karen, Quality in Flight. *Quality Progress Magazine*, Vol. 25, No. 7, July 1992.
- Cannan, James W., A Model for Mobility, Arlington, VA, The Air Force Association, *Air Force Magazine* Vol. 76, No. 9, September 1993.

Campaign Planning, CAMPEX 94, Maxwell AFB AL, Air University, 1994.

Davies, David P., Handling the Big Jets. 3rd ed. England: Daniel Greenaway and Sons Ltd., 1979.

Dorr, Robert F., Boeing KC-135 Stratotanker. Runnymede, England. Ian Allan Ltd., 1987.

Flight Manual USAF Series KC-135R Aircraft, T.O. 1C-135(K)R-1, Change 18, Secretary of the Air Force, 1 May 1984.

Hadley, Arthur T., The Straw Giant. New York. Random House, Inc., 1987.

Hoar, General Joseph P., USMC, Eyes On The World's Likeliest Flashpoint, Alexandria VA, American Forces Information Service, *Defense* 93, Issue 3/4, 1993.

Hughes, David, Airbus' New Twins Surprisingly Similar, New York, McGraw-Hill, *Aviation Week and Space Technology*, October 4, 1993.

Keaney, Thomas A. and Cohen, Eliot A., Gulf War Air Power Survey Summary Report, Maxwell AFB AL, University Press, 1994.

Laming, Tim, Flying Tankers, London, Osprey Publishing Limited, 1989.

McCabe, Major Thomas R., USAFR, The Limits of Deep Attack, *Air Power Journal*, , USAF, Vol. VII. No. 3, Fall 1993.

McPeak, General Merrill A., Americans could do with a better understanding of our military presence, Houston, TX, *Houston Chronical*, April 10, 1994.

Morocco, John D., Easing C-17 Specs No Threat To AMC, New York, McGraw-Hill, *Aviation Week and Space Technology*, January 3, 1994.

Parmentier, Lt Col Gerald, French Air Force, Interview on lease/purchase options for the build-up of French Air Force tanker aircraft, February 1994.

Rhodes, Jeffrey P., Up From Kitty Hawk, Arlington, VA, The Air Force Association, *Air Force Magazine*, Vol. 76, No. 12, December 1993.

Stephens, Richard H. and White, Eston T., *Science and Technology*, Washington D.C., National Security Management Series, National Defense University, 1983.

Strategic Vision for the Armed Forces of the United States in the 21st Century,
JCS J5 Draft Working Paper, Distributed by Colonel Joseph L. Blank, Jr,
USAF, Chief, Strategy Division, 2 April 1993.

Tirpak, John, The Secret Squirrels, Arlington, VA, The Air Force Association, *Air Force Magazine*, Vol. 77, No. 4, April 1994.

USAF Air Mobility School Learning Guide, Scott AFB IL, AMS/DTC, December 1992.

Velocci, Jr., Anthony L., Perry Forges New Shape For Industry, New York, McGraw-Hill, *Aviation Week and Space Technology*, November 15, 1993.

Westenhoff, Lt Col Charles M. The CADRE Digest of Air Power Opinion and Thoughts. Maxwell AFB, AL. Air University Press, October 1990.

Woodward, Bob. The Commanders, New York, Simon & Schuster, 1991.