Defense Time Bomb

Background
F-22/JSF Case Study
Hypothetical Escape Option

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March 6, 1996

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an official position of the Department of Defense

The President and Congress are painting themselves into a corner by placing the defense budget off limits in their battle over budget priorities. Despite their differences, each side claims it can balance the budget in 2002 by cutting taxes, containing the growth of social spending, and increasing defense expenditures over the long term. In the 1980s, Ronald Reagan said increased defense spending was needed to counter a growing Soviet threat--an imperative, he asserted, that was independent of domestic politics or the need to balance the budget. Now that the Cold War is over, one would think defense reductions would have a major part in the budget balancing act. But this is not the case. Quite to the contrary, defense spending, like entitlements, is now poised to explode over the long term. The result will be ugly if the politicians continue to run away from the problem.

The mistaken belief that the politics of defense are different from those of social spending will have collateral damage that goes well beyond subverting the struggle to put government's fiscal house in order. It will also unleash a hungry horde of industrial interests that can survive only by consuming the money needed to maintain the fighting power of our military forces. Ultimately, the military's capacity to support foreign policy and the legitimacy of the government's moral claim to represent the needs of all the people could be sacrificed.

The recent struggle by Democrats as well as Republicans in Congress to resurrect the B-2 stealth bomber, a quintessential Cold War dinosaur, which ended in a five hundred million dollar handout to Northrop-Grumman, is a harbinger of worse things to come.

Let us take a look at the brave new world of post-Cold War "national security" decision making. What can we expect to see over the next eighteen to twenty years? As will be made clear in the following pages, we are setting the stage today for huge defense budgets in the future. The budget bomb will detonate when the weapons now in research and development go into production early in the next century, ironically, at about the same time the President and Congress have promised to produce a balanced budget. Even if there are no cost overruns, the size of our military forces could continue to shrink while the average age of our weapons increases rapidly over time. We could easily end up with a military that is not ready to cope with unexpected crises.

While no one can predict the details of future events, we can examine how the interplay of chance with necessity shapes and constrains the evolution of these events. Once these interactions are understood, it is possible to describe the general consequences of today's decisions with considerable confidence. My aim is to paint a portrait of the future by describing these interactions--first by summarizing the background of emerging pressures to increase defense spending, then by using a representative case study--that of tactical fighters in the Air Force--to translate this abstract background into a quantitative portrait of the defense time bomb. I will conclude by describing the nature and extent of the corrective action needed to prevent a debacle.

The Interplay of Pressures to Increase Defense Spending

On November 14, 1995, the day President Clinton and Speaker Gingrich shut down all "nonessential operations" of the US government for the first time, Richard S. Keevey, the Director of the Defense Finance and Accounting Service, told a congressional panel that financial managers in the Pentagon can not audit their books. On a scale of 1 to 10, Keevey rated the ability to track where defense dollars are spent as a sorry "3," according to a little noticed report in the *Washington Post.* Auditors from the General Accounting Office, the investigative arm of Congress, reinforced Keevey's assessment, saying that at least $20 billion of expenditures could not be matched to the items they purchased. The Defense Department's Inspector General agreed with both assessments, testifying that one should not expect a turnaround until the year 2000, even though she assigned 700 auditors to clean up the accounting mess. If the Pentagon cannot audit its own books, it is not accountable to or controlled by the people.

So, in terms of accountability, defense spending does not meet the minimum standard of acceptable performance for any public or private institution.

In January 1995, the President approved a plan to increase the procurement budget by 50% between Fiscal Years 1996 and 2000. But this was not enough to satiate the members of Congress, and last summer, substantial majorities in the House and Senate voted to add seven billion dollars to the current budget for programs the Pentagon did not ask for, like the B-2 bomber and missile defense systems. Moreover, on November 11, just three days before the budget crisis forced the federal government to shut down its operations, the *Washington Post* reported that the Chairman of the Joint Chiefs of Staff, General John Shalikashvili, poured gasoline on the fire by issuing a Program Assessment Memorandum calling for the 50% rise in procurement spending by 1998 instead of 2000.

A few weeks after Shalikashvili's memo, despite repeated threats to veto the seven billion dollar Congressional add-on, the President caved in and let the appropriations bill become law without his signature--in part to gain support for deploying an armored division to Bosnia. But while this deployment will drive up operating costs, the new appropriation increased procurement spending by ten percent and operations and maintenance (O&M) spending by only one-half of one percent. Readers should not be surprised if the President asks Congress for a supplemental appropriation to cover the "unanticipated" costs of operations in Bosnia.

Less than two months after caving into the Congress, the President raised the stakes another notch by adding even more money to the defense budget. On February 20, 1996, according to a report in the Associated Press, Pentagon spokesman Kenneth Bacon announced that new, lower-than-expected inflation projections created an unexpected $13 billion inflation "dividend" in the "outyears" of the defense budget plan. Rather than applying the savings to deficit reduction, Bacon said the President would use the money to buy additional weapons. But that was not enough for the Pentagon, and a few days later, according to the February 26 issue of *Aviation Week,* Admiral William Owens, the soon-to-retire Vice Chairman of the Joints Chiefs of Staff, said the $13 billion "will not fix the problem." By March 5, the *Washington Post* reported that the White House would allow the Pentagon to keep $30.5 billion of a $45 billion dividend.

Most of this money would be used to buy weapons in the last two years of the Fiscal Year 1997 to 2002 plan.

The "unexpected" add-ons at the end of the most recent budget cycle were by no means unique. Indeed, they are part of a recurring pattern. In the Fall of 1993, readers may recall, Secretary Aspin revealed the Pentagon needed an additional $50 billion to cover "unanticipated" increases in pay and inflation--and, after considerable internal debate between the Pentagon and the Office of Management and Budget, the President added $19 billion to the defense budget. One year later, on December 1, 1994, Mr. Clinton unexpectedly added another $25 billion to the Pentagon's six-year plan to counter growing Congressional criticisms about pay and readiness. Put bluntly, at the end of the each of the last three budget cycles, the bureaucrats in the Pentagon or the politicians in Congress blindsided the President of the United States with an unexpected call for more money--and the President responded dutifully by suddenly increasing the defense budget.

So, not only is the defense budget out of control from the perspective of accountability, these unexpected "add-ons" are evidence of uncontrolled political/bureaucratic pressures to *increase* defense spending over the long term.

After all, the Cold War just ended in a "victory" for the West. Are the increases in defense spending justified by any threat or combination of post-Cold War threats? Certainly not in terms of total spending levels. According to Lawrence Korb of the Brookings Institution, the United States already spends about 37% of the world's total defense expenditures Add in the contributions of our allies, and the non-threatening share rises to 67%. By contrast, Russia's share is about 11%, China's is about 1%, and the combined share of the rogue states is about 2%. To be sure, after removing the effects of inflation, the current defense budget is about 30 percent smaller than it was on average between 1982 and 1991. But this was the most expensive decade of the Cold War. Forces, moreover, have been cut back by even greater than 30 percent--for example, Air Force tactical fighter wings have been reduced by 50%, the Navy fleet by 37%, and the Army's active duty maneuver battalions by 44%.

Finally, given the overwhelming size of the US defense budget and the disproportionate reductions in the size of our forces, not to mention the accounting shambles and the pressures to increase defense spending, there can be only one reason why General Shalikashvili wants to accelerate the rate of budget growth. The *costs* of the new weapons entering the inventories are going through the roof.

Case Study

The defense cost explosion is the gasoline fueling the defense time bomb. The best way to demonstrate this problem is to use a concrete example to illustrate the connection between the cost explosion and the budget bomb. In no area is this link more evident than in the Air Force's

plan to spend $86 billion (in constant Fiscal Year 1996 dollars) between 1996 and 2013 to buy 982 F-22 and Joint Aircraft Strike Technology (JSF) fighter aircraft.

Figure 1 portrays the number of fighters purchased each year between 1953 and 1995 as well as those the Air Force hopes to buy between 1996 and 2013. Figure 2 attaches inflation-adjusted dollars to the quantities in Figure 1. The bars, measured on the left scale in billions of dollars, depict the total expenditures for the airplanes bought each year, while the black line, measured on the right scale in millions of dollars, portrays the average cost of each airplane in the annual market basket. Note how the line rises inexorably between 1953 and 1995, while the bars fluctuate up and down during the same period. This contrast means the average cost per aircraft grew *faster* than total expenditures during the entire Cold War. The following discussion will show why this asymmetrical relationship can not be sustained over the long term.

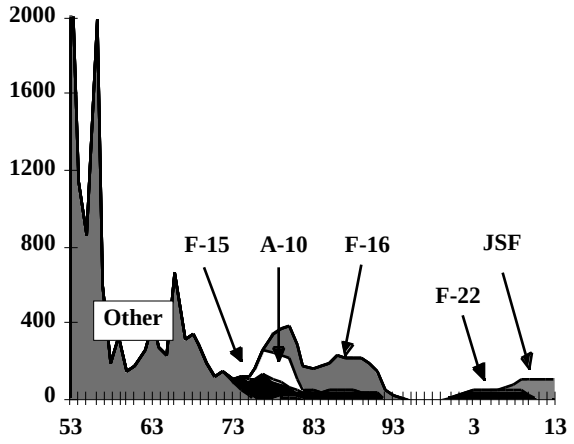

Figure 1: Airplane Procured Per Year

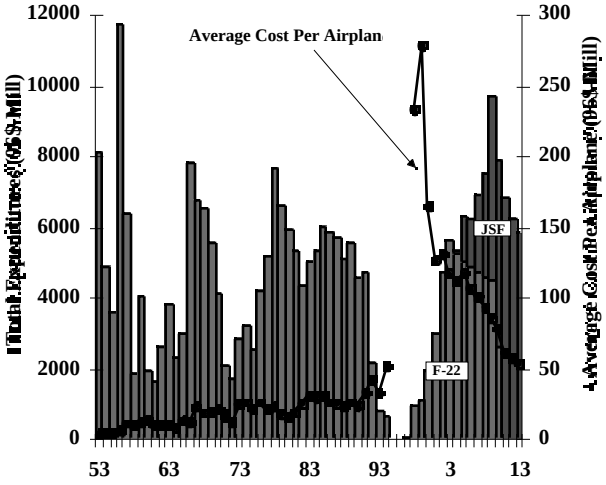

Figure 2: Budgets and Costs

The compounding effects of this relationship are so important that I have summarized six decades of history in Table 1. If we compare the second decade of the Cold War (1963 to 1972) to its first decade (1953 to 1962), Table 1 shows that expenditures (or budgets) decreased by 7%, but the average cost per airplane increased by 140%. Consequently, cost growth exceeded budget growth by 147%. The bottom row of Table 1 shows cost growth exceeded expenditure growth in each succeeding decade of the Cold War. The compounding effect of this relationship is astounding when one compares the first decade to the last decade of the Cold War (i.e., 1953-1962 to 1983-1992). Total expenditures increased by 7% from $47 billion to $50.3 billion, while the average cost per airplane increased by 359% from $6.1 million per copy to $28 million per copy. In other words, over the long term, cost growth exceeded budget growth by multiple of fifty one to one (359% divided by 7% equals 51).

Table 1:
Economics (Adjusted for Inflation)

		Cold War			Post Cold War Plans	
Air Force Fighter Procurement	1953-62	1963-72	1973-82	1983-92	1993-02	2003-12
Total Expenditures (Billions--FY96$)	$47.0	$43.9	$48.1	$50.3	$13.3	$68.6
Expenditures--% Change		*-7%*	*+10%*	*+5%*	*-74%*	+416%
Average Cost/Plane (Millions--FY96$)	$6.1	$14.7	$20.5	$28	$115	$86.7
Cost/Plane--% Change		*+140%*	*+40%*	*+36%*	*+309%*	*-25%*
Cost Growth Minus Expenditure Growth (%)		***+147%***	***+30%***	***+31%***	***+383%***	***-441%***
		% chg. relative to preceding decade				

Now, let's look at the plan for the future. The predictions for 1996 to 2013 are premised on a future cost-budget scenario that is stunningly different from this forty-two year history. Go back to Figure 2. The plunging black line beginning in 1998 means that the marginal cost per aircraft is predicted to decline precipitously over the long term. Even so, the average cost of the new airplanes will be the highest in history. For example, Table 1 shows that average cost per aircraft will increase by 309% when the ten years between 1993 and 2002 are compared to the previous decade.

If marginal costs decline as fast and as far as predicted, Table 1 shows that the total expenditures in the second decade of the post-Cold War era (2003 to 2012) would be $68.6 billion, or 36% *more* than the $50.3 billion spent during the most expensive decade of the Cold War (i.e., 1983-1992). Nevertheless, Table 2 (below) shows the plan would buy 56% *fewer* airplanes (792 versus 1800), because the new fighters would still cost 210% more on average than they cost between 1983 and 1992. (Go back to Table 1. Between 2003 and 2012, it shows the average cost per plane is predicted to be $86.7 million or 210% more than the average of $28 million per copy experienced between 1983-1992.)

Table 2:
Production and Modernization

		Cold War Reality			Post-Cold War Plans	
	1953-62	1963-72	1973-82	1983-92	1993-02	2003-12
Production of New Aircraft						
# of Aircraft Purchased (10-Year Total)	7688	2994	2347	1800	116	792
% Change (Relative to Preceding Decade)		*-61%*	*-22%*	*-23%*	*-94%*	*+583%*
Modernization						
% of Inventory Replaced Each Year (Avg.)	11.7%	6.7%	6.3%	4.2%	0.5%	3.6%
Time to Turnover All A/C in Inventory	*8.6 yrs*	*15 yrs*	*15.9 yrs*	*23.5 yrs*	*216.4 yrs*	*28.1 yrs*

Some readers might think a 56% slash in production is acceptable, given the need to modernize the smaller forces of the post-cold war era. In fact, this production plan will produce a much smaller and older Air Force. The first two rows in Table 2 show that the total production of new airplanes declined significantly in each successive decade of the Cold War. If one compares the first decade (1952-1962) to the last decade (1983-1992), production declined from 7688 to 1800 new airplanes, or by 77%, even though, according to Table 1, inflation-adjusted

expenditures increased from $47 to $50.3 billion. The second two rows of Table 2 show that the percent of the inventory replaced by new aircraft each year declined, on average, over the entire period of the Cold War. Naturally, declining replacement rates imply mean longer inventory turnover times, as shown in the last row of Table 2.

Turning our attention to the predictions for the future, the first two rows of Table 2 show the purchases of new airplanes will collapse by 94% to 116 airplanes during the first decade of the post-Cold War period (1993 to 2002), before increasing to 793 airplanes during the second decade (2003-2012). So, in a best case scenario, a flawless execution of the F-22/JSF plan would replace only 0.5% of the inventory each year during the first decade of the post-Cold War era (1993-2002) and only 3.6% per year during the second decade
_-by far the lowest replacement rates and highest turnover times in Table 2.

Plummeting production and declining replacement rates naturally produce an evolution toward a smaller and older inventory of airplanes. Figure 3 shows this. The shaded area, measured on the left scale, portrays the number of fighter/interceptors and attack airplanes in the inventory. Note how the size of the inventory *decreased* over time. The rising black line, measured on the right scale, shows how the average age of the fighter/attack airplanes making up that inventory *increased* over time. The Air Force hopes it can stop further shrinkage of its inventory by permitting the average age of its fighters to skyrocket from 9.6 years in 1996 to an all-time high of 19.2 years in 2006, where it would level off until 2013.

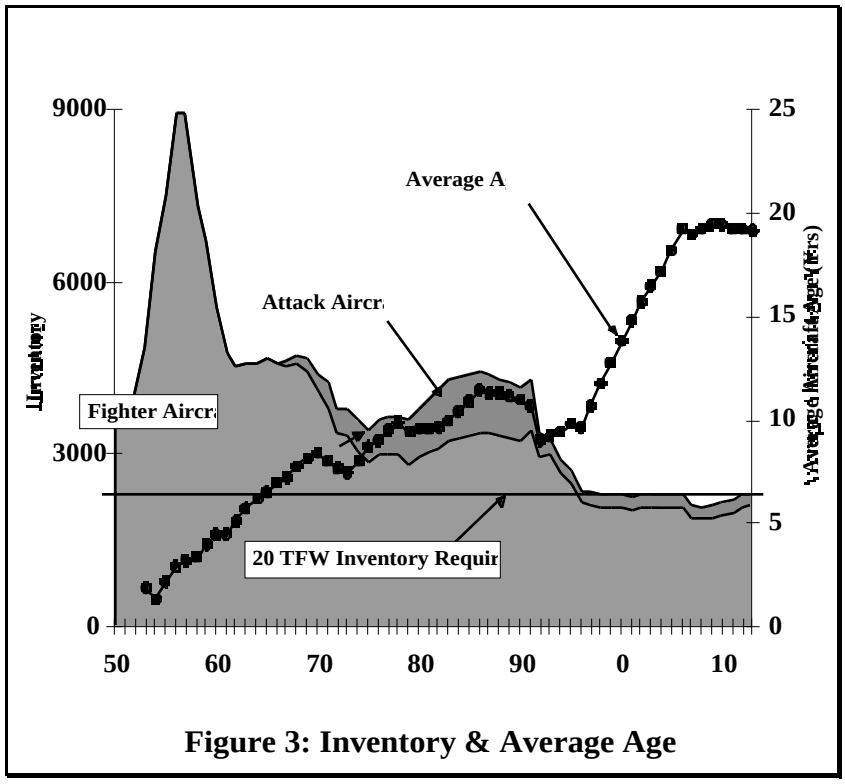

Figure 3: Inventory & Average Age

Bear in mind, Figure 3 portrays the consequences of the best-case scenario--a quick ramp up to greater-than-cold-war budgets coupled to plummeting unit costs and no cost overruns. In the real world, where budget cutbacks and cost overruns are the norm, the actual evolution will, no doubt, be much worse than implied by these predictions. But even in a dream world of perfect outcomes, an average age of 19.2 years implies a policy decision to retire fighters at 40 to 42 years, once the need to replace crashed airplanes is accounted for. This would be, by far, the most extreme retirement policy since the dawn of fighter aviation in 1914.

No one really knows how much it will cost or how difficult it will be to operate and maintain our fighter forces in a high state of combat readiness, when its airplanes are as old as those portrayed in Figure 3. Most of these airplanes are high-G, maneuvering fighters, equipped with high-temperature, high-pressure engines, and complex electronic control technologies. Structural fatigue, particularly in the case of composite materials, becomes ever-more uncertain when aircraft are extended to, or beyond, the limits of their design lives. The high powered aircraft designs and computerized fuel controls permit more frequent throttle fluctuations over a wider range of temperatures during combat maneuvering than was possible with earlier engines. Consequently, more frequent thermal fluctuations over more extreme temperature ranges, coupled with higher operating pressures, will increase material fatigue and raise the cost of operating and maintaining the engines in unpredictable ways over the long term. Finally, replacing and repairing avionics will become ever-more expensive and unpredictable as rapidly changing civilian electronics technologies diverge farther from relatively stagnant military technologies. One thing is sure, however--given the complexity of modern fighter aircraft, the care and feeding of this force will be much more difficult than operating and maintaining a fleet of several thousand equivalently-aged Chevrolets.

Although no one can predict the details of future events, these plans are setting the stage for an unfolding welter of conflicting decision-making pressures that will almost certainly reduce the combat strength of the Air Force as it moves into the real world of the twenty-first century, for example,

1. Decision makers may have to shrink forces again, if the cost of operating the oldest airplanes becomes prohibitive.
2. Cost overruns and/or budget cutbacks might cause production stretch outs and force decision makers to lower replacement rates even further, thereby magnifying the rate of age growth and increasing the pressure to cut back force size.
3. Planners may have to cut back training rates to contain the growth of operating costs, which is a consequence of the increasing age of equipment and of assigning a smaller number of older aircraft to combat units and bases.
4. Retention rates for skilled maintenance personnel could decline, if higher workloads and morale-busting workarounds are needed to support aging, depot-intensive, hi-tech equipment.
5. Morale problems could increase and training opportunities might decrease, if a shortage of aviation squadrons makes it necessary to increase the proportion of forward-deployed units in support of foreign policy commitments.
6. Planners or politicians might reduce readiness even further by robbing the operations and maintenance budget to bail out the collapsing modernization program.

7. Politicians might cave in to the pork-barreling pressures of the defense industry and adjust the National Strategy to conform with the reality of a shrinking force structure made inevitable by out-of-control costs in the procurement program.
8. And if past is prologue, technologists and defense intellectuals will probably declare that further force reductions are not only necessary, but *desirable*, because the revolution in new technologies makes it possible to replace manned aircraft with a variety of un-manned, higher-cost, remote-controlled, surveillance and reconnaissance sensors, computerized command and control systems, and precision-guided weapons.

The plan for the F-22 and JSF is by no means an isolated example. Although the case of tactical fighter aviation in the Air Force is perhaps the sharpest example I could have picked, the age of equipment is increasing in all mission areas for the same reason: the cost per individual weapon (i.e., the cost of missiles, tanks, ships, artillery pieces, helicopters, trucks, etc.) is growing faster than the total expenditures (or budgets) for these weapons. Unless there is a major restructuring of the procurement wish list, the General's solution--which is to pour more money into the status quo--will have the same effect as the spendup in the 1980s: It will exacerbate the cost-budget asymmetry and do nothing to prevent an inevitable collapse.

The reason why this is so is grounded in the simple arithmetic of compound growth. When a political decision process rewards economic decisions to increase the costs of its individual "parts" (i.e., individual weapons) faster than it increases total expenditures for the "whole," (i.e., defense budgets), then the total number of "parts" purchased must decrease inexorably over time. Like a patient with cancer cells growing faster than the other cells in his body, the *inventory* of weapons is therefore doomed to extinction over the long term. That is why a 30 percent reduction from the all-time record spending spree of the 1980s caused a modernization collapse and age explosion of a much smaller force in the 1990s.

Hypothetical Recovery Strategy

It is reasonable to ask what level of production would be needed to prevent a debacle early in the next century. Let us return to the example of Air Force's tactical fighters and construct a hypothetical recovery plan. This plan may not be optimal, and some defense analysts will no doubt disagree with its mix of capabilities, but its construction will enable us to understand what is needed in the near term to effect a real correction over the long term.

Any viable recovery strategy must attack the root causes of the rapid age growth depicted in Figure 3. First, low production rates are the central cause of the looming age increases. Second, low production rates in the near term are the inevitable consequences of the F-22's high unit costs. If, for example, we adhere to the current plan and neglect the need to replace aircraft losses due to peacetime attrition, production rates between 1993 and 2002 are so low that Table 2 shows it would take 216 years to replace every aircraft in the inventory. Third, the advent of

JSF will do nothing to relieve the age pressure in the near term, because even if it entered the inventory on schedule, it would arrive after the age explosion is a *fait accompli*. Moreover, as Figure 3 shows, its production rates will be too low to make it a viable recovery option before 2013. If optimistic assumptions like plummeting unit costs, no cost overruns, and a rapid return to greater-than-cold-war budgets cannot combine to buy enough airplanes to prevent an age explosion of a much smaller inventory, there can be only one salutary pathway out of the trap: terminate the high-cost programs as soon as possible and start buying *lower-cost* airplanes.

We must make a few clarifying points. First, it is clear from Figure 1 that the immediate source of the modernization crisis is the eleven year gap in procurement between 1992 and 2002, during which almost no new aircraft enter the inventory. Consequently, the distribution of the ages of the individual aircraft making up the inventory will become progressively distorted over time, and a disproportionately large number of fighters will reach retirement age at the same time. Since we are already half way into this "hole," some age growth in the near term is now inevitable. The only way to reduce the aging pressures is to obtain a large number of "new" airplanes as fast as possible in the short term. The question is--how many?

Two criteria are needed to answer this question--an age goal and a size goal. First, I will argue that the Air Force should set a goal of *10 years* to be reached by 2002 for the average age of its inventory of fighter aircraft. While an average age of ten years would be very old by historical standards (see Figure 3), it is the same rule of thumb adopted by planners in the Air Force between the late 1970s and early 1990s. This rule of thumb was not pulled out of thin air. It was adopted by the Air Force after a long agonizing debate. Under this assumption, fighters would be retired at about twenty-two years of age, once the need to replace crashed aircraft is accounted for.

The second criterion is the size of the force. The Air Force is already straining to meet its overseas commitments with its current force of twenty tactical fighter wings. Another cut back in force size would probably require abandoning some of these commitments and changing the national strategy. Foreign policy and military strategy should *never* be held hostage by a deficient procurement program. The Air Force, therefore, should plan to retain its goal of twenty tactical fighter wings, which President Clinton's Bottom-Up Review identified as being needed to execute the national strategy.

Taken together, the distortion in the age distribution and these two planning criteria imply the Air Force needs to acquire 980 new or re-manufactured fighters between 1997 and 2002 and 1492 new fighters between 2003 and 2013. On the other hand, the current plan would buy only 80 F-22s during the first period and 902 F-22 and JSF aircraft during the second period.

The only lower-cost production options available in the near term are to re-manufacture existing airplanes and produce additional F-16s. It is possible for the Air Force to build a near-term modernization strategy around the idea of refurbishing some of the F-16s now in its active inventory, re-manufacturing and re-activating F-16s and A-10s now in flyable storage, and

buying 60 to 100 new F-16s per year. For illustrative purposes, I will assume the F-16 and A-10 re-manufacturing options would cost $11 and $5 million per copy respectively and new F-16s would cost $25 million per copy (all costs have the effects of inflation removed). Part of the total cost of buying or refurbishing 980 F-16s and A-10s between 1997 and 2002 would be paid for with some of the funds released by canceling the F-22.

The Air Force would also terminate its contribution to the JSF development program and use some of the near term research and development savings from the F-22 and JSF cancellations to begin two lower-cost, fast-paced, fly-before-you-buy, competitive prototype programs. Before describing these programs, let me explain why a *fly-before-you-buy* strategy is so important.

Competitive prototyping is a sequential, decision-making strategy for reducing technical and economic risks while preserving the decision maker's freedom of action. Its goal is to work the bugs out of a design *before* committing substantial resources to its factors of production (manufacturing engineering, specialized machine tools, unique factory facilities, a network of supplier relationships, and the hiring of production workers). Although prototypes are handmade by design engineers and skilled technicians using general purpose machine tools, production engineers should be deeply involved in a prototype's design to insure the ultimate product can be produced at a reasonable cost. Moreover, as more detailed information flows out of the design and testing activities, they should prepare for an orderly transition to efficient production by continuously refining their plans for factory layouts, machine tools, worker skills, subcontractors, etc. But under a competitive prototyping strategy, the decision to commit resources to production would be deferred until rigorous testing demonstrated which product best met the specifications. Prototyping also reduces risk by reducing up-front costs. This gives decision makers the flexibility to simultaneously explore multiple design options, even during periods of declining budgets. (During the post-Viet Nam contraction in the early 1970s, for example, the Air Force successfully designed and flight tested six new designs in three competitive prototype programs--the YF-16/17, YA-9/10, and YC-14/15 aircraft).

In contrast, the standard engineering and manufacturing development (EMD) strategy used by managers in the Defense Department makes large financial commitments to production of an airplane *while* it is being designed. This concurrent strategy purports to shorten development time, but it also reduces a decision maker's flexibility and magnifies technical and economic risks. The test program must use airplanes produced during the low rate initial production (LRIP) run of a working assembly line. In theory, if an airplane fails to meet its specifications during these tests, it would be either re-designed during production or terminated. In reality, the cost of fixing major design flaws on airplanes moving down an assembly line can escalate rapidly to prohibitive levels, particularly if assembly line tooling or factory layouts must be changed.

Nevertheless, cancellation is usually impossible, because the early commitment to low rate production permits the contractor to build a powerful political base by hiring a large number

of production workers and establishing a nation-wide network of subcontractors. A second deterrent to cancellation stems from the high up-front cost of the EMD strategy--it forces decision makers to put all their eggs in one basket, and in contrast to a competitive prototyping strategy, they can not afford to explore other options. So, when a new weapon fails to meet its performance specifications or cost goals, the economic and political pressures of the real world force decision makers to reduce specifications, accept large cost increases as being inevitable, stretch out production schedules, and cut back total production quantities. The routine practice of waiving specifications and goals is known among defense contractors as managing to a rubber baseline.

Competitive prototyping reduces the risk of being boxed in by rubber baselines. Risk reduction is particularly important when budgets are tight. To maximize risk reduction, each prototype should be as close to being a fully combat-capable replica of the eventual production item as possible. Let's see how we could use this idea of *fly-before-you-buy* to build two new airplanes which would be the central ingredients of a more realistic long-term modernization strategy.

The first program would produce at least four combat-capable, flying prototypes based on at least two competitive designs for an F-X, a new air-to-air fighter (with a secondary bombing capability) to replace the F-16C and F-15C. The F-X would have a production cost target no greater than the actual inflation-adjusted costs of the F-16A. The second prototype program would be similarly structured to produce at least two competitive designs for an A-X, a new air-to-ground attack aircraft to replace the A-10. The A-X would have a cost target no greater than the actual inflation-adjusted costs of the A-10. The aim of both programs would be to maintain a viable fighter/attack force over the long term by designing a modernization program that incorporates the best mix of effectiveness and affordability. This goal would be achieved by using a rigorous testing strategy to reduce technical risks and economic uncertainties and a vigorous competition among different contractors to drive down costs.

To achieve these objectives, the F-X and A-X prototype programs would be paradigms of the scientific method, modeled after the stunningly successful Lightweight Fighter program of the early 1970s. The F-X and A-X programs would culminate in a series of competitive flyoffs and shootoffs to determine which of the new designs would be most effective in combat and whether or not the capability improvements over existing weapons would be large enough to warrant its introduction into the force. The testing team of combat pilots and maintenance personnel would pick the winners of each competition.

Each airplane would be designed to operate as part of a truly integrated, air-ground, combined-arms team in expeditionary warfare against the likely threats in the post-cold war era. Each must be easy to deploy from the continental United States to overseas operating locations and would be able to operate for extended periods of time from relatively primitive forward locations. In contrast to the Pentagon's current practice of concurrent development and initial production, the information gleaned from the flyoff/shootoff tests of prototypes would enable

decision makers in the Pentagon to understand and reduce technical and economic uncertainties *before* they made any long term commitments. While a vigorous prototype competition would increase the business risk to the contractors, the simulation of capitalistic market forces would also stimulate their creativity, efficiency, and enthusiasm, as it clearly did during the Lightweight Fighter competition in the early 1970s.

Evaluation and Concluding Remarks

How would this hypothetical acquisition strategy compare with the F-22/JSF plan portrayed in Figures 1 through 3?

Procurement Quantities: Between 1997 and 2013, the alternative plan would purchase 2,472 re-manufactured and new fighter/attack airplanes, or 152% more than the 982 F-22 and JSF airplanes now planned.

Average Age: Under the alternative plan, the age of the inventory would increase to an all-time high of about 13 years in 1999 before declining to 10 years in 2002, where it would remain relatively constant until 2013. On the other hand, Figure 3 shows that the age of the inventory under the F-22/JSF plan would skyrocket to 19 years in 2006, where it would level off until 2013.

Average Unit Costs: The mix of re-manufactured F-16s and A-10s, new F-16s, F-Xs, and A-Xs would average about $18 million per copy between 1997 and 2013--a reduction of 33% from the average of $27 million per tactical fighter paid by the Air Force between 1982 and 1991, the last decade of the Cold War. This cost reduction would be more in line with the 30% reduction in total defense spending than the 226% increase to an average cost of $88 million for the mix of F-22 and JSF airplanes in the current plan.

Total Procurement Expenditures: The alternative plan to buy 2,472 re-manufactured or new airplanes would require a procurement budget of $44 billion, a reduction of 49% from the $86 billion needed to buy 982 F-22 and JSF airplanes.

Although total procurement expenditures would be reduced by 49% between 1997 and 2013, the alternative plan would require an increase of $7 billion over the F-22/JSF plan between 1997 and 2001. In other words, there is no easy way out of the trap. Even if when one assumes the Air Force could slash future unit costs by 80% (from $88 million to $18 million per airplane), the President would still have to add $7 billion to the Air Force procurement budget in the short term in order to stabilize the average age of its fighters at 10 years by 2002. That is the real consequence of the eleven year procurement "hole" in the current plan. No doubt, the real budget increase would be more than $7 billion, because the government would also have to pay substantial contract cancellation penalties to the contractors affected by the termination of the F-22 and JSF programs.

Capabilities: Defenders of the F-22/JSF status quo would no doubt assert that the United States can not afford to forgo the capability improvements provided by these aircraft.

For this assertion to stand, however, it is incumbent on them to provide the taxpayers and the pilots who will put their lives at risk with rational answers to the following questions: Why should cold-war budgets be needed when the cold-war threat to survival no longer exists? How can the Air Force provide an effective fighter force in the real world of budget uncertainties and cost overruns, if its own projections of cold-war budgets produce the meltdown shown in Figure 3? Given the virtual certainty of an age explosion, and the emerging welter of conflicting selection pressures with unknowable but certain reductions in combat power in the short term, why is this outcome a reasonable price to pay for theoretical increases in capability, which would become apparent only in the long term, if ever? In making the case for the F-22, the defenders of business as usual should also explain why this high-cost legacy of the NATO-Warsaw Pact scenario is needed now that the Warsaw Pact and the Soviet Union do not even exist? This explanation is particularly needed to counter the revelations that the CIA knowingly served as a conduit for KGB disinformation that may have inflated Soviet strengths in order to dupe U.S. decision makers into spending money on unneeded, high-cost weapons.

Finally, the defenders of the status quo ought to explain to the American people why defense contractors should not be made to compete like their counterparts in the private sector--particularly those in the electronics industry--and produce technology that increases performance while it *reduces* costs.

Naysayers might also argue that the mix of capabilities in the proposed recovery option is wrong, because it would trade off Air Force's capabilities to attack fixed targets deep in enemy territory for an increase in its capability to support the Army in combined-arms combat. Countering this critique is a matter of balancing several controversial considerations: First, it is important to remember that the Air Force overwhelmingly concentrated its most recent investments in aircraft designed to support or carry out attacks on deep targets--i.e., the B-1, B-2, F-15C, F-15E, the F-16C, and F-117. Consequently, after the turn of the century the oldest airplanes in the tactical inventory will be A-10s, which were procured between 1975 and 1982. I would argue, therefore, that the current plan is unbalanced and replacing the A-10 should be a high priority.

Second, judged by their plan, the Air Force does not intend to replace the A-10. After JSF, the next airplane on the long-range wish list is a so-called Replacement Interdiction Aircraft, a deep strike fighter-bomber which would be procured after 2013. In other words, the policy implications of the F-22/JSF plan are tantamount to a decision to abolish the close air support mission altogether, yet there has been no explicit debate over the wisdom of this choice.

Third, the effectiveness of deep bombing campaigns remains one of the most contentious issues in military affairs. It is well known that actual deep bombing campaigns did not achieve

their desired goals in World War II, Korea, or Viet Nam. Even in the Persian Gulf, the evidence of success is by no means clear. Indeed, an inferential case can be made that the strategic objectives were not achieved. The bombing campaign against Iraq had three well-defined objectives:

- Destroy the Republican Guards divisions (in conjunction with U.S. Army), which were Saddam's strategic reserve and the key to maintaining his political power. We now know that four and one half of seven Guards divisions escaped with about half of their equipment in a coordinated, if hasty, retreat.
- Decapitate the government from the army and the people. It now appears that Saddam retained communications connectivity to his forces in Kuwait as well as his people. Moreover, Saddam's decisive defeat of two widely separated rebellions immediately after the war suggests he still possessed a functioning command, control, and communications system after being bombed intensively for forty-three days.
- Destroy Iraq's weapons of mass destruction. Yet after the war, investigators assigned to the United Nations determined that large quantities of these weapons survived the bombing. While some argue that poor intelligence was the prime cause of this outcome, it is important to remember that poor intelligence is part of the unavoidable atmosphere (or Clausewitzian friction) of war. Since it will always be in the enemy's interest to hide his most valuable assets, any warfighting theory that is premised on an assumption of perfect information is doomed to be undermined by the inevitable friction of the real world.

On the other hand, while the bombing campaign did not achieve the level of strategic paralysis planners hoped for, it did have significant effects--particularly at the tactical and operational levels of war: It provided an effective umbrella which permitted our ground forces to operate freely throughout the Kuwait theater of operations. It degraded Iraq's ability to observe our forces and made it impossible for its heavy divisions to take offensive action. Finally, the bombing of Kuwait contributed to the unnerving of the Iraqi troops.

Fourth, even if one believes in the effectiveness of deep bombing, the primary justification for deep bombing capabilities, and the highly complex technologies needed to carry out this mission, was the set of targets deep in the well-defended air space of the Soviet Union. But with the collapse of the Soviet Union, it can be argued that the need for deep bombing in any conceivable war is now greatly diminished and current deep-strike assets--the F-15E, B-1, B-2, and F-117--are more than adequate to handle what is left.

Fifth, the overwhelming majority of deep targets are fixed targets at known locations. If one accepts the promises of our technologists, these targets are particularly appropriate for unmanned, long-range, stand-off, precision-guided weapons, like cruise missiles.

We will never know whether or not we can reduce the costs of new weapons until we try. The end of the Cold War provides a unique breathing space to break the cost spiral without

jeopardizing our national security. But there is one stumbling block to progress, and it goes to heart of the real defense crisis facing the Pentagon, Congress, and the American people. The F-22 may be *impossible* to stop, because its political engineers had the foresight to buy protection by spreading R&D subcontracts to 1,150 companies, employing 15,000 people in 43 states and Puerto Rico. The Air Force may have to eat the F-22 and watch helplessly as its forces disintegrate, because, according to the Secretary of the Air Force, as many as 160,000 jobs may be at risk, once the effects on local economies are accounted for. Out-of-control political selection pressures, like those evident in the porkfest on Capital Hill last summer, evolving within a real world of cost overruns and budget cutbacks, could easily wreck our military forces in order to prop up the contractors who created the problem, with the active assistance of the bureaucrats in the Pentagon and the threat inflators at the CIA.

Let us hope the tired old men of the KGB do not have the last laugh as they watch "budget-balancing" porkbarrelers and hide-bound bureaucrats in Washington cave in to the special interests and squander their moral authority by refusing to defuse a budget bomb of their own making.