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Form Approved
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1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 9 Apr 94	3. REPORT TYPE AND DATES COVERED FINAL	
4. TITLE AND SUBTITLE THE FUTURE OF THE DEFENSE INDUSTRIAL BASE IN AN ERA OF USAF DOWNSIZING			5. FUNDING NUMBERS	
6. AUTHOR(S) GREGORY W. LEWIS LT COL, USAF			8. PERFORMING ORGANIZATION REPORT NUMBER Unnumbered AWC research paper	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) AIR WAR COLLEGE 325 CHENNAULT CIRCLE MAXWELL AFB AL 36112-6427			10. SPONSORING / MONITORING AGENCY REPORT NUMBER N/A	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			10. SPONSORING / MONITORING AGENCY REPORT NUMBER N/A	
11. SUPPLEMENTARY NOTES PAPER IS WRITTEN TO FULFILL ACADEMIC RESEARCH REQUIREMENTS FOR AN IN-RESIDENCE SENIOR SERVICE PROFESSIONAL MILITARY SCHOOL.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)				
DTIC QUALITY INSPECTED 2				
94-19179 3070			94 6 22 106	
14. SUBJECT TERMS Future, Defense, Base, USAF, Downsizing			15. NUMBER OF PAGES 29	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLAS	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLAS	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLAS	20. LIMITATION OF ABSTRACT UL	

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THE FUTURE OF THE DEFENSE INDUSTRIAL BASE
IN AN ERA OF USAF DOWNSIZING

BY

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A RESEARCH REPORT SUBMITTED TO THE FACULTY
IN
FULFILLMENT OF THE CURRICULUM
REQUIREMENT

Advisor: Dr. David Blair
9 April 1994

INTRODUCTION

The September 1993 Bottom-Up Review: Forces For A New Era, conducted by former Secretary of Defense Les Aspin is the closest document yet published by the Clinton administration detailing a national military strategy for the United States of America. In the Bottom-Up Review (BUR), Mr. Aspin states the United States will maintain sufficient military forces to fight two "nearly simultaneous major regional contingencies". Additionally, he mandates 20 fighter wing equivalents as sufficient force to meet a two war scenario, thus requiring the United States Air Force (USAF) to continue downsizing by an additional six fighter wing equivalents from the current 26 fighter wings now possessed, and from the all time high of 37.25 in 1988.

Using the Korean, Viet Nam, and Gulf Wars as a baseline, each conflict required between 10.4 and 10.6 USAF fighter wing equivalents to prosecute the wars.¹ Assuming a two war scenario and using past historical requirements, the USAF appears to be one fighter wing short of having sufficient forces; however, this paper will not challenge Mr. Aspin's assumptions in arriving at 20 fighter wings for the USAF of the future. Nonetheless, it should be obvious that in a two war scenario, the USAF will have little if any reserves left to feed into the fights if required.²

Suppose in a future two war scenario, victory does not come as fast and "cheap" as it did in the recent Gulf War. What if instead of the 22 planes lost in Operation Desert Storm, 250 or more are shot down, more closely replicating our experiences in Korea and Viet Nam?³

1. Taken from a speech at the USAF War College on 1 December 1993 by Major General Richard C. Bethurem, Director of Plans, Deputy Chief of Staff, Plans and Operations, HQ USAF.

2. Reserves in this case means excess forces and not the Air Reserve Component (ARC) of the USAF consisting of the Air National Guard and the USAF Reserve. The ARC's seven fighter wing equivalents plus the 13 fighter wings in the active USAF make up the 20 wing total USAF. All ARC units are assumed committed in a two war scenario.

3. As Chief of Weapons and Tactics, 363 TFW (P), the author was a member of the "Black Hole" Desert Storm planning cell, HQ CENTAF,

With little or no reserves remaining, where will the USAF find replacement aircraft to continue fighting with 10 fighter wing equivalents? In the past, the United States' "fifth service", the industrial base, has risen to the occasion. This paper will examine the aircraft industrial base. What goes in to making military aircraft? How will the industrial base survive the downsizing of United States' military forces? Can it still surge to provide military aircraft in a future two war scenario as it has in the past? What will be its future role?

CURRENT ASSESSMENT OF THE INDUSTRIAL BASE⁴

The military aircraft sector of the defense industrial base consists of public and private facilities that design, develop, produce, and maintain both fixed-wing and rotary-wing aircraft for all the armed services. By far the largest sector of the defense industrial base, it contains over five hundred major contractors and a dozen depots operated by all three military departments. For purposes of this paper, only fixed wing airframe integration and its subtier contractors will be studied in detail. Detailed analysis of the remaining essential parts of the industry, crew station design, propulsion systems, and electronic systems plus rotary-wing production, depot operations, and the general aviation segment are beyond the scope of this paper.⁵

Riyadh, Saudi Arabia, during the pre-war period of Desert Shield. Two independent studies, one by the USAF and one by a civilian contractor, predicted losses in excess of 250 aircraft for the air campaign plan against Iraq. Thankfully, they were proved to be wrong!

4. Much of the below assessment was taken from telephonic interviews, private notes, and unpublished reports provided by a well known Washington DC defense expert who was under contract of the Bush administration as a consultant to study the industrial base. The American Defense Preparedness Association provided his name to me. Dr. "X", director of a prominent national security studies program, wished to remain anonymous for political reasons.

5. Several general aviation prime contractors produce Department of Defense (DoD) aircraft such as the C-12, C-20, C-27, C-29, T-1, T-3, and the future Joint Primary Aircraft Trainer System (JPATS).

The prime-contractor level of the military aircraft industry consists of broadly diversified aerospace companies with expertise in aeronautical research, design, development, testing, fabrication, assembly, systems integration, and technical support. As of September, 1993, fourteen prime contractors produce fixed and rotary-wing aircraft in the United States. Several additional major subcontractors are also capable of producing aircraft. The near-term outlook for this large and important industry is shaped by four key factors:

- 1) Shutdown in the 1990's of the long running production of the F-14, F-15, F-16, and AH-64 programs.
- 2) Significant budgetary and technical uncertainties for the C-17, F-22, V-22, and RAH-66.
- 3) Perceived lessened world threat. The need to procure new aircraft is reduced due to the attractive, less expensive alternatives of service life extension programs. This trend will generate considerable revenues for some contractors -- but not on a scale comparable to the production of new aircraft.
- 4) Reduced potential for foreign military sales due to the relaxation of east-west tensions and growing global competition in world arms markets. Further impediments to exports may arise from the sensitivities surrounding the transfer of technologies such as low observable "stealth" to foreign powers.

Clearly, these factors will cause a severe contraction of the military aircraft sector.

To better understand the prime contractor and key first-tier subcontractor population, all military fixed-wing aircraft programs are listed below. Note the list includes all aircraft in the current procurement budget from FY-94 thru FY-99 and all significant modification and research and development (R&D) programs excluding those perhaps being developed in the classified "Black World". Several programs should transition from R&D to production during this period.

Fixed-Wing Selected SystemsProduction Programs:

<u>USAF</u>			<u>NAVY</u>			
B-2	F-16C/D	JPATS	EA-6B	E-2	AV-8B	JPATS
F-15E	C-17	AC-130U	T-45	F/A-18C/D		KC-130T
F-22	C-130H/J		F/A-18E/F			

Modification Programs:

F-15	C-141		F-14	P-3
B-1B	B-52H		E-2	AV-8B/R

R&D Programs:

F-15E	F-22	B-2	F/A-18E/F
F-16	C-17		AV-8B/R

The next chart reflects DoD's planned budget in constant FY-94 dollars for fixed-wing production programs along with additional projected DoD work consisting of fixed and rotary aircraft modifications and R&D programs that sustain many capabilities.

Total Military Aircraft Production In FY-94 Constant Dollars⁶

(Billions \$)	FY-94	FY-95	Fy-96	FY-97	FY-98	FY-99
Combat Aircraft	3.217	3.328	3.376	6.182	6.075	6.345
Trainer & Transport	2.786	3.801	4.084	3.967	4.361	4.218
Modification	2.117	2.436	2.820	2.515	2.491	2.270
R&D	5.231	4.432	3.362	2.46	1.862	1.941

These figures do not reflect Clinton administration budget proposals currently before Congress for approval. President Clinton's budget forecasts a continuing decline in defense authority -- from \$263.4 billion in FY-94 to \$231.7 billion in constant 1994 dollars for FY-97, a 17% cut.⁷ In real terms, the budget has fallen 41% from the period of the mid-1980's to the mid-1990's along with a one third cut in force structure. If 41% of the total budget has been cut while only 33% of the force structure was cut, some other component of the budget has to be decreased disproportionately greater. Since the Clinton administration has pledged to maintain readiness which implies robust operations and maintenance accounts are a necessity, modernization or

6. Taken from the Bush Administration Defense Budget.

7. Spring, Baker. "Supporting the Force: The Industrial Base and Defense Conversion", ROA National Security Report, December 1993, pp 27-35.

research and development are the only components left to make up the shortfall. In President Clinton's proposed budget, a conscious decision to "live off" the weapons bought during the buildup of the 1980's has been made; thus, the modernization account takes a heavy hit -- approximately 60 to 65%.⁸ More words later on R&D. Accordingly, several aircraft such as the F-16C/D and F/A-18C/D are targeted for termination more quickly than the Bush administration had planned.⁹ The number of military aircraft to be procured in FY 95 is 127, including 42 trainers and 60 utility helicopters, down from 900 in FY 85.¹⁰ While substantial reductions in the combat aircraft line are likely, these may be partially offset by increases in the modification and R&D lines.¹¹ These figures provide a good illustration of the amounts of money in all parts of the aircraft production budget.

FIXED WING PRIME CONTRACTORS

Description

The fixed-wing aircraft industrial base is actively downsizing to maintain profitable operations with projected business. Reduced procurements have already caused companies to realign as subcontractors and/or joint venture team members on planned aircraft production and modification programs. These arrangements allow companies to focus limited R&D resources in essential areas and share

8. Perry, William. "U.S. Military Acquisition Policy", Comparative Strategy, volume 13, 1993, pp 19-24. Secretary Perry also points out that defense spending has fallen from 6% of Gross National Product (GNP) to the current 4%, and will continue to fall to 3% in the very near future.

9. "Navy May Cut F/A-18", St.Louis Dispatch, November 27, 1993.

10. Morrocco, John D. "Arms Modernization Key Long-Term Goal", Aviation Week and Space Technology, March 14, 1994, pp. 48.

11. As an example, the USMC has recently won approval from the Defense Acquisition Board to remanufacture 73 AV-8B Harrier II jets into a night attack, radar equipped, version. Old APG-65 radars, taken from F/A-18s as they are upgraded with APG-73 radars, will be modified and installed along with other equipment. "USMC Gets Go-Ahead for AV-8B Rebuild", Janes Defense Weekly, 2 April 1994.

program financial risks among partners. As an example, Boeing has expertise in the design and manufacture of composite wing systems for combat aircraft (A-6, B-2, F-22) in addition to expertise as an aircraft system integrator. Currently, ten prime contractors exist with contracts on 17 fixed-wing aircraft. In addition, several prime contractors operate nine government-owned production facilities which represent additional manufacturing capacity, although many of these facilities are judged to be outdated and inefficient by modern standards.¹²

Present/Future Viability

Current and projected demand for fixed-wing aircraft will not sustain all of the systems integrators that were in business in the 1980's. Recognizing this fact, most prime contractors are restructuring their aircraft operations through mergers, acquisitions, divestitures and site consolidations. Several manufacturers, such as General Dynamics, LTV and Grumman, left the prime integrator business entirely, transitioned to major support partners, or may be purchased outright by competitors.¹³

12. Power, Nathan J. "Industrial Mobilization Preparedness", Army Logistician, July-August 1993, pp 2-5. The nine government owned, contractor operated aircraft plants are listed below:

<u>Plant</u>	<u>Location</u>	<u>Tenant Contractor</u>	<u>Program</u>
AF3	Tulsa, OK	McDonnell Douglas/ Rockwell	F-15, F-18 AV-8B
AF 4	Ft Worth, TX	Lockheed	F-16, F-22
AF 6	Marietta, GA	Lockheed	C-5, C-141 C-130, F-22
AF 42	Palmdale, CA	Lockheed/Northorp	B-2
AF 85	Columbus, OH	McDonnell Douglas	C-17
Navy 205	St Louis, MO	McDonnell Douglas	AV-8B, F-15E F-18 T-45
Navy 387	Dallas, TX	Vought	C-17, B-2
Navy 264	Bethpage, NY	Grumman	F-14, EA-6B E-2C
Navy 466	Calverton, NY	Grumman	F-14, EA-6B E-2C

13. "Grumman Chapter Closing", Aviation Week and Space Technology, October 18, 1993, pp.33.

The end result of these restructures will be a smaller United States' production base. Only one completely new fixed-wing combat aircraft, the F-22, is currently in full-scale development.¹⁴ The first new military transport that the United States has built in a generation, the C-17 Globemaster III, is in the early stages of a planned 120 aircraft production program which has been repeatedly delayed, and may in fact be cut to only 40 aircraft.¹⁵

All prime-contractor facilities depend on DoD programs for most of their workload. Five of the facilities are more than 90% dependent; therefore, they are extremely vulnerable to terminations or reductions in military aircraft programs. In the past, some fixed-wing military aircraft producers looked to their commercial transport operations for relief from declining military sales; however, that luxury is now gone. Lockheed exited the commercial airliner business in the early 1980's, and the two remaining commercial transport producers, McDonnell Douglas and Boeing, face an uncertain commercial market characterized by weak demand and growing foreign competition. Thus, while commercial aircraft production lines can provide limited potential for valuable surge capability for similar type military aircraft in a national emergency, they are of little significance in helping their parent companies withstand the economic consequences of reduced military production.

Companies have little choice but to downsize when defense programs are canceled or cut. The tremendous costs of carrying an underproductive aircraft operation will financially ruin companies that do not shed unneeded facilities and workforce. All contractors today are facing tough, unpopular economic choices because, with one exception, all are operating at less than 50% plant capacity. Accordingly, employment in the fixed-wing sector is projected to drop

14. Telephonic interview with Mr. Dave Osterhaut, Vice President, Lockheed Corporation, Washington D.C., on 30 November 1993. While providing significant improvement to USN fighter and attack capability, the F/A-18E/F is essentially a major upgrade of an existing design.

15. Morrocco, John D. "Congress Leaves JAST, C-17 Quandaries", Aviation Week and Space Technology, November 22, 1993, pp. 33-34.

to approximately 100,000 by 1999 from a high of 180,000 in 1986, a drop of over 55%.¹⁶ Current average capacity utilization for the ten prime fixed-wing manufacturers is 49% and forecast to drop to 41% by FY-97. Individual manufacturing sites are running from a low of 16% to a high of 78% utilization rates, with one specialized company having no production programs.¹⁷

Military aircraft production is an extremely complex activity requiring literally hundreds of essential capabilities. A few examples include: resin transfer molding, multi-axis high-speed machining, superplastic forming, diffusion bonding, and signature reduction. Specialized facilities essential to production include test cells, anechoic chambers, wind tunnels, flexible manufacturing systems, autoclaves and robotic centers. The industry probably employs more critical technologies in its products and manufacturing processes than any other industry in the United States. In fact, identifying a single advanced technology that does not have direct application to the development or production of military aircraft is difficult. The pervasiveness of high technology in the industry is reflected in the statistics on R&D expenditures: nearly one in every four dollars spent on industrial research and development is spent by the aerospace industry, of which the military aircraft sector is the largest part. As such statistics imply, the rate of technological innovation in the military aircraft sector has implications for other industrial programs throughout the economy.

16. On 30 March 1994, Lockheed announced the lay-off of 2000 employees at its C-130 and P-3 factory at Marietta, GA. Looking at the entire defense aerospace industry, one analyst claims that between 50,000 and 100,000 jobs will be lost this year alone, and that 450,000 out of total of 1.35 million jobs have been eliminated since 1990. "Lockheed to Cut Jobs", Minneapolis Star Tribune, 30 March 1994.

17. This particular company, an independent profit division of a corporation, has been responsible for building many advanced-technology aircraft which have supported national and tactical intelligence programs. By virtue of its small size and specialized workforce, the company has performed many of its activities in complete privacy, thereby giving the nation the opportunity to quickly field advanced capabilities. Failure to generate profits soon could result in this company's rapid closure.

AIRFRAME SYSTEMS SUBCONTRACTORS

Description

The majority of an aircraft's airframe is designed and manufactured by the prime contractor. In some cases, portions may be subcontracted when specialized capabilities are needed or when a prime contractor lacks the capacity to meet contract requirements. Three dominate areas within the airframe system are normally subcontracted 100% of the time: materials, hydraulic/actuation and control services, and landing gears. While numerous suppliers of most airframe materials and hydraulic and control systems exist, currently only four domestic and three foreign companies support military landing gear requirements. The four domestic companies (Cleveland Pneumatic, Allied Signal, Menasco and a Canadian company) have extensive fabrication and assembly technology for new and replacement production. The landing gear for major aircraft programs are designed in conjunction with the overall aircraft design. The landing gear contracts are bid competitively with the winning contractor usually remaining the supplier for the duration of the production program.

Present/Future Viability

At the subtier vendor level, the large steel struts for the landing gear are provided essentially from only two forging facilities -- Alcoa and Wyman Gordon. At the material-melting and refining level, Latrobe Steel and LTV are the only two primary suppliers of steel alloy forms and billets used as landing gear strut material.

United States manufacturers account for 95% of the landing gears sold in the country. DoD current and planned orders when combined with commercial orders should be sufficient to sustain the domestic industry for the foreseeable future. The landing gear industry is in good financial health due primarily to commercial orders. In 1992, 88% of landing gear sales were for commercial aircraft, and only 12% for military aircraft. A similar split is expected for all of 1993. The economic viability of landing gear manufactures is tied much more closely to the commercial airliner business than to military aircraft

production. The annual value of landing gear shipments has decreased by about 10% since 1988. Firm backlogged orders should allow manufacturers to recover lost ground by 1997.

Average capacity utilization in 1992 for the landing gear manufacturers in the United States was 71%. For 1993, capacity utilization is projected to decrease to 60% with DoD contracts accounting for 13% of total business. The industry projections show that average capacity utilization should increase slightly and stabilize at 67% by 1997. The all-time high was 82% in 1988 and the low was 60% in 1993. Employment data indicates that the 1993 employment of approximately 2300 has decreased from 3600 personnel employed in 1988. Employment is forecast to rise to 2700 by 1997. Thus, while the industry is not growing, it is not economically at risk.

Material suppliers have several growing concerns. In the case of metals, manufacture of aluminum-lithium and finding adequate sources of titanium are current problems. The metal casting industry is also in decline along with declining availability of skilled machinists and tool-and-die workers in general.¹⁸

Advanced composite materials are increasingly used in today's sophisticated aircraft. Although the composite materials industry can be characterized as having an excess capacity worldwide, only a single domestic source exists for some important materials. Pitch based carbon fiber is used in numerous high temperature applications. AMOCO is the only known producer in the United States. Hexcell provides the only special treatments necessary to meet radar absorbing requirements to the materials prior to fabrication rather than as a post-fabrication treatment. This feature provides considerable advantages in meeting stringent weight and cost criteria. These materials were a

18. Power, Nathan J. "Industrial Mobilization Preparedness", Army Logistician, July-August 1993, pp 2-5. In his article, Lt Col Power states that more than half of the tool-and-die makers will retire by the end of the decade, and only 25% are being replaced. This potential shortage of a critical skill could have major implications for future production programs and surge capability.

key technology for the A-12, F-117, and B-2, are under strong consideration for the F-22, and will surely be used for future advanced aircraft.

THE FUTURE

The defense industrial base will undergo major changes over the next decade. Secretary of Defense Perry stated, "The defense industrial base will be compressed by a factor of two, and possibly as much as three. Put another way, more than half of our industrial base is going away or start doing other things."¹⁹ Clearly, ten fixed-wing prime contractors will not survive. The fighter production lines alone will decrease from six active lines in the mid-1980s to two by the year 2000: the F-22 and F/A-18 E/F. Consequently with the possible exception of the F-22 and F/A-18 E/F and the ability to "steal" foreign F-16 production in the very near-term, the United States will not have the surge capability to produce fighter aircraft replacements that it once had during the Cold War.²⁰ This is not, however, a new phenomenon. Only during World War II when industrial mobilization began substantially before Pearl Harbor, was the industrial base able to make significant contributions before three years. In fact, according to General Hank Miley, former president of

19. Perry, William. "Guarding the Base", interview in Government Executive, August 1993, pp 40-47.

20. Telephonic interview with Mr. Dave Osterhaut, Vice President, Lockheed Corporation, Washington D.C., on 30 November 1993. Lockheed is hoping to produce up to 500 more F-16s for foreign customers; however, they are very concerned that once the F-16 is no longer the frontline USAF fighter, foreign interest may decline and orders will be canceled in favor of newer American or foreign fighters. An additional variable which could be favorable to U.S. surge capability is the "mini arm race" underway in the Pacific Basin. General Robert L. Rutherford, commander of Pacific Air Forces, has noted 25% of the world's weapon's sales in the coming years will be in Asia. With U.S. troops in the region, and good U.S./Japan relationships, sales could be dampened; however, with China emerging as a regional military power, should U.S./Japan relations sour over trade issues, sales could skyrocket. See Fulghum, David A. "Experts See \$5 Billion In Asian Fighter Sales" Aviation Week & Space Technology, 14 March 1994, pp 54-55.

the American Defense Preparedness Association, the entire Korean War was fought with World War II stocks. No new goods reached the theater until after hostilities ceased.²¹ We now "live in an era of the Six-Day War, 100 hour ground war, and the possibility of rapid nuclear exchanges as nuclear weaponry is further proliferated. The come-as-you-are war is upon us" and will be fought with inventories on hand.²²

The defense industrial base will continue to be charged to ensure America's armed forces fight with the world's most superior technology needed for force multiplication and power projection, and to maintain information superiority for communication, intelligence, surveillance, and early warning. This advanced technology depends upon a robust, healthy industrial base. According to James Kitfield,

"The focus of the industrial base will shift from massive production runs of major weapons systems to "silver bullet" research projects and upgrades, with limited production. Where possible, competition will be preserved in each market segment by keeping a few key companies involved in new weapons production. Where production runs are too limited to support more than one firm, the government will make sure that firm survives, in part by carefully doling out upgrade or even "make work" assignments to preserve a critical industrial capability."²³

To this end, the government may even buy some weapons systems it might not need such as nuclear submarines "just to keep the production line open."²⁴

The challenge is for the federal government to create an R&D environment within a severely stressed industrial base that encourages technology growth, with recognition that large follow-on production programs may not happen. The views of government and industry vary on how best to accomplish the task.

21. Lead Time Zero, a film by the American Defense Preparedness Association. Also, Power, Nathan J. "Industrial Mobilization Preparedness", Army Logistician, July-August 1993, pp 2-5.

22. Augustine, Norman R. "America At The Crossroads", RUSI Journal, June 1993, 29-34.

23. Kitfield, James. "Shrinking the Industrial Complex", Government Executive, August 1993, pp 29-38.

24. Perry, William. "Guarding the Base", interview in Government Executive, August 1993, pp 40-47.

AN INDUSTRIAL BASE PERSPECTIVE

The answer from industry's perspective lies in smarter downsizing while improving quality to drive costs down. Mr. Ronald D. Sugar, President of TRW Space & Electronics Group, offers ten policy recommendations echoed by many of his fellow industry leaders.²⁵

1. Defense spending should be reduced in an orderly manner. Precipitous downsizing has severe ramifications which can be irreversible, particularly in states like California that have a large share of the industry. Orderly downsizing minimizes dislocations and maintains the economic viability of industry participants by allowing time for transfers and retraining of skilled people. Industry needs greater stability in planning, particularly in key anchor programs.

2. The large government bureaucracy that oversees defense procurement, provides services, and conducts research and development should be downsized, at least proportionately with private sector downsizing, and perhaps faster. Despite reductions of over 40% in the aerospace industry, some data suggests that DoD's acquisition work force may have actually increased even though DoD is downsizing. The government should weigh carefully the cost of its extensive oversight activities against value returned and the burden placed on contractors. As an example, Boeing claims they need five times as many finance people per dollar of sale on government contracts as on commercial contracts.²⁶

3. A healthy balance should be maintained between work performed in private industry and in the R&D, production, and maintenance activities of the government's national labs, depots, and federally funded research and development centers. Do not displace industry jobs in depots and research labs. Industry involvement in depots and operations and maintenance work serves as an important link to the needs of the military and encourages pre-planned program improvement opportunities. Several national laboratories are expanding into work traditionally done well by industry such as satellite design and integration. This amounts to de facto nationalization of the industry and may not serve America well.

25 Sugar, Ronald D. "Industry's Role in U.S. Aerospace Superiority: Some Policy Recommendations", Comparative Strategy, volume 14, 1993, pp 289-293. I have taken the liberty in expanding Mr. Sugar's views by including the comments of other industry leaders where noted.

26. Hardy, Richard. "The Industrial Base and the Future of U.S. Aerospace Power", Comparative Strategy, Volume 12, 1993, pp. 285-288.

4. While downsizing, the procurement system should be streamlined and fundamentally restructured for the realities of the 1990s. With technology moving as rapidly as it is, and budget pressures limiting opportunities to field new state-of-the-art advances, the most common way to field proven new technologies before they become obsolete will be to incorporate them in very limited buys of new systems or upgrades to existing weapon systems. The cumbersome acquisition procedures, geared to very large production quantities, used in the past are no longer affordable. They take too long, they are too expensive, and they are too inefficient when applied to buys of hundreds rather than thousands or tens of thousands.²⁷ They must change to meet the realities of today's environment characterized by the chart below:

	<u>1980s - What expanding defense budgets brought us:</u>	<u>1990s - Necessary new realities responses:</u>
<u>Competition</u>	Expand competition to control costs and share the wealth	Encourage collaboration to ensure survival of core capabilities
<u>Industrial Base</u>	Get more companies involved, multiple sources	Shake out and rationalize to retain critical mass
<u>Procurement approach</u>	Congressional criticism encouraged adversarial relationship	TQM and cooperation essential
<u>Procurement process</u>	Accrete procurement "reforms" and complexity to control fraud, waste, and abuse - oversight stifles efficiency and saps resources	Simplify and restore trust to improve efficiency and reduce costs
<u>RDT&E</u>	Encourage industry to subsidize RDT&E - payoff in large scale production	Properly fund and incentivize RDT&E to preserve continuity of critical capability

5. DoD laws, regulations, and practices should be overhauled. These include accounting requirements and audits, specifications and standards, technical data requirements, government-unique contract requirements, and security. Regulations must be revised to reduce barriers to mingling commercial and defense R&D efforts, and foster commercial-military technology integration where possible.²⁸ Another example of needed reform is standardizing the

27. Stein, Robert. "U.S. Military Technical Requirements -- Views from U.S. Defense Industry" Comparative Strategy, volume 13, 1993, pp 93-100.

28. Gregory, William H. The Price of Peace, Lexington Books, 1993, pp

over 1000 specialized security systems into a single government standard. Several specific suggestions from industry include:²⁹

a. Raising the threshold of the Truth in Negotiations Act to \$500,000. This would simplify the procurement process by eliminating costly requirements for price data, thus producing savings for all.

b. Increasing the simplified acquisition threshold to \$100,000. This would make all purchases by the government under \$100,000 fall under simplified procurement rules, which would also generate savings by eliminating added bureaucratic costs.

c. Use value-added contracting. Contracting for value and quality will materially improve the quality, responsiveness, and cost-efficiency of purchases by the government.

d. Simplify the solicitation process. By making the process shorter and less complex, the government can procure in a more timely manner, as well as realize savings in cost and efficiency. This suggestion was included in Vice President Gore's national performance review.

e. Use contractor past performance as a source-selection factor. Consistent criteria is lacking among federal agencies for applying contractor's past performance in the source-selection process. A uniform government-wide approach will make the process more equitable and increase the quality of goods and services delivered to federal customers.

51. In his book, Mr. Gregory cites the following example as representative of potential savings:

Commercial versus Milspec Semiconductors
(comparable part for comparable environment)

<u>Part Cost</u>	<u>Commercial</u>	<u>Milspec</u>
Bipolar digital logic	\$1.67	\$15.78
Bipolar linear	.42	11.40
Reliability (failure index) (high is worse)	0.06	1.9-4.6
Lead time for new part	1-12 months	17-51 months

High commercial volumes drive continuous process and product improvements, and hence costs down and quality up.

29. Meadows, Sandra I. "Perry Pledges Sweeping Overhaul in Procurement" National Defense, March 1994, pp 9-10.

6. Investment in the U.S. private sector should be stimulated, including the defense industrial base, through tax, trade, and regulatory policies, such as R&D tax credits. Financing of both U.S. government and foreign contracts should be simplified and improved. The current, overly complex, system deters many firms from competing for government contracts. Legislation needs to be amended to permit greater use of commercial type financing and time-based progress payments.³⁰ Government should also proactively assist U.S. industry in increasing exports and encouraging international cooperation arrangements for world-competitiveness. Again in the area of financing, the government could help U.S. industry globally compete by providing direct financing or financial guarantees to foreign customers. Most European industries with whom we compete offer their potential customers financing packages at very attractive rates. They can do this because their own governments either provide the financing or guarantee it. Without U.S. government guarantees, we are often non-competitive when offering less attractive financing packages than our competition; thus, the industrial base and U.S. government lose in a number of ways. Industry does not make the sale, research and development investments are not recouped which often terminates production, and the government loses potential tax revenues.³¹

7. Adequate profitability should be allowed on RDT&E activities. The 1980s practice of encouraging large profit investments by contractors in the R&D phase, in hope of subsequent large productions runs, should be changed. In the near future with few large productions runs, profits will prove elusive. In a market economy, capital will move out of arenas where profits can not be made. Fair returns on RDT&E work will encourage continuing capital investment in defense work.

8. An adequate stable production base should be maintained, including subcontractors, suppliers, and vendors. We cannot develop a prototype and put it on the shelf, then be able to move quickly into massive quantity production. On some systems, we must maintain a sustainable level of production to retain production capacity and skills. Manufacturing know-how is in itself a critical technology and is just as important to aerospace power as research and development.

9. Where dual-use technology is applicable, lighten up on regulation and oversight that limits outside profit. It is in government's interest to encourage flourishing, dual-use commercial applications. The military can no longer afford the luxury of custom

30. Ibid, pp. 9.

31. Stein, Robert. "U.S. Military Technical Requirements -- Views from U.S. Defense Industry" Comparitive Strategy, volume 13, 1993, pp 93-100.

design as money dries up for weapons procurement. Currently, commercial "dual-use" technology is used in less than 10% of all DoD procurements.³² This percentage must grow immensely.

10. In the military-unique technologies where dual-use is not applicable, we must recognize the industrial base implications of future procurement decisions. Whether intended or not, upcoming major competitive awards will essentially define DoD's industrial policy. Therefore, keeping an eye on the health of certain military-unique technologies is important. In some case, direct support to companies performing unique work may be needed.

Improving quality in an era of program starts and stops, cancellations, stop-work, stretch-outs, build-outs, and slow rate production orders is a tough challenge; however, to survive in today's environment of reduced DoD dollars, defense industrial base companies must figure out how to offer quality products, at lower cost, and in less time. They must learn how to establish production facilities that are more flexible in terms of what they produce. Dedicated production lines for a single product, predicted upon producing that product in large numbers over a span of many years, are no longer affordable. This will require creativity and new thinking in terms of how processes are automated, workers are trained, vendor bases are established and selected, inspections are performed, quality control is maintained, testing is performed, factory floors are arranged, etc.³³

Certainly adoption of some or all of Mr. Sugar's suggestions would be extremely helpful. Another key is advanced computer technology which will allow concurrent engineering at reduced risk. Doing things right the first time will be taken to a new level in the next 25 years with virtual reality. According to Raymond S. Colladay, Strategic Defense Systems, Martin Marietta:

Imagine designing piece parts of a product, suiting up with tactile sensor gloves and visual display helmet, picking up the parts, and assembling the system. Is there an interference fit? Go inside and find the problem, change the design, and go on. Is there an

32. Gregory, William H. The Price of Peace, Lexington Books, 1993, pp 51.

33. Stein, Robert. "U.S. Military Technical Requirements -- Views from U.S. Defense Industry" Comparitive Strategy, volume 13, 1993, pp 93-100.

optical path problem? Ride a photon through the optical train and correct the design. Is it a tough part to manufacture? Simulate it and modify the design.³⁴

Breakthroughs in nano-technology applied to microelectro-mechanical devices will enable unimaginable improvements to control systems for various critical processes, fluid flow stability, and robotics. New systems will be procured and developed by simulating before building and prototyping before producing. Simulation and prototyping will be up to a system-of-systems level, where operational performance can be evaluated and flaws corrected before production. Millions of dollars will be saved by reducing re-engineering and production delay expenses.

A DOD PERSPECTIVE

Maintaining the defense technology base during the current period of budget reductions is a high priority for DoD. Secretary Perry's efforts have been focused primarily on providing relatively constant and stable funds for R&D, putting all known acquisitions "on the table" as soon as the requirement is known, and pursuing acquisition reform.

In the area of funding, sections 6.1, 6.2, and 6.3A of the defense budget, the parts that deal with the technology base, are being held relatively constant over the Future Years Defense Plan. In fact, the main reason for the 60% reduction in the procurement budget is to maintain the R&D budget. By the mid-1990s, the technology R&D budget will almost equal the procurement budget.³⁵

Responding to defense contractor pleas of "tell us what the requirements are" within the budget so that industry can carry out long term planning, the USAF has compiled its first long-range

34. Colladay, Raymond S. "Direction and Pace of Aerospace Technology", Comparitive Strategy, volume 14, 1993, pp 295-297.

35. Perry, William. "U.S. Military Acquisition Policy", Comparitive Strategy, volume 13, 1993, pp 19-24. In this article, Secretary Perry also acknowledges the importance of shedding overhead in bases, depots, and personnel, and assisting U.S. companies in exporting their products across the world by relaxing export controls.

Acquisition Estimate covering over 2000 planned procurements over \$100,000 for FY 94 and beyond.³⁶ Other services should follow the USAF lead. In addition, an electronic bulletin board has been established which lists all known DoD acquisitions. All contractors have access.

The Administration and Congress agree with industry that excessive rules and regulations have made defense products unnecessarily expensive. Numerous studies including a recent report by the Defense Department Advisory Panel on Streamlining Acquisition Reform -- also known as Section 800 study -- indicate that the federal defense procurement pays 30% to 50% more due to current buying practices.³⁷ Additionally, these barriers prevent technology sharing between defense and civilian products -- so called "dual-use technology" -- and hinder companies' efforts to diversify into commercial fields. Secretary Perry has recently written:³⁸

DoD faces unprecedented challenges in preserving force effectiveness in light of a radically changed threat, substantially declining defense budgets, and rapidly changing technology. The existing acquisition system will not be, and in some cases already is not, capable of responding to customer needs in this new environment. The fact is -- the world in which DoD must operate has changed beyond the limits of the existing acquisition systems' ability to adjust or evolve -- it must be totally re-engineered.

Acquisition reform is consistent with many of our most important national goals: saving the taxpayer money; reinventing Government; strengthening our military; and improving our economy. To meet these goals in today's environment DoD must:

1. Be able to rapidly acquire commercial and other state-of-the-art products and technology from reliable suppliers who utilize the latest manufacturing and management techniques;
2. Assist in the conversion of U.S. defense-unique companies to dual-use production;

36. Aspin, Les. "Annual Report to the President and the Congress" January 1994, pp.274.

37. Meadows, Sandra I. "Perry Pledges Sweeping Overhaul in Procurement", National Defense, March 1994, pp 9-10.

38. Perry, William J. "Acquisition Reform". DoD Memorandum signed by SECDEF, 15 Mar 1994, pp 1.

3. Aid in the transfer of military technology to the commercial sector;

4. Preserve defense-unique core capabilities (e.g., submarines, armored vehicles, and fighter aircraft);

5. Integrate, broaden, and maintain, a national industrial base sustained primarily by commercial demand but capable of meeting DoD's needs;

6. Be able to adopt business processes characteristic of world class customers and suppliers (including processes that encourage DoD's suppliers to do the same);

7. Be free to stop applying Government-unique terms and conditions on its contractors to the maximum extent practicable.

Calling today's acquisition system "an industrial era bureaucracy in an information age", Secretary Perry makes some more interesting observations:³⁹

1. It results in higher prices to DoD even when lower-cost commercial alternatives exist for the same requirements, loss of a broad domestic production base that could be available to defense for peacetime and surge demands, and lack of access to commercial state-of-the art technologies. Additionally, the wall between engineers and scientists engaged in commercial and military work impedes the kind of shoulder-to-shoulder contact that is the essence of technology transfer and that is basic to achieving greater job stability and growth opportunities for the U.S. work force.

2. In the past many companies were willing to accept these additional costs because of the large volume of sales to DoD, and the fact that government reimbursed them for the costs on products it purchased. However, as DoD's share of many contractor's sales continues to shrink, the companies are often no longer willing to accept the additional costs and production inefficiencies associated with complying with government administrative requirements. The cost is too high in today's competitive environment and results in DoD being unable to buy from many commercial companies even when their costs are cheaper, or their technology superior. The semiconductor market is a perfect example of this situation. In 1965 DoD accounted for over 75% of all U.S. semiconductor purchases. By 1995, predictions are sales to DoD will be around 1% of all U.S. company sales. When DoD sales are such a small part of their market, companies are less willing to let the government dictate to them the terms and conditions for selling their product. They would rather concentrate on their commercial business or sell their product to the

39. Ibid, pp 3-7.

government through third parties as a means of avoiding excessive rules and regulations.

3. DoD's acquisition process costs are 40% of the total acquisition budget compared to 5%-15% for commercial firms.

4. The design cycle for commercial technology is approximately 3-4 years, in DoD it is 8-10 years.

Mr. Perry's opinions and directions to DoD, and the views of industry represented by Mr Sugar appear to have much in common. To assist in DoD investment of dual-use technology, the Technology Reinvestment Program has been established which dedicates more than \$1 billion of DoD money and calls for matching industry funds. This investment by DoD is a major effort at assisting defense companies in their diversification efforts.⁴⁰ Additionally, to facilitate DoD's acquisition reform efforts, a new office, the Deputy Under Secretary of Defense for Acquisition Reform (DUSD/AR) has been chartered to "fundamentally restructure and improve the acquisition process by directing the conception, development, adoption, implementation, and institutionalization of new and innovative acquisition policies and processes."⁴¹ With statutory waivers from Congress, seven pilot programs, including the USAF's new jet trainer aircraft, have been identified as test programs to integrate new defense and commercial acquisition practices; however, the degree to which Secretary Perry will be able to implement major acquisition reform will depend on the mood of Congress. With little resulting from over 23 past studies since 1981, Eleanor Spector, DUSD/AR, characterized the DoD procurement system as "not organized to be efficient, it is organized to be accountable to Congress."⁴² While DoD certainly may be able to work on 50% of the required "massive changes" without Congressional legislation by trimming military specifications, the keys to meaningful acquisition reform are in the hands of Congress. Time will

40. Perry, William. "U.S. Military Acquisition Policy", Comparative Strategy, volume 13, 1993, pp 19-24.

41. Perry, William J. "Acquisition Reform". DoD Memorandum signed by SECDEF, 15 Mar 1994, pp 2.

42. As quoted by Mr. Gordon England, President, Lockheed Fort Worth, in remarks to the Air War College on 14 January, 1994.

tell if the heat has risen enough to alter the normally recalcitrant Congressional mood.

CONCLUSION

More wholesale mergers among major aerospace defense companies are likely in the near future; however, the most dramatic changes will come in the reshaping of these companies as they acquire and divest different lines of business. While more "megadeals" such as Grumman's purchase by Northrop are likely, many companies will seek to purchase like or complementary capabilities in order to consolidate facilities and drive up utilization rates.⁴³ As the defense industrial base continues to downsize by buy-outs, consolidations and mergers, reconstitution and surge seem to be of secondary importance to the Clinton administration -- at least in comparison to its importance in the Cold War era.⁴⁴ General Colin Powell noted the United States would have years of warning for any potential threat including a re-emerging Russia, and that we could reconstitute our defense industry faster than any potential enemy.⁴⁵ Secretary Perry acknowledged the importance of maintaining "the minimum essential defense industrial base" to reconstitute United States military forces as a "realistic hedge" against a future unfriendly Russian government.⁴⁶

43. As an example, Hughes Aircraft Company acquired General Dynamics' tactical missile business. They consolidated five facilities into one, drove utilization up to 85% from 35%, and obtained double digit profit margins. The \$450 million purchase price was paid off in 18 months. The next big "shocker" may well be Douglas Aircraft Company, McDonnell Douglas' commercial aircraft unit. They appear to be at a stage similar to Lockheed's commercial aircraft operation of 1981 when Lockheed announced it was exiting the commercial marketplace. Velocci, Anthony L. "Consolidation Outlook Stormy", Aviation Week and Space Technology, 14 March 1994, pp 44.

44. Reconstitution is defined as the ability to generate new industry to build new forces in time of war or national emergency. Surge is the ability to get more production from existing industry.

45. As quoted by Dr. David Blair, "Can We Plan the U.S. Defense Industrial Base", Downsizing Defense, Congressional Quarterly Inc., 1993, pp 33.

46. Taken from a speech at the USAF War College on 5 April 1994 by Dr.

Consequently, any surge or reconstitution capability that survives the downsizing will be a by-product of the R&D budget, acquisition reform, defense conversion to dual-use technology, and selected cases of government financial support to critical defense industries.

Nevertheless, the ability to continually modernize the existing armed forces is of the utmost importance -- independent of size of those forces. For defense industrial base to play well in this pursuit, "warm production lines" are essential to preserve some surge capability, and more importantly, to keep the R&D blood pumping. Production today may not be possible at efficient rates, but "once a factory line closes, the intellectual capital rusts as quickly as the production tooling."⁴⁷ Therefore, the Clinton administration is putting its scarce budget resources and future savings into R&D with the intent of saving intellectual capital and critical production capability. Enabling modernization of aging weapons systems down the road -- the next administration's problem -- is the goal. While virtuous in intent, people should be leary of the notion that high technology weapons systems can be developed through milestone 1 or 2 in the acquisition process and put on the shelf until needed or "rolled over" into the next generation weapon. With technology having a shelf life of about two years, resurrecting engineering databases, technical expertise, and materials is harder than thought. Beyond two years, companies essentially start over since the project's skilled workforce has most likely left at project completion.⁴⁸

William Perry, Secretary of Defense.

47. Kitfield, James. "Shrinking the Industrial Complex", Government Executive, August 1993, pp 31. Secretary Perry, uses almost the same quote six months later in his article "U.S. Military Acquisition Policy" published in Comparitive Strategy, volume 13, 1993. The submarine force is being reduced from approximately 90 to 50 as a result of the BUR. Defending his decision to build new nuclear submarines at a low rate even though new submarines are not needed until the end of the decade, he states "while we had plans to mothball the factory and then reopen it, we did not have any plan for how you would mothball the intellectual capital that goes into making submarines. Our fear was that once we shut it down and the people dispersed, it would take years, probably decades, to try to reassemble and rebuild the intellectual capital."

48. Colladay, Raymond S. Colladay. "Direction and Pace of Aerospace

To keep production lines at least lukewarm, "the Administration has encouraged the services to identify a very few priority acquisitions, such as the USAF's F-22, the USN's F/A-18E/F and Aegis cruiser, the Army's Comanche helicopter and Advanced Field Artillery System, and the USMC's V-22, to serve as "technology drivers" for their future arsenals."⁴⁹ Dual-use technology offers tremendous potential savings; however, the public should not be deceived into believing that all factories can produce domestic wares in peacetime and quickly convert to military wares in wartime. Production lines that produce VCRs during peacetime and convert overnight to Patriot production probably are not feasible; however, subtier contractors, especially electronic firms, may be capable of simultaneously manufacturing key military and civilian components for both if current rules are reformed.

Subtier contractors are likely to be more severely affected by current downsizing because their business bases are more narrow than the system integrators they supply. Resident in those subtier industries are some critical defense industrial capabilities, such as composite material manufacturing, the only tank casting foundry, and some electronics/avionics producers, which may require government support. Additionally, the knowledge base of design and testing requirements for carrier based and low observable aircraft does not reside uniformly with all companies. Ultimately, however, market forces will determine the characteristics of the United States' industrial base. We should therefore resist the temptation to subsidize weak or inefficient companies except in the most extreme circumstances. While some subcontractors will benefit from the downsizing as they become sole surviving suppliers of critical technology, how the total defense industry responds to today's hard realities should be a major national interest. Failure to maintain a healthy, robust industrial base may mean the difference between fighting totally unprepared with inferior equipment, as we did during

Technology", Comparitive Strategy, volume 14, 1993, pp 295-297.

49. Kitfield, James. "Shrinking the Industrial Complex", Government Executive, August 1993, pp 31.

the Korean War resulting in 54,000 American deaths, or fighting totally prepared with superior technology, which enabled the smashing defeat of Iraq with only 220 deaths in the Gulf War. Unfortunately as the nation concentrates on solving a number of difficult social problems, the scrapping of billions of dollars worth of defense industrial base capital continues with major implications for the future combat capability of the United States. The discussion seems of little interest outside DoD and a few interested congressmen.

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