BOOZ·ALLEN & HAMILTON

U.S. Defense Industry Under Siege— An Agenda for Change

Viewpoint

Executive Summary

This *Viewpoint* reviews the current state of the U.S. defense industry, and outlines a change blueprint for industry and government to ensure that the future U.S. defense industry remains the world's premier supplier of national security capabilities. The *Viewpoint* is organized as follows:

- **The Financial Health of the Industry –** *Does the recent string of bad news reflect a passing cold or serious pneumonia?*
- **Ten Underlying Causes –** *What are the fundamental reasons for the industry's poor performance?*
  - **Declining R&D –** "Eating the Seed Corn"
  - **Disinvestment in Assets –** "Letting the Roof Leak"
  - **Increasing Capital Intensity –** "Raising the Ante"
  - **High Stake Awards –** "Betting the Ranch on Winning in Vegas"
  - **Funding Instability –** "Driving on a Winding and Icy Road (with a back-seat driver)"
  - **Tightened Export Controls –** "Cutting off Your Nose to Spite Your Face"
  - **Customer Savings Retention –** "A Penny Saved Is Not a Penny Earned"
  - **Disinvestment in People –** "Exodus to dot.coms"
  - **Constrained Management Talent Pool –** "Limited Deep Bench Strength"
  - **Buried in Debt –** "Making the Mortgage Payments from the Grocery Jar"
- **The Rx –** *What proactive steps can industry and the DoD customer take to stem the erosion and create a path to a long-term sustainable industrial base?*

<u>An Agenda for the Contractors:</u>

I. Growth
- Pursuing value-added vertical integration into services
- Building an Innovation Engine within defense
- Commercializing technology outside defense
- Forming international alliances

II. Operational Excellence
- Achieving lean manufacturing and rationalizing capacity
- Redefining supply chain management via e-business
- Reducing complexity through tailored business streams
- Restructuring the role of the corporate center/shared services

III. Management/Leadership
- Building employer of choice into HRM
- Improving Post-Merger Integration
- Using Best Practices to leapfrog performance

<u>An Agenda for Government Policy Makers:</u>

I. Tone of Relationships
- Strengthening the partnership

II. Rules
- Stabilizing programs and funding
- Creating incentives for the industrial base to rationalize capacity
- Living with selected monopolies
- Sustaining a spirit of innovation

III. Processes
- Considering industrial-base issues in the acquisition process
- Understanding industry's metrics
- Streamlining the export control process
- Addressing the human resource issues

U.S. Defense Industry Under Siege – An Agenda for Change

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The U.S. defense industry is clearly at a crossroads. The underlying health of the industry is seriously suspect. As we entered the new millennium, the industry's combined operating profitability has declined from 9.2% in 1996 to 7.7% in 1999, and the industry's collective interest coverage ratio has fallen to 2.7 times in 1999 from 7.1 times in 1995; debt ratings have fallen to almost junk bond levels, and the industry's market capitalization is down 33% from $100.1 billion in January 1997 to $66.7 billion today. For perspective, the whole industry combined is valued at 14% of Microsoft, 17% of Intel, 50% of AOL and 76% of Yahoo. On February 23, 2000, you could buy the defense and space parts of Boeing, Lockheed Martin, Raytheon, General Dynamics, Hughes, TRW, Northrop Grumman, Loral and Litton all for $47 billion, which was less than the one day market value appreciation of Cisco ($50 billion) the day before. In response to these pressures, the industry is eating its "seed corn" in terms of reinvesting in innovation.

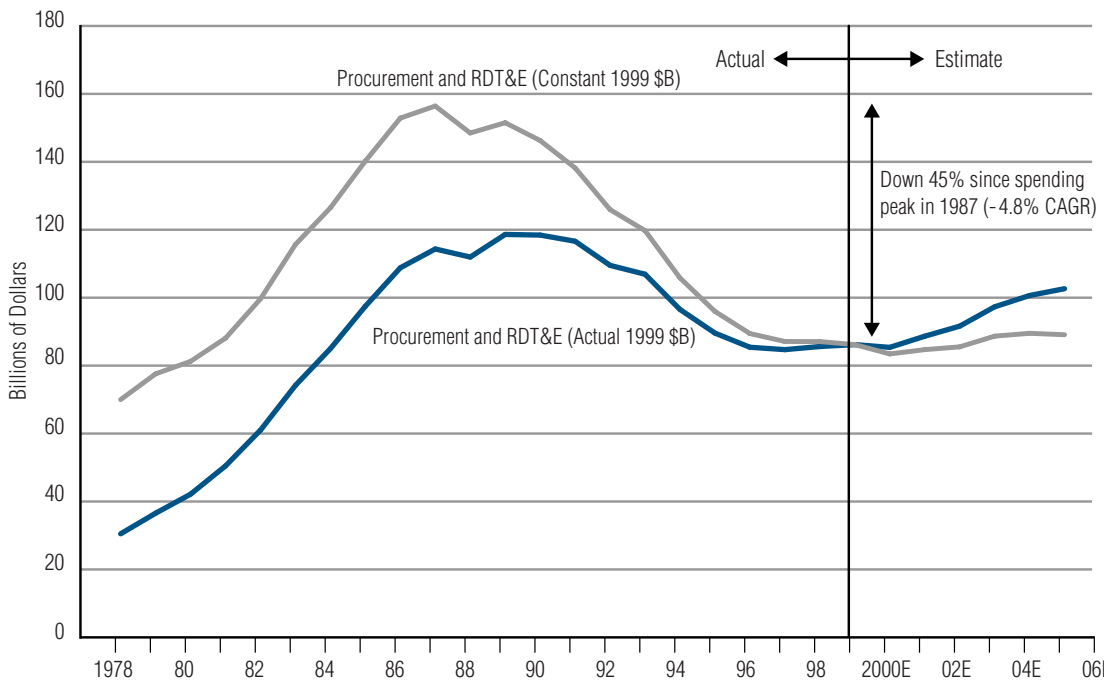
On the positive side, demand is recovering modestly from the 45% drop in spending on RDT&E and procurement between 1987 and 1999, and stable revenues or modest growth is expected in the next five years. Combined, the five largest U.S. defense contractors have taken $9 billion out of their cost base in the past three years, which followed aggressive rationalization of redundant capabilities and excess capacity in the wake of the merger wave. And worldwide, the U.S. retains its technological lead in almost all areas of defense platforms and sub-systems. As a result, our systems have allowed us to dominate all conflicts since Vietnam, and no U.S. soldier has been a casualty of enemy air attacks since 1953.

What went wrong? What are the forces that have caused this deterioration in the financial health of the industry? What are the consequences of business as usual, both by contractors and the government customers? Is there reason to panic? What can be done?

This *Viewpoint* will strive to answer these tough questions, and outline a blueprint for restoring the industry to its unfulfilled potential. It is organized as follows:

- **The Financial Health of the Industry –** Does the recent string of bad news reflect a passing cold or serious pneumonia?
- **Ten Underlying Causes –** What are the fundamental reasons of the industry's poor performance?
- **The Rx –** What proactive steps can industry and the DoD customer take to stem the erosion and create a path to a long-term sustainable industrial base?

Exhibit 1. U.S. Defense Procurement & RDT&E Budget (Actual & Estimate)



Sources: U.S. Office of Management and Budget; Booz·Allen & Hamilton Analysis

The Financial Health of the Industry

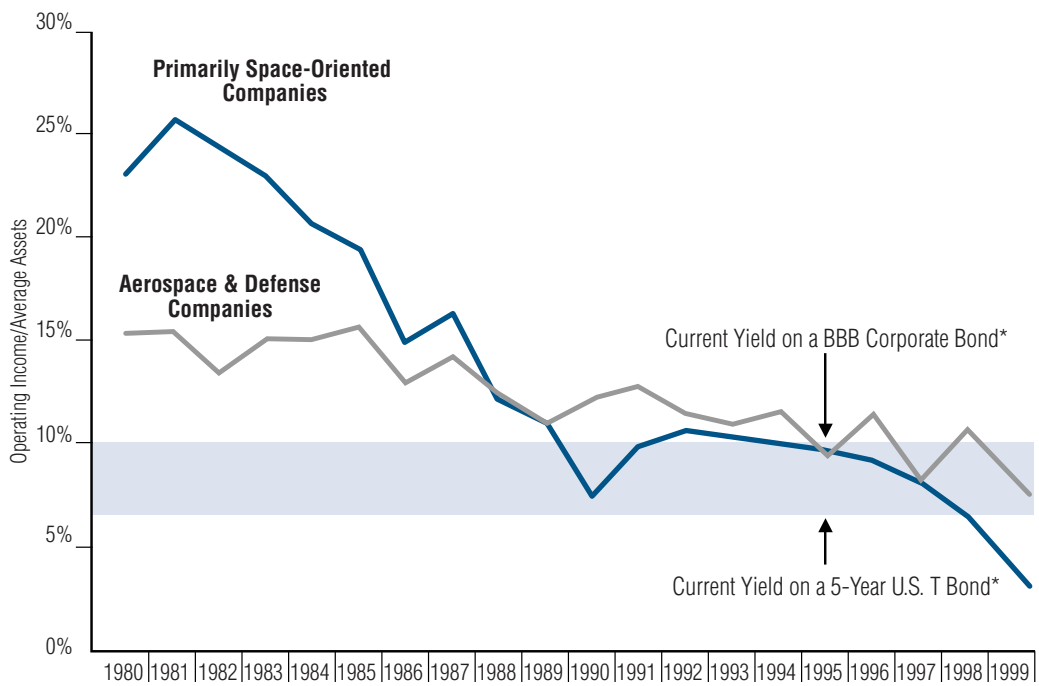
The good news is that top-line revenues are projected to be stable, even slightly growing, after a twelve-year period of declines linked to the fall of the Berlin Wall, the outbreak of peace and changes in priorities by the current administration (see Exhibit 1).

However, the long-term trend in profitability has been declining since 1980, fueled more by the increasing asset intensity of the industry than by margin erosion. For some segments such as space, the current profitability is one-fifth of the historical peak, and overall industry Return on Assets (ROA) fails to exceed the cost of capital. Overall industry ROA is half what it was in the 1980s (see Exhibit 2).

The reasons for these trends are numerous and will be detailed in the next section.

However, the most important factor has not been the outbreak of peace. Instead it is a fundamental shift in the nature of the risk/reward relationship that has been thrust on contractors as a result of otherwise well-meaning procurement reform and the Russian roulette stakes of "end game" procurements such as F22, JSF, etc. All of these competitions define a winner and a loser, as did the thousands of competitions before them. But this time, the winner takes all and the loser cannot sustain their capabilities until the next competition occurs in the distant future.

Exhibit 2. Return on Asset Trends for the Aerospace and Defense Industry



Sources: Booz•Allen & Hamilton Defense & Aerospace Company Data Base; Deutsche Bank Corporate Bond Report

Note: The data base contains over 200 companies or sectors of large companies. Primary data is publicly released financial information, 10Ks and annual reports

** Current bond yields – the lower and upper limits will change based on market conditions*

So the Darwinian competition leads to extinction of the "losing" species.

The poorer financial returns, coupled with the increased debt load from the mergers of the past eight years (particularly those that were accomplished at high premiums), have left the industry's balance sheets under stress and has challenged the ability to service that debt. The declining creditworthiness increases pressure by raising the cost of capital to levels above the industry's current returns (see Exhibit 3).

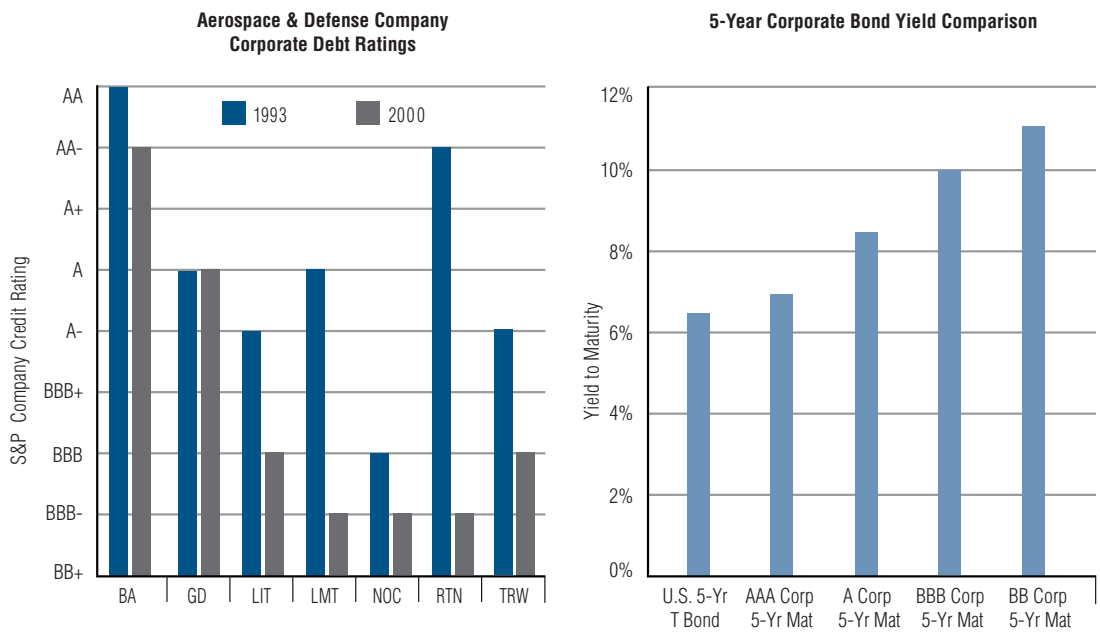
These stresses have taken a toll on the contractors' stock prices, further increasing the cost of capital. All of the top seven U.S. Defense contractors' stocks are trading below their 1997 levels, and several are trading at less than half the 1997 price. All this during a rampant bull market that carried NASDAQ stocks to 5.5 times their levels at the beginning of 1996, and S&P 500 stocks to over 3 times the 1996 levels (see Exhibit 4).

Some may say that the industry earns 6–8% return on sales, and that should be enough. But investors look at the returns for companies without patriotic or national security considerations, and the bottom line is that defense companies earn a rate of return that falls well below those of many other industries (see Exhibit 5).

This is particularly true when considering the higher risk levels now associated with defense stocks. Simply put, the defense industry earns insufficient profits to justify the level of risk involved (see Exhibit 6).

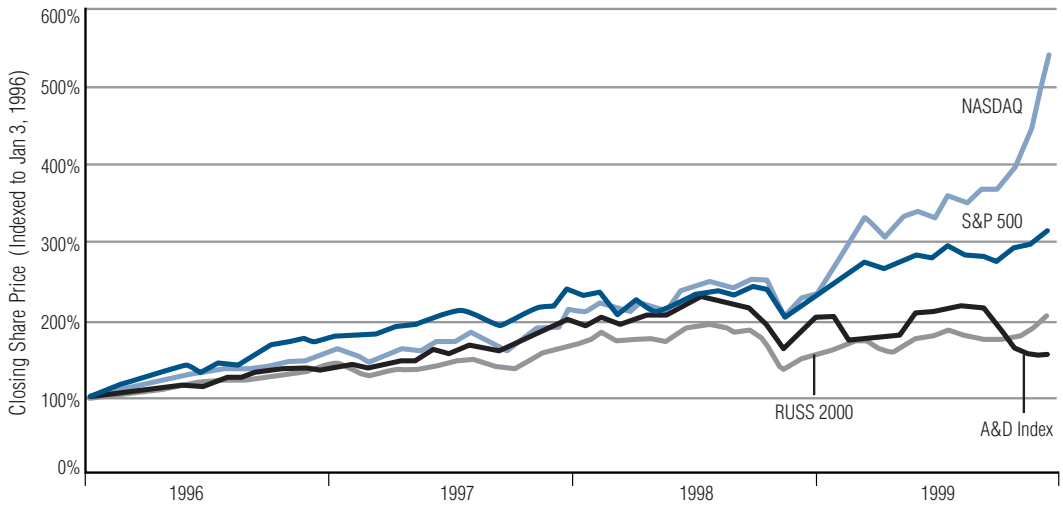
These trends have been evident to many companies who have decided to divest their defense businesses. These include such scions of industry as GE, IBM, AT&T, Unisys, Honeywell, Westinghouse, Texas

Exhibit 3. Aerospace & Defense Company Corporate Debt Ratings and 5-Year Corporate Bond Yield Comparison



Source: S&P

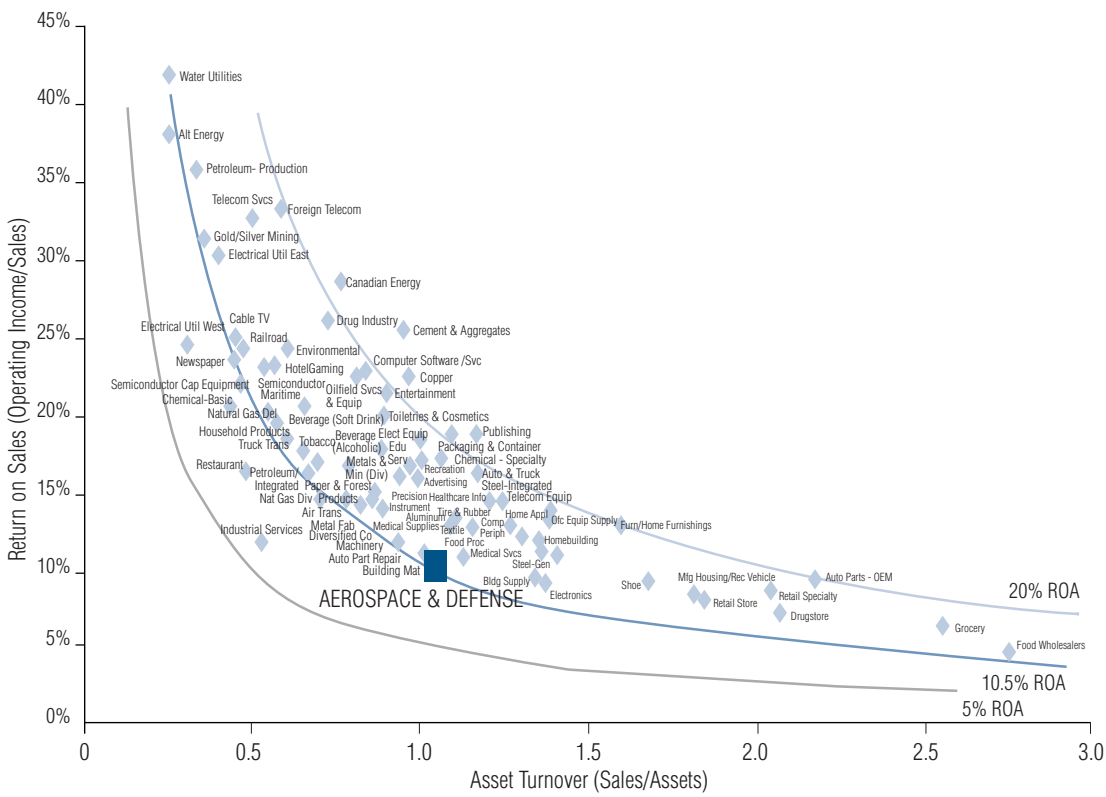
Exhibit 4. U.S. Aerospace & Defense Shareholder Return (Based on Stock Price)



Sources: MSN Moneycentral.com; Booz•Allen & Hamilton Analysis

Note: Index values are calculated at close of business weekly.
A&D Index includes leading aerospace & defense companies.

Exhibit 5. Industry ROA Comparison



Sources: Value Line 1999 excluding insurance and financial services industries; Booz•Allen & Hamilton Analysis

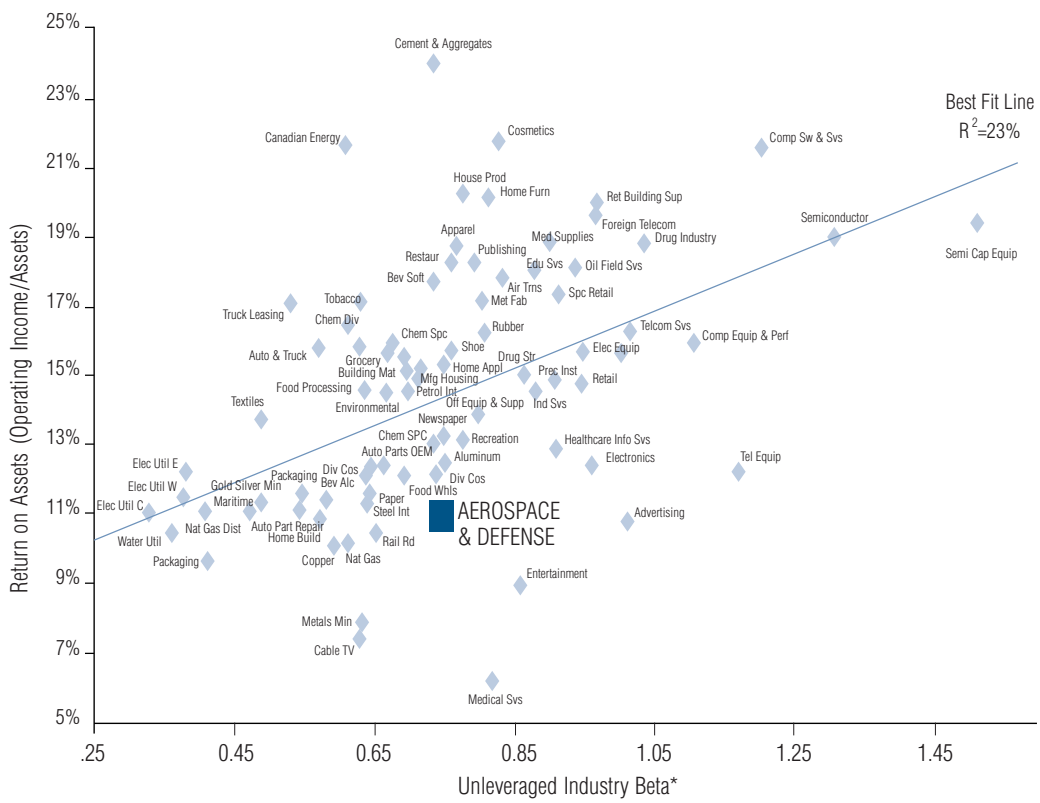
Instruments, Philips Magnavox, Teledyne, FMC, Goodyear, Tenneco, Ford and Chrysler. And others have been slowly disinvesting in their defense and space assets, such as GM Hughes Electronics, which sold Hughes Aircraft to Raytheon and has announced the sale of their world-leading commercial satellite business to Boeing. Both of these were viewed by GM as low-growth, low-return businesses. Instead, GM Hughes is now focusing on the higher growth/higher return businesses of satellite services such as DirecTV, DirecPC, Spaceway, Pan Am Sat and network services (see Exhibit 7).

The loss of these commercial companies as participants in the defense industry has hindered the flow of innovation from commercial to defense – at a point in history when it is most needed and most relevant. While the government customer is encouraging the application of commercial practices to defense programs, the contractors who know most about commercial practices are leaving the industry. The remaining contractors are essentially becoming pure defense players.

Overall and compared to other industries, the aerospace & defense industry earns below average ROA and ROE (see Exhibit 8).

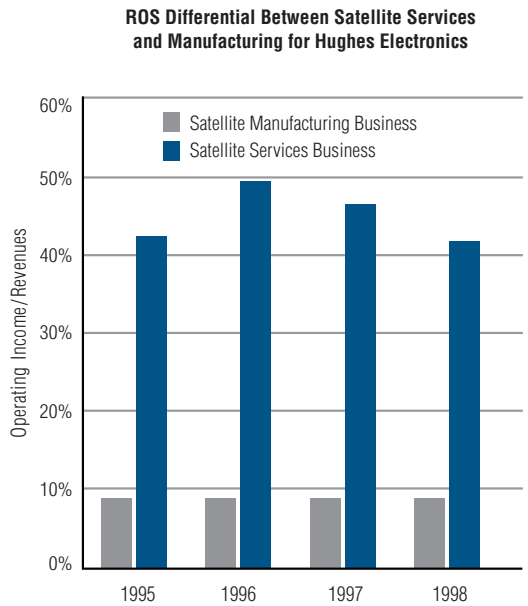
A final concern is that defense is losing visibility on the national agenda – it is politically more expedient to support expenditures for "butter" rather than "guns." In fact, defense as a percent of GNP has been declining pretty consistently since the peaks of World War II and the Korean War (see Exhibit 9).

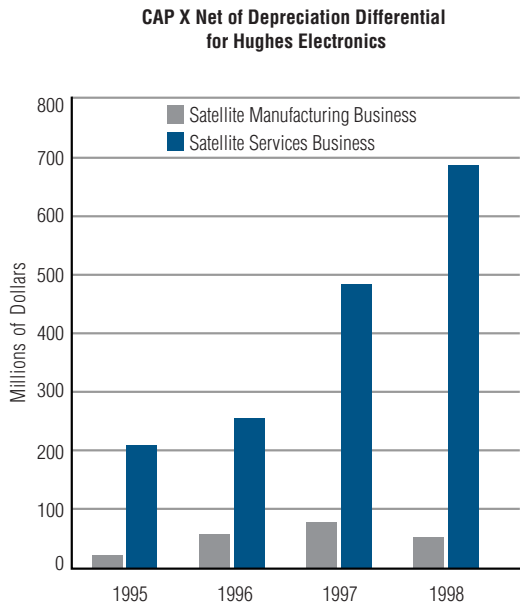
Exhibit 6. Risk Return Profile for Various Industries



Sources: Value Line; Booz·Allen & Hamilton Analysis
* Unleveraged beta is the equity beta adjusted for capital structure and hence asset beta

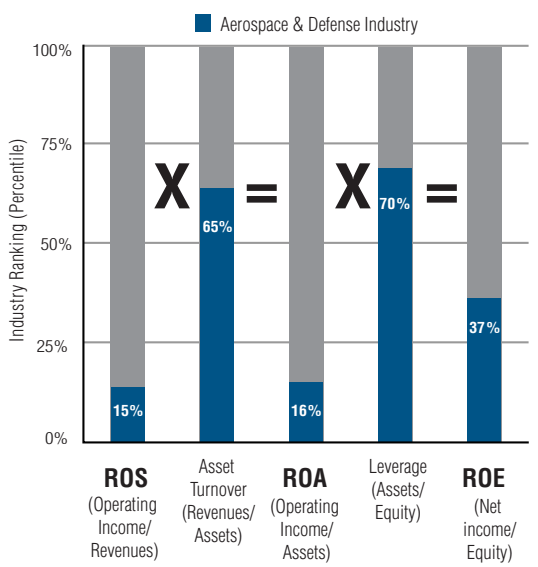
Exhibit 7. Comparison of Financial Ratios for Satellite Manufacturing and Services Businesses of Hughes Electronics





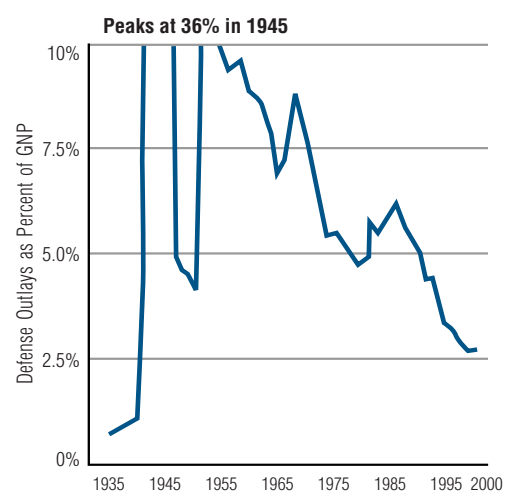
Source: Hughes Electronics 10Ks & 10Qs

Exhibit 8. Aerospace & Defense Industry Financial Performance Relative to Other Industries



Sources: Value Line 1999 of 1,700 companies, excluding insurance and financial services industries; Booz·Allen & Hamilton Analysis

Exhibit 9. Defense Outlays as a Percentage of GNP



Sources: U.S. Office of Management and Budget; Booz·Allen & Hamilton Analysis

Ten Underlying Causes

What are the fundamental reasons for the industry's poor performance? We have identified ten, and we will discuss each of them in the following pages:

- Declining R&D – "Eating the Seed Corn"
- Disinvestment in Assets – "Letting the Roof Leak"
- Increasing Capital Intensity – "Raising the Ante"
- High Stake Awards – "Betting the Ranch on Winning in Vegas"
- Funding Instability – "Driving a Winding and Icy Road (with a back-seat driver)"
- Tightened Export Controls – "Cutting off Your Nose to Spite Your Face"
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- Buried in Debt – "Making the Mortgage Payments from the Grocery Jar"

Here are the specifics on the ten underlying causes:

Declining R&D – "Eating the Seed Corn"

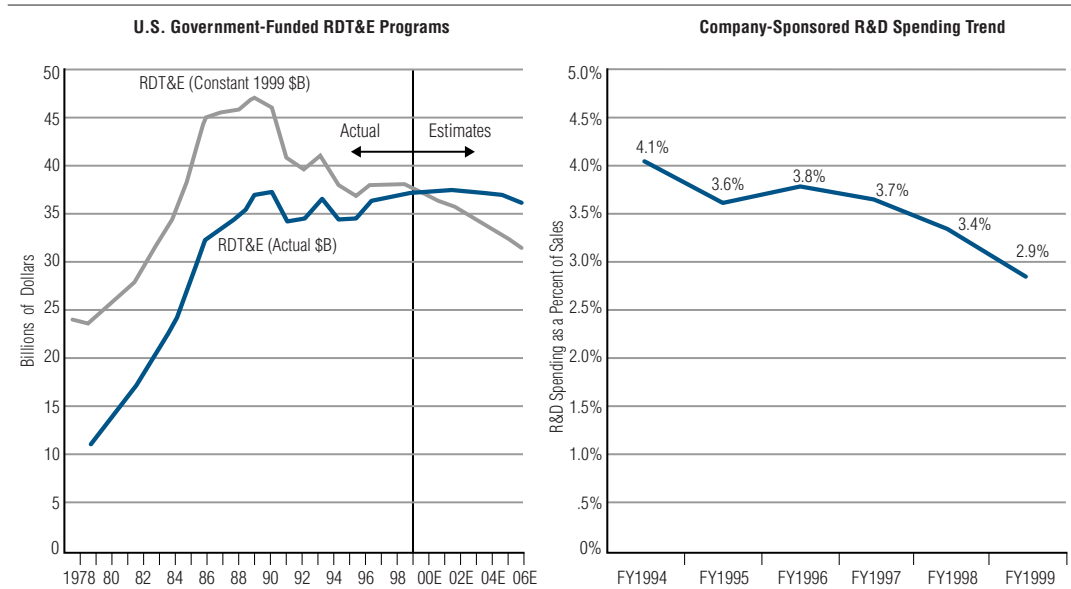
There are some disturbing trends in the total amount and how our defense industry spends its R&D funds today. There traditionally have been three sources of R&D funds for the defense industry:

1) U.S. Government (contract R&D) for funded development programs
2) Company-sponsored R&D
3) Independent Research and Development (IRAD) paid for by the government but spent at the discretion of the contractor.

The first two categories have been in decline in recent years (see Exhibit 10). The overall spending by the U.S. Government in R&D has declined and is expected to continue to decline in real terms. This decline will be accentuated by the fact that fundamental breakthrough research costs more today than it did ten years ago.

Compounding this problem, discretionary IR&D funds are becoming less discretionary; simply put, the "I" in "IR&D" is slipping away. While total IR&D has increased, the increases are

Exhibit 10. Decline in R&D



Sources: U.S. Office of Management and Budget; Booz•Allen & Hamilton Analysis

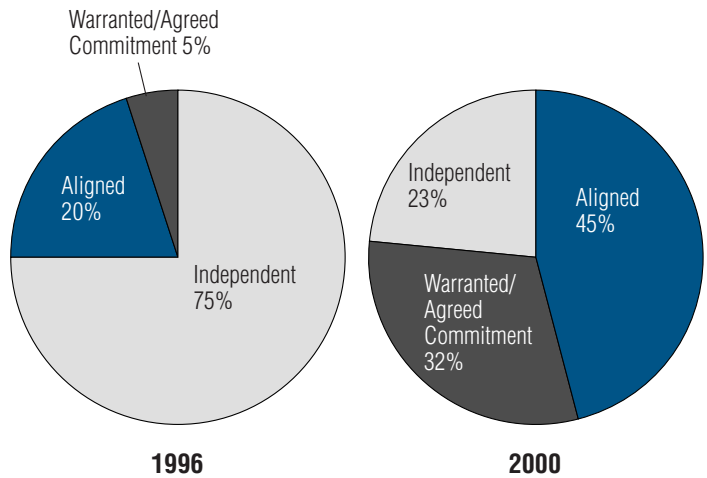
Sources: Based on 10Ks of Boeing, General Dynamics, Lockheed Martin, Litton, Northrup Grumman, Raytheon and TRW

aligned toward near-term programs or used to warrant the development of a specific deliverable rather than long-term independent R&D. While the near-term risks to the contractors have increased, the long-term risks to the U.S. and its citizens have increased even more (see Exhibit 11).

Disinvestment in Assets – "Letting the Roof Leak"

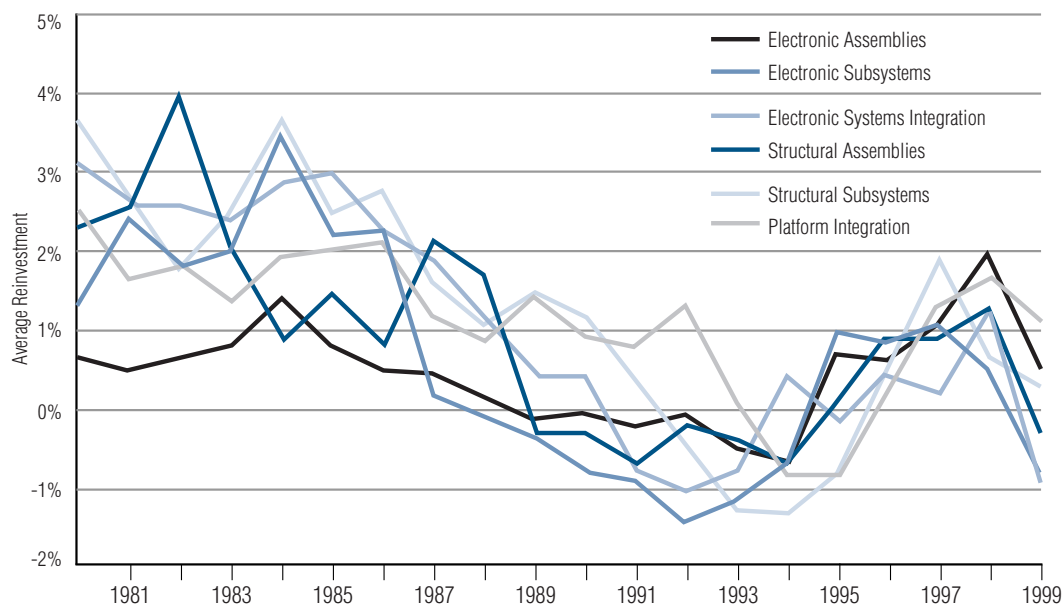
For much of the early 1990s, aerospace & defense firms were disinvesting in the underlying assets and capabilities. Capital expenditures less depreciation turned negative for most groups of companies, and only recently turned slightly positive. But it is still well below the 1980s when there was aggressive investment in capabilities (see Exhibit 12).

Exhibit 11. Trends in IRAD for Space Companies



Source: Booz•Allen & Hamilton Survey of Space Contractors

Exhibit 12. Reinvestment Profile Capital Expenditures Less Depreciation, as a Percent of Sales Aerospace & Defense Business Segments



Source: Booz•Allen & Hamilton Aerospace & Defense Company/Sector Data Base

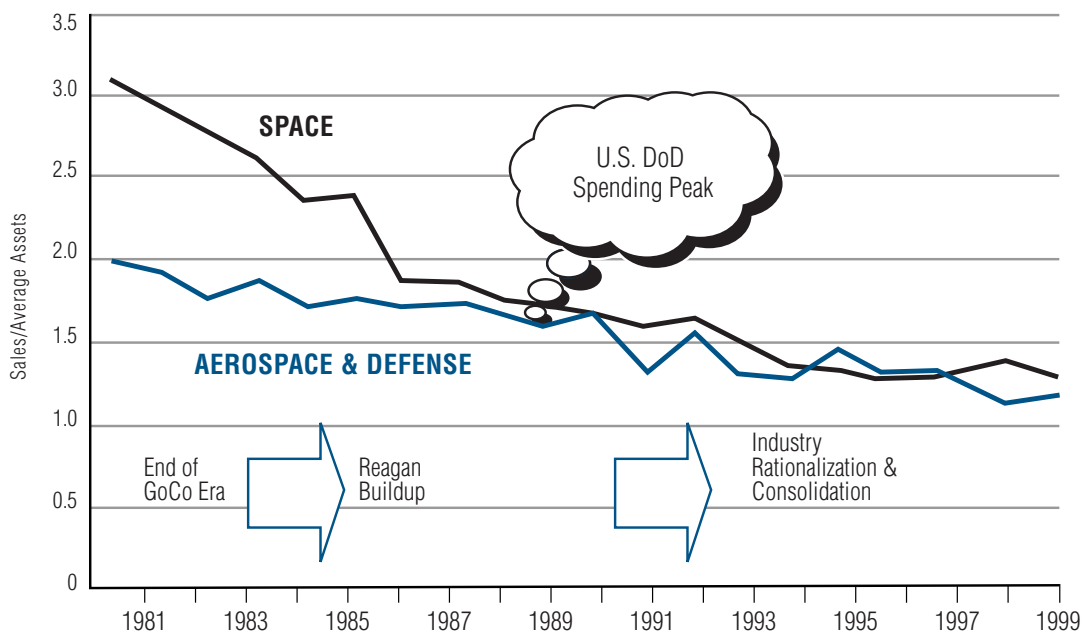
Simply put, the industry invested in acquisitions during the 1990s, rather than enhancing the overall industry's capabilities; this was quite rational given the declines in government spending and the need to rationalize rather than build, but it has put a damper on new capabilities and innovation.

Increasing Capital Intensity — "Raising the Ante"

Historically, the defense industry worked as a service industry. The U.S. Government furnished the facilities/equipment and the contractors supplied the labor. That changed in the early 1980s. In response to higher government spending, defense contractors increasingly invested their own capital to build infrastructure. Some corporations (such as GM, AlliedSignal and Chrysler) even entered the industry (see Exhibit 13).

Today, the capital investments that the U.S. Defense industry made to build capacity exposes the industry to higher levels of business risks than it has ever faced before. The sharp reduction in DoD spending drove the consolidation of the '90s with the intent of taking fixed capacity out of the system. Huge market premiums were paid by companies to consolidate the industry, further increasing the asset base for the defense industry. In July 1993, John Deutch (as Undersecretary of Defense for Technology and Acquisition) introduced the Government's pro-consolidation merger policy; however, at the same time Congress was busy introducing regulatory hurdles to make the capacity rationalization process even more difficult. The battle cry in Congress was "no payoffs for layoffs." Congress did this by passing regulations that would ban cost reimbursement for restructuring costs associated with plant and company rationalization.

Exhibit 13. Asset Turnover Trends in the Aerospace & Defense Industry



Source: Booz•Allen & Hamilton Aerospace & Defense Company/Sector Data Base

Note: The data base contains over 200 companies or sectors of large companies. Primary data is publicly released financial information, 10Ks and annual reports.

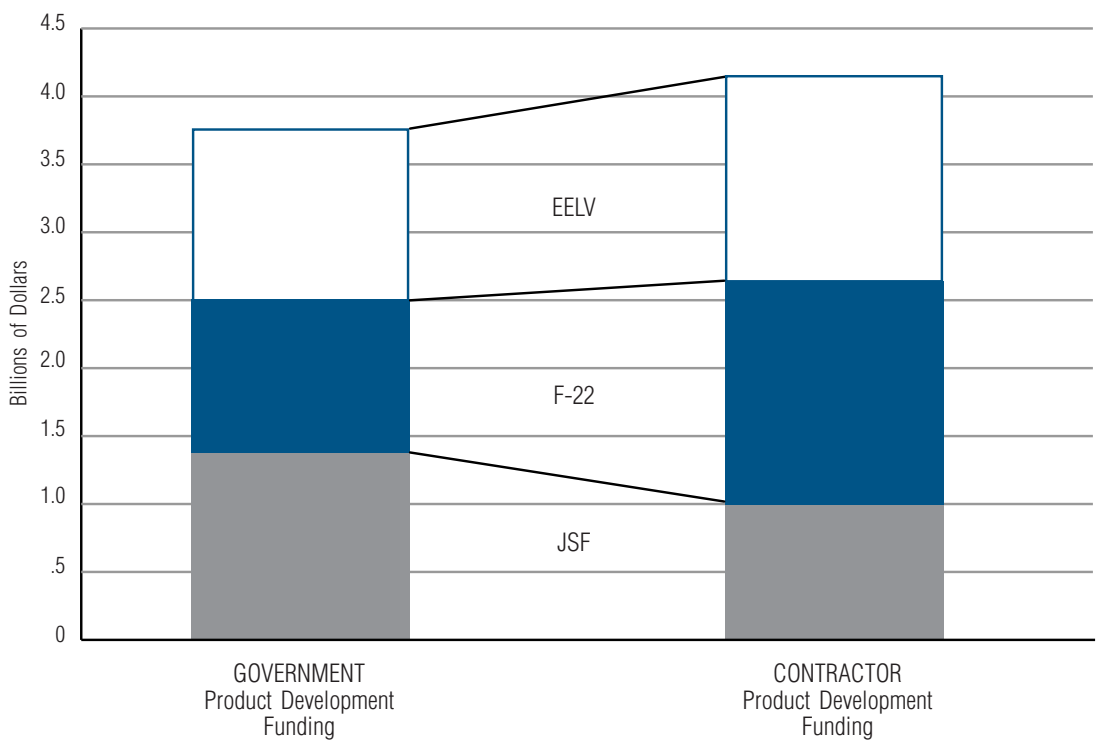
For mergers after September 30, 1996, a contractor would need to show a $2 savings for every $1 of up-front cost reimbursement in order for the plant rationalization to be funded. This sent a clear message to the defense industry—no more plant rationalizations.

High Stake Awards – "Betting the Ranch on Winning in Vegas"

The U.S. Defense industry has become highly competitive as a result of the uncertainties associated with the declining defense budgets, program funding uncertainties and fewer new defense programs. It is not unusual to see cut-throat pricing to win programs because there are so few programs that will be funded in the future. In some situations, one would wonder whether the victor would generate any profits as a result of winning certain programs. However, the risks associated with the loss of a key program could cause some companies to exit that line of business.

In order to ensure that a program goes forward and that the contractor is properly positioned, the contractor often invests as much on the development of a program as the government. The contractor faces two risks, program funding risk and competitive risk. While a contractor may invest in the development phase of a program, there is no guarantee that Congress will not axe the program or that the contractor will win a competitive bid. The result is a lot of assumed risk just to stay in business (see Exhibit 14).

Exhibit 14. Government vs. Industry Funding for Key Programs*



Sources: Forecast International and literature searches

* Government and contractor funding includes only funds to prime contractors and is only for development (no procurement funds).

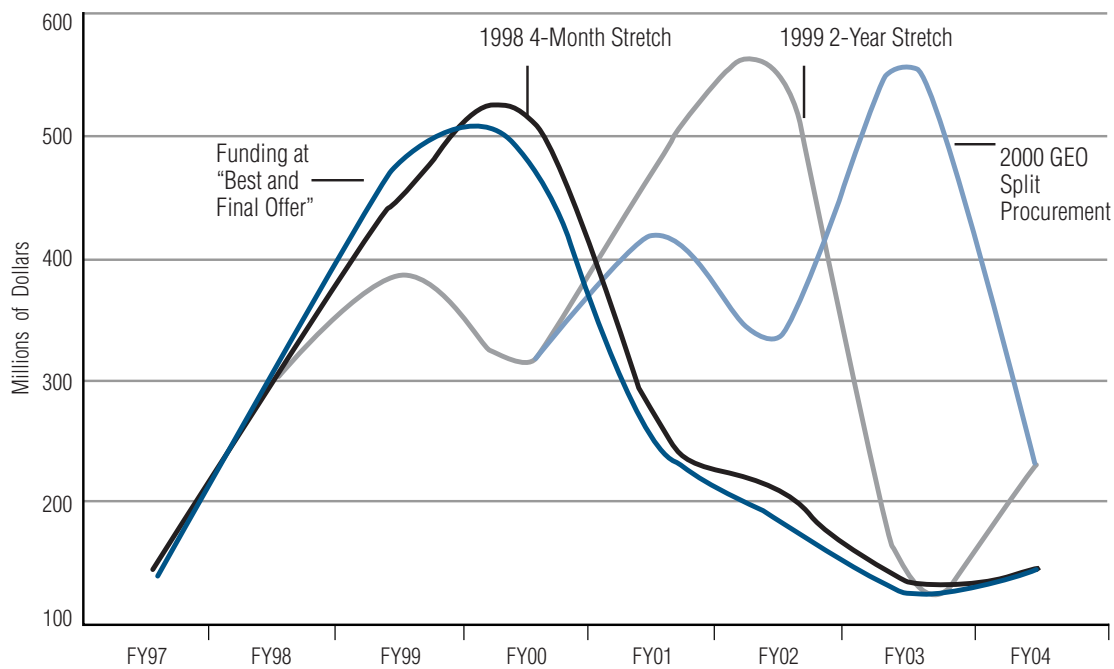
Funding Instability – "Driving a Winding and Icy Road (with a Back-Seat Driver)"

It is highly irregular to find a large program that has not been restructured multiple times before it goes through the complete life cycle of the program. For example, the Space Based Infrared System (SBIRS High) program faced three restructurings since inception. Most likely it will be restructured several more times before it achieves full operational capability (see Exhibit 15).

Stability of a program's schedule and funding is critical for a supplier and can save the customer a significant amount of money. Stabilization will directly translate into less risk for the supplier and a less expensive product for the customer. The benefits to a supplier are obvious. Schedule and funding stability give the supplier the ability to plan their work and to optimize the utilization of their human resources and other physical assets. It is difficult for a contractor to manage their assets effectively with a customer who changes the funding profile with each new annual budget, forcing companies to make suboptimal economic decisions based on political negotiations.

In addition to the volatility of program funding, there is a second problem, which we call the "exaggerated carrot" problem. For almost every recent major procurement, the actual numbers of platforms deployed falls far short of the numbers promised at the point of initial contractor decisions on investments (see Exhibit 16).

Exhibit 15. SBIRS High Funding Delays and Program Changes



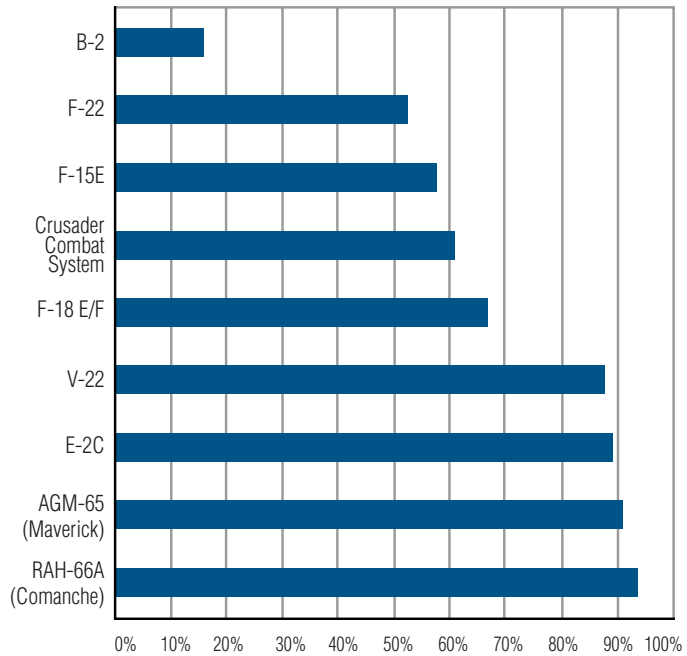
Source: Lockheed Martin

Tightened Export Controls – "Cutting Off Your Nose to Spite Your Face"

One way the aerospace and defense industry has been trying to overcome this large defense budget decline is by expanding into export and commercial market segments. However, the U.S. Government has also made these prospects highly risky. A case in point is the communication satellite manufacturing industry. A highly successful industry, the U.S. industrial base historically has dominated the market with approximately 70% of the global market for GEO communications satellites. However, with the recent changes in export control regulations and the regulating body that oversees it, the U.S. Government could significantly damage this thriving industry for the near and distant future.

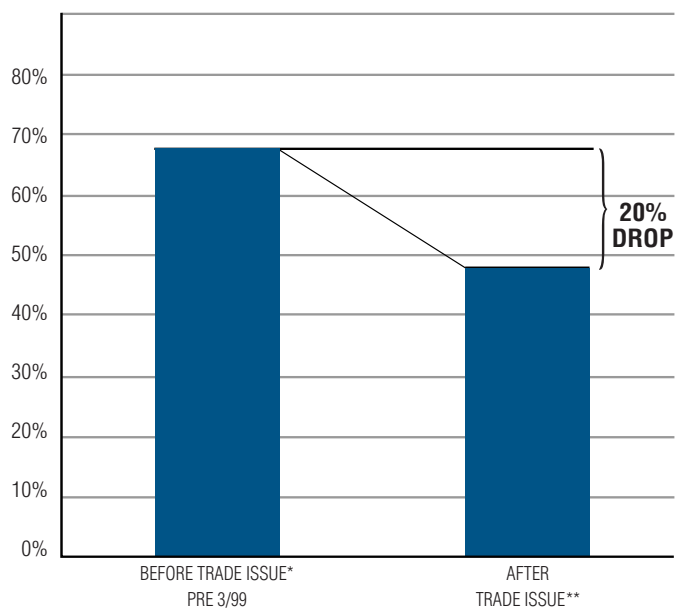
Based on industry interviews, the U.S. satellite manufacturing industry's competitiveness in international markets has been significantly impacted. Industry estimates that their probability of win has declined by approximately 20%, reflecting the loss of confidence as a direct result of the export control restrictions by the U.S. Government. We estimate that this particular U.S. industry could lose up to $1 billion of sales annually if the export controls issues are not resolved (see Exhibit 17).

Exhibit 16. Actual Program Volumes as Percent of Initial Plan



Sources: Forecast International; Booz•Allen & Hamilton Analysis

Exhibit 17. Change in Probability of Win for U.S. Prime on International Satellite Programs



Source: Company Interviews

* Estimate of probability of win based on orbit market share for U.S. primes

** Based on discussions with three large U.S. commercial prime contractors

Customer Savings Retention — "A Penny Saved Is Not a Penny Earned"

In the past three years, the major defense primes have taken a combined $9 billion out of their cost base. During the same period, the cumulative change in net earnings was slightly negative, at $0.5 billion. Thus, more than $9 billion flowed through to the government customer.

To be fair, the government does finance some of the initial expenses that a company takes on when making the cost cuts, since some up-front costs incurred to consolidate or rationalize a company are passed on to the customer via the "cost plus" nature of most contracts. While the initial savings flowthrough to customers depends to a large extent on the mix of contracts that a company has with its customer, the intensity of competition causes defense contractors to "go public" with anticipated savings earlier, often before they are realized, in order to win favorable Wall Street ratings. This leads to customers capturing savings that may or may not occur.

How much does the customer finance the non-recurring expenses and to what extent do company shareholders get rewarded for taking on the risks of implementing this cost-cutting exercise? The data suggests that the government recoups more than their fair share of the cost savings. One major contractor has kept close tabs on how quickly the savings flow through, and concluded that they retained only 17% of the savings in year one and almost none of the savings in year two and beyond. Ironically, few in the government perceive that the savings are being passed on to this extent. There are at least two reasons:

Exhibit 18. Diminished Interest in Aerospace & Defense as a Career Choice by Technology Graduates

TOP CAREER DISCIPLINES CITED BY TECH B.S. HOLDERS	TOP REASONS CITED FOR CAREER DECISIONS BY TECH B.S. HOLDERS
1990	**1990**
1 Biotech & Agriculture/Genetic Sciences	**1** Technical Challenge
2 Computers & Software Development	**2** Advancement Opportunity
3 Aerospace & Defense	**3** Location
4 Telecommunications	**4** People & Team
	5 Compensation
1998	**1998**
1 Telecommunications	**1 Advancement Opportunity**
2 Computers & Software Development	**2** Technical Challenge
3 Internet (e-business)	**3 Equity/Variable Compensation**
4 Biotech & Agriculture/Genetic Sciences	**4** Location
7 Aerospace & Defense	**5 Small Size/Strong Market Position**

Source: *Science and Engineering Indicators,* 1998 Edition

1) The savings on existing programs are masked by the impact of declining volumes on per unit costs; the savings often allow unit costs to hold flat in the face of declining volume, but the customer does not perceive this as a savings.

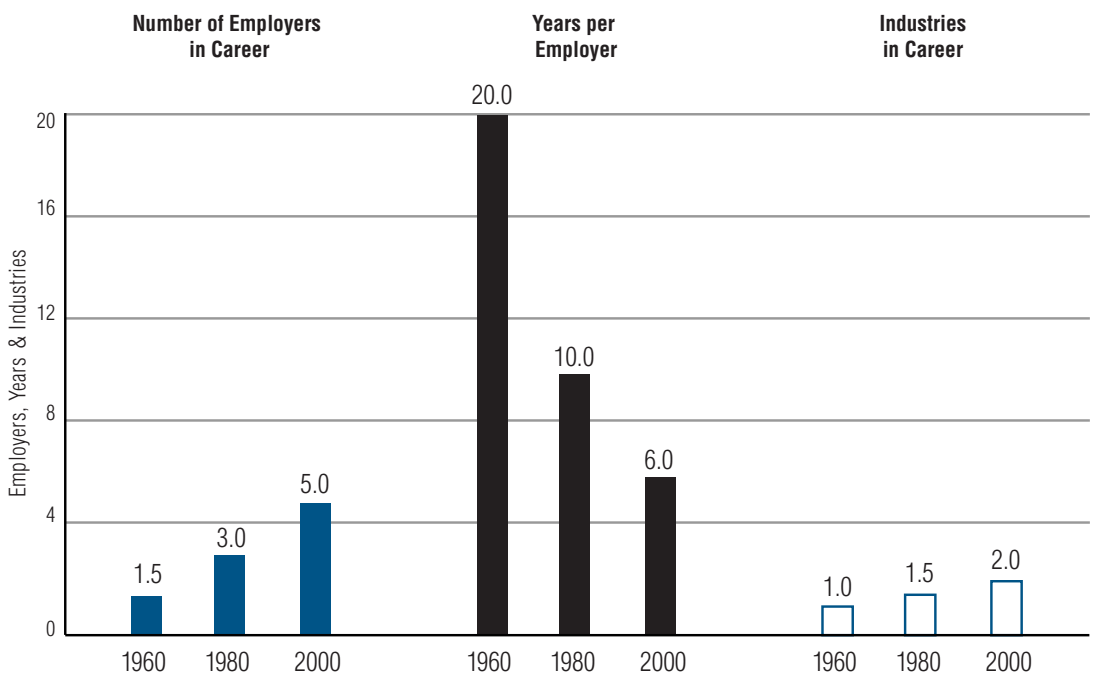
2) The savings on new programs are not visible since there is no benchmark. Thus the significant savings on a program such as Future Imagery Architecture (FIA) are baked into the initial bids, and are not visible in year-to-year comparisons.

Disinvestment in People – "Exodus to Dot.coms"

While companies continue to consolidate their assets, the human capital in the U.S. Defense industry has also been declining sharply. Massive layoffs at all major defense contractors were applauded by industry analysts as CEOs announced more and more layoffs. Today, these same companies are facing significant operating risks from lack of key human resources at the middle management level, as well as lack of interest from college recruits because there is no perceived growth or rewards associated with this industry. Obviously, this is not an isolated trend. All industries are having to fight for their share of college and graduate school recruits, but the U.S. Defense industry seems to have been hit especially hard. As a high-technology endeavor, the defense industry is populated with a well-educated workforce which has relevant training in the fields that commercial high-technology industries are vying for, mainly software and electrical engineers (see Exhibit 18).

Compounding the problem, over 37% of undergraduate technical grads from U.S. colleges are not U.S. citizens, making them largely ineligible for defense contractors; up from 21% in 1987. Finally, these graduates expect much more frequent career moves than just ten years ago, and in fact most expect they will not stay in the same industry their entire career (see Exhibit 19).

Exhibit 19. Employer & Industry Expectations at Graduation for U.S. BS Degrees, 1960-2000



Sources: U.S. Labor Statistics Report: Education in America; U.S. Statistical Abstracts; National Science Board Science & Engineering Indicators 1981-1998; "Free Agency," *Fast Company* magazine on line

Constrained Management Talent Pool – "Limited Deep Bench Strength"

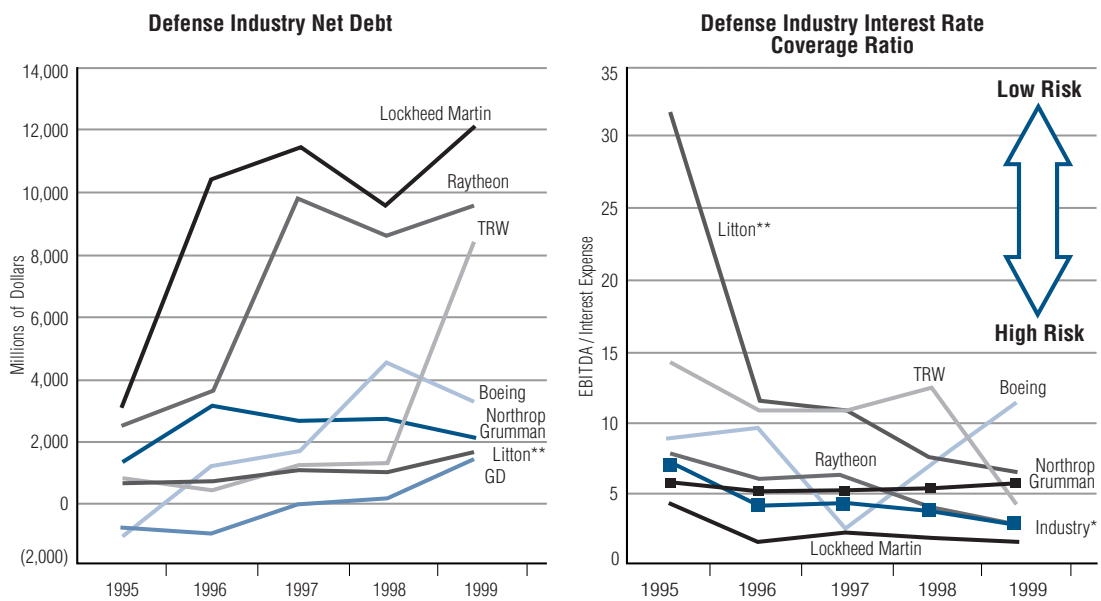
In the past fifteen years, we have seen at least two waves where a single company has achieved an impressive record of competitive wins, only to struggle in the implementation of the programs won. In the late 1980s, McDonnell Douglas had unprecedented success winning such programs as C-17 and the National Aerospace Plane, and in the mid 1990s Lockheed Martin was eight for eight in key program wins with such program down selects as JSF, JDAM, JASM and EELV, and such outright wins as THAAD and Venturestar. Yet in both cases the companies struggled to meet the technical and cost challenges of those programs. In our opinion, this was largely due to the lack of "deep bench strength," meaning few (if any) companies in this industry have enough top-quality program managers to deliver the programs effectively when strained by an extensive string of program wins. ALL defense contractors face similar challenges, meaning that tomorrow's "hot" company will likely also face some disappointments as the allocated scarce management resources are insufficient.

Buried in Debt – "Making the Mortgage Payments from the Cookie Jar"

During the merger activity of the 1990s, the defense industry relied heavily on debt to consolidate. While there have been examples where companies used equity financing (e.g., Boeing/McDonnell Douglas), companies were primarily acquired with debt. Leverage is a wonderful tool; if used properly, it reduces taxes and increases return on equity. But highly leveraged acquisitions are uncomfortably dependent on the ability of the acquiring company to make aggressive cost cuts (and retain the savings) in order to pay down the debt. Effectively managing the post-merger integration process (both with the customer and operationally) becomes essential not just to prosper, but to survive.

As a result of this added debt load, some companies now face a declining interest expense coverage ratio (EBITDA divided by interest expenses). This does not take into consideration the

Exhibit 20. Defense Industry Debt Load Increases Risk



Sources: Company 10Ks; Booz•Allen & Hamilton Analysis

** Defense Industry does not include Boeing due to commercial air transport segment*

*** Litton includes Q1 2000*

capital expenditures and working capital financing that would be required to sustain a business. The industry interest expense coverage ratio has steadily declined from 7.2 in 1995 to 2.7 today (see Exhibit 20).

These facts are collectively a wake-up call primarily for the industry but also the customer, and ultimately the citizens of the United States. Is there reason to panic? No, not yet, but it is imperative that both industry and the Government customer work cooperatively to create a healthier environment and a more stable industrial base. It is essential for both economic and national security reasons.

What the Industry Must Do

Executives at the leading defense contractors have multiple levers which they may use to proactively optimize their business regardless of changes in the "system" that the government might choose to make. Put simply, there are three types of challenges in the industry today, and a total of 11 levers to help position companies for the next level of performance:

I. Growth
- Pursuing value-added vertical integration into services
- Building an Innovation Engine within defense
- Commercializing technology outside defense
- Forming international alliances

II. Operational Excellence
- Lean manufacturing and rationalizing capacity
- Redefine supply chain management via e-business
- Reduce complexity through tailored business streams
- Restructure role of the corporate center/shared services

III. Management/Leadership
- Build employer of choice into human resources management
- Better Post-Merger Integration
- Use Best Practices to leapfrog performance

The following pages share some perspectives on each of these levers.

I. Growth

Pursuing Value-Added Vertical Integration into Services

In the 21st century, we believe the few successful aerospace & defense companies that remain standing will have moved past the factory gate and repositioned their value proposition by developing a portfolio of unique service and product offerings that provide improved customer service and significant cost savings. In the offering, they will have leveraged strategic innovations in product architecture, information transfer and product specific attributes that facilitate systems integration and test capabilities. They will have accessed whole new capabilities in logistics and strategic alliances.

The forces driving this next wave of competition are compelling:

1) Wall Street pressures will dictate that aerospace & defense companies seek out new opportunities for growth — new markets, more content and/or a different proposition

2) There is strong evidence to support that companies focused on defense have difficulty sustaining a successful run at competing in the commercial world

3) DoD funding for post-delivery support (O&S) depends on the specific weapon system, but is often five to ten times the cost of designing and constructing the platform

4) The fiscal tightening and demand requirements across all branch sectors means that the DoD is short of critical monies needed to provide next-generation innovation technology and new construction. A major DoD priority is to reduce "Total Ownership Cost"(TOC) by reducing operating and support costs once the platform is delivered.

We believe the next wave of competition will be in post-delivery services that heretofore have been almost exclusively in the DoD's domain. The advent of the Internet, design collaboration, virtual product modeling, advanced simulation and open architecture are all giving rise to new corporate capabilities that can be leveraged in the post-delivery arena. These innovations

in technologies will allow a disintegration of the value chain due to the inherently frictionless ease of performing transactions. These capabilities can fuel new engines of growth in the services arena for prime contractors that historically have been relegated or self-compromised to solely designing and building products.

Building an Innovation Engine within Defense

We believe that innovation capabilities can provide a distinct competitive advantage for aerospace & defense competitors. By mastering the key components of the Innovation Engine (market understanding, technology management, product line planning and product development) a company will be better able to meet competitive demands of the marketplace:

- Identifying and creating new market spaces with higher returns
- Developing and prioritizing the right technologies
- Developing and competitively delivering differentiated products and services

Improving innovation capabilities along the above dimensions can have significant top-line and bottom-line performance impact:

- Earnings captured sooner
- Faster response to competitive threats
- Lower innovation costs
- Higher throughput – more products, more markets, targeted products, higher revenues
- Increased market share
- Revenue growth
- Higher margins
- Improved customer satisfaction

With significant improvements in shareholder value drivers like these, aerospace & defense companies can get back in the game. The corresponding challenge is to select, build and deploy the right innovative capabilities effectively – one useful technique is Best Practices identification and transfer, which will be discussed later.

For more on the concept of Innovation Engines, please see our series of eight Viewpoints *on this topic.*

Commercializing Technology Outside Defense

The consolidation of the past eight years has left aerospace & defense firms less diversified today and more focused on their core of aerospace & defense. The industry "gorillas" have divested many non-defense businesses, and many diversified firms (as mentioned previously) have divested their defense businesses. However, defense firms remain underexploited hotbeds for attractive technologies that have applications in a variety of commercial markets, such as telecommunications, medical, automotive and other diverse industries. We all know the horror stories of past attempts to commercialize technology by defense firms. However, at Booz·Allen we firmly believe that careful adherence to Best Practices can lead to a high success rate.

The essential elements to achieving growth through commercialization include:

1) Creating incubators outside the defense businesses to avoid distractions and the pressures to meet short-term profit objectives, which consistently stymie the new initiatives

2) Capturing market valuation by partial spinoffs that allow the market to value the new business for its growth potential (and take away the drag on the mother company's profits and market valuation)

3) Credibly assessing the full range of capabilities necessary to succeed in the new market, and forging alliances with other companies to provide market and customer access and fill in other capability gaps

4) Giving appropriate credit to the defense businesses who have spawned the key technologies and talent, and helping them overcome reluctance to provide discriminating people resources in order to protect the defense business

5) Developing a realistic business plan for initial market entry, as well as a defensible position bolstered by continued innovation and evolution of the technology.

For more information, please see our Viewpoint, Aerospace/Defense Diversification: Avoiding Pitfalls on the Perilous Path.

Forming International Alliances

Consolidation within the United States and Europe is well advanced in most segments of aerospace & defense. However, global consolidation is just beginning. The most viable end game will consist of global players rather than continent champions since the markets within Europe and the U.S. are not large enough to support competing indigenous programs. In order to have true competition, government customers will need to look to global competitors, and these relationships will need to extend beyond teaming to a more complete and permanent set of strategic alliances.

Our extensive research into Best Practices at over 800 global companies involved in over 8,000 alliances shows compelling evidence that:

1) Strategic alliances are a compelling growth engine, as they quickly fill critical capability gaps to expand the service offering and markets served in a way not possible with internal development, given the scarcity of time and resources to invest

2) Alliances earn ROI 50% higher than base business, and returns more than double as firms gain experience in alliances

3) Alliances are a powerful alternative to acquisitions because they avoid costly accumulation of debt and buildup of balance sheet goodwill (increasingly an issue as new accounting regulations in the U.S. will eliminate "pooling of interests" as an option in mergers)

4) There is a rich body of knowledge on Best Practices in alliances, which can allow aerospace & defense companies with limited experience in strategic alliances to successfully leapfrog the learning curve and achieve the high ROI and success rates that experienced companies capture

For more information, please see our book Smart Alliances: A Practical Guide to Repeatable Success *(the top-selling book on alliances) and our seven* Viewpoints *published on this topic.*

II. Operational Excellence

Achieving Lean Manufacturing and Rationalizing Capacity

The aerospace & defense industry can address the burgeoning excess capacity that is driving less value-added labor conversion per dollar spent. Maintaining the weapon production capacity of the mid-'80s buildup exacts a substantial domestic cost—supporting high fixed costs that must be paid even during low rates of production. By conservative estimates, most major aerospace & defense platform designers and producers are operating at less than 50% capacity utilization, and some segments such as shipbuilding are operating as low as 20%. Process specific technologies are even lower, e.g., machining capacity was found to be operating at less than 10% utilization industrywide. For aerospace & defense contractors, we recommend a focused market-back approach to "right-sizing" the existing infrastructure. Essential elements to achieve significant improvements in the asset base are:

1) Defining core/non-core work and assets

2) Establishing a realistic minimum base scenario — "the floor"

3) Developing direct/indirect spending targets to support out-year financial envelopes — based on the "floor"

4) Sizing a footprint that complements the "floor"

5) Determining the "right size" organizational structure to support the "floor"

By creating single site economics across a broad spectrum of similar or related products and programs and focusing on truly discriminating activities within the value chain, successful aerospace & defense companies have made dramatic improvements on ROA and sales per employee.

Redefine Supply Chain Management via e-Business

The Internet is transforming supply relationships of aerospace & defense companies across a broad spectrum of activities.

By e-enabling the process, e-sourcing improves the accuracy and availability of information on both the supply and demand side, facilitating collaboration, as well as control and compliance. E-sourcing solutions create value by reducing three elements in a company's cost structure: (1) transactions, (2) material, and (3) flow time.

Wherever a company resolves to apply the tools of e-sourcing in its supply chain, the results promise to be powerful. Booz·Allen & Hamilton has developed considerable expertise in this arena – helping clients both in building strategic, ongoing e-sourcing capabilities and in realizing "quick hit" savings. In our experience, the companies that transform themselves from "bricks" to "bricks and clicks" will usually outperform the pure clicks – but the transformation is not easy and requires a new business model and approach.

For more information, please see our Viewpoint, e-Sourcing: 21st Century Purchasing.

Role of the Corporate Center/Shared Services

The historical management models in place in most defense suppliers are no longer valid. These models, designed for narrowly focused $3-6 billion companies operating in a favorable market environment, are not suited to today's and tomorrow's environment. The new management model must be able to address the issues of size, complexity and adaptability to a rapidly changing market environment. They must address head-on how these newly merged organizations will create (rather than destroy) value above that created by the individual operating company.

The CEO and the functional leaders in the corporate head office can no longer participate in the myriad details it takes to run each line of business. Instead the role of the CEO changes to one of organization designer, risk manager and strategic leader. Operating companies will be realigned into natural business units (capturing the benefits of scale and scope that was made possible through industry consolidation). These new businesses will become more autonomous—charged with finding growth and delivering competitive financial returns—with the freedom to develop alliances as required in order to succeed. The head office will shrink to a small "core" of high-level executives who focus on a narrowly defined set of missions dealing with policy and strategy. Other traditional head office activities will be outsourced, eliminated, pushed back to the business units or transferred to a shared services organization (which could be real or virtual).

Underpinning these changes will be a new performance ethic: more rigorous goal-setting processes, clearer accountability for results, more accurate reporting mechanisms and reward systems that effectively recognize differences in value creation.

For more information, please see our recent Viewpoints *on* Shared Services: Management Fad or Real Value?, Beyond Shared Services: e-Enabled Service Delivery, *and* Getting Shared Services Right: Capturing the Promise.

III. Management/Leadership

Build Employer of Choice into HRM

At a minimum, the war for top-notch human resource talent will not diminish in the near term and could worsen as demand increases for systems integration and technical skills as dot.com and B2B/B2C software development companies continue to drive the financial markets. This pressure will continue to raid our finest technical talent from both university graduates and corporate America.

That said, there are companies that have mastered the capabilities needed to source, hire and retain the very best in these demanding technical fields. Not surprisingly, our study of corporate best practices indicates that "Employer of Choice" and employee development are inextricably linked. Those companies that have made Human Resources part of the strategic management team have found ways to effectively bundle and integrate employee development needs with their overall corporate strategy, and are more successful at fine tuning both their search criteria and their package offering.

Better Post-Merger Integration

Post-Merger Integration (PMI) is difficult, and few companies have effectively cracked the code. Some of the notable ways an incomplete PMI process has hindered companies from achieving superior results and contributed to recent disappointments in defense company earnings are:

1) Differences in cultures are not addressed, resulting in confusion and inadequate communication about expectations and results

2) Redundant capabilities are allowed to co-exist in different locations, thus suboptimizing and preventing realization of the true synergies from mergers

3) A less than disciplined negotiation with the customer prevents retention of the savings for a period long enough to justify the investment in the merger

4) Inadequate metrics in place to measure the benefits from the PMI.

Booz·Allen has done extensive research on best practices in PMI, and captured this in publications such as our Viewpoint*,* Making Acquisitions Work: Capturing Value After the Deal.

Use Best Practices to Leapfrog Performance

Best Practices identification and deployment is a critical capability for the Aerospace & Defense Industry where mergers and consolidations have brought together companies with many great talents. Today, the key is to harness the extensive body of knowledge that already exists within a corporation's boundaries using best practices, rather than create and/or acquire new corporate knowledge. By identifying and transferring an organization's best internal processes, resources and know-how, a company can leapfrog its historical performance. By replicating superior best practices with respect to key performance dimensions like cost, speed, flexibility, quality and service, an organization can quickly move their game to a new level and derive tremendous benefits.

Best Practices can be applied across entire business streams to improve performance. Deploying internal best practices, rather than utilizing external benchmarks, is attractive since these best practices already reside within the organization. They can reduce complexity by disseminating common processes, and they are generally easier and more effective to transfer.

What Policy Makers in the Government Must Do

We have outlined the systemic problems facing the defense industrial base and have described the steps industry participants should take to restore the industry's viability. At the same time, the Government has a major role to play in maintaining an environment favorable to a strong industrial base.

As the sole customer for many defense and space systems, the U.S. Government shapes the industrial base in terms of tone, rules and processes. First, the fundamental "tone" of the Government's relationship with industry sets the stage for specific interactions. Since the enactment of defense procurement reforms in the mid-1980s, this tone has oscillated between an emphasis on partnership and a more contentious relationship. These shifts in the quality of the relationship usually coincide with budget levels—with tension increasing as funding goes down. Second, the Government establishes the rules—the laws and acquisition regulations to which industry must conform. These rules provide guidelines for virtually all aspects of the business and hence exert enormous influence on the industry. Third, there are processes by which the Government oversees and guides the overall defense industrial base and specific sectors. These processes may include implicit understandings and guidance, as well as explicit policies and statements.

To ensure a healthy and productive defense industrial base for the 21st century, we believe the Government must take action in all three areas:

I. Tone of Relationship

- Strengthening the partnership

II. Rules

- Stabilizing programs and funding

- Creating incentives for the industrial base to rationalize capacity
- Living with selected monopolies
- Sustaining a spirit of innovation

III. Processes
- Considering industrial base issues in the acquisition process
- Understanding industry's metrics
- Streamlining the export control process
- Addressing the human resources issue

I. Tone of Relationship

Strengthening the Partnership

The Government has responsibilities for its stewardship of industries that support the common defense. While the Government cannot and should not rescue individual firms from the consequences of flawed management, it does have a critical obligation to create an environment conducive to the long-term health of industrial sectors that support its unique requirements for systems critical to our national security.

As the customer for defense materiel, the U.S. Government has certain responsibilities and obligations. Most important, it has the responsibility to ensure that the systems, products and services it purchases are the best value for the American public, and adequately provide necessary performance and capability to ensure the nation's security. In seeking the best value, acquisition program managers are directly accountable to senior civilian leaders and Congress. Program managers also face scrutiny from news media and public interest groups.

As noted earlier, the budget for Department of Defense investment – the sum of research and development and procurement spending – has declined sharply since its peak in the mid-1980s. One of the consequences of this decline has been an unprecedented period of consolidations and mergers as well as a large number of companies exiting the defense business. During this same period, the Government has sought to reform its acquisition rules and processes. While these reforms have resulted in needed process improvements and significant efficiencies, they have also created certain tensions between Government and industry. These tensions are heightened by the decrease in the number of new acquisition starts – often making a single source selection decision a "matter of life or death" for some manufacturers. Additionally, there are indications that the Government's focus on mission success has occasionally been lost in favor of cost reduction.

Government as well as industry must share in the responsibility for failure and success. We believe that the deteriorating financial health of the industry mandates a closer partnership between the customer and supplier. This partnership must be based upon improved communications, and a mutual appreciation of the challenges facing both sides. On the government side this means developing an understanding of the Defense marketplace and a sensitivity to market demands and pressures.

II. Rules

Government laws and regulations have profound impact on the viability of the defense industrial base. Especially critical are policies with respect to improving program and funding stability, the sharing of cost savings between customer and supplier, supporting innovation and addressing the human resource dimension.

Stabilizing Programs and Funding

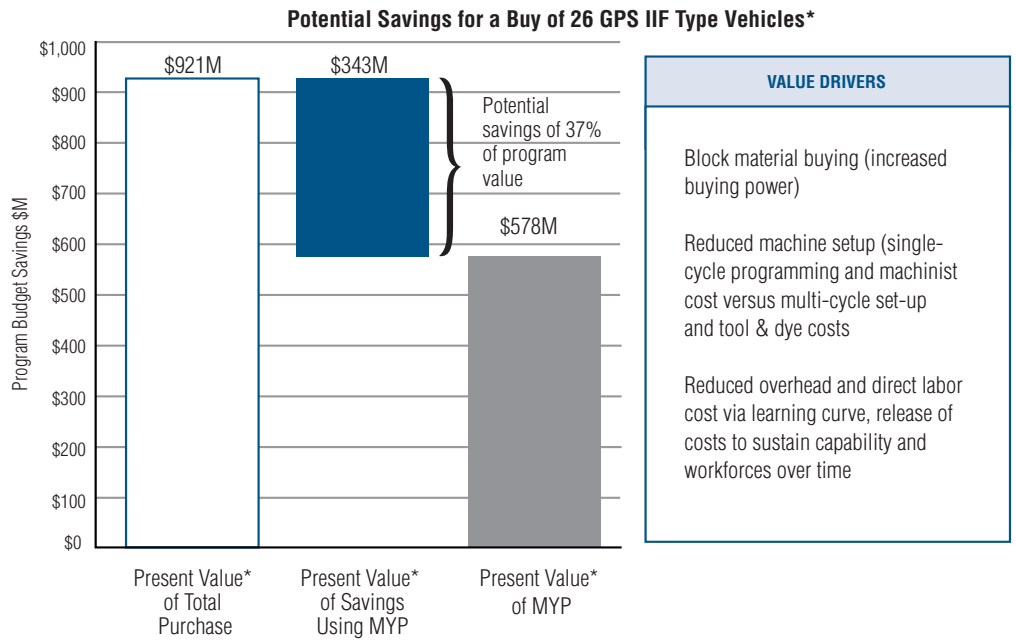
The increasing uncertainty of the business is one of the major reasons that numerous companies have exited the defense industry. The past two decades are replete with new acquisition programs, which (after considerable industry investment) have been either cancelled or stretched out due to DoD and Intelligence Community budget cuts. Greater than 60 percent of the cost

growth in the defense procurement budget is estimated to be due to program and budget adjustments rather than technical factors. Establishing new policies to stabilize programs and funding would address two major issues confronting the defense industry—reducing uncertainty and minimizing cost growth.

One solution is to increase the use of multi-year programming (MYP). Historically, Congress has been reluctant to grant MYP status to programs as it erodes Congressional flexibility in exercising the annual review and approval of the President's budget. The legislative branch's reluctance is underscored by the fact there are few programs approved for MYP. For example, the Air Force has just one program approved for MYP—the C-17 transport. The result for the C-17 has been a stable, very well-executed program and a saving of several billion dollars. We believe that DoD should ask Congress to approve MYP status for several more programs. MYP selections should be based upon solid estimates of the total buy, efficient production rates, and anticipated savings. To address concerns about development delays, we suggest a DoD-wide study with industry of the cause of slippage and the resultant impact on both cost growth and industrial efficiency. Such a joint study can not only improve understanding of the criticality of the problem but also form the basis of a consensus for action.

DoD should consider additional changes to introduce greater levels of stable funding, thereby improving cash flow. These include: increasing progress payments; automating payment practices to reduce transaction time; revising the "paid cost rule" to include both existing and future contracts in paid and invoiced amounts; authorizing lifetime buys in select cases when maintenance

Exhibit 21. Potential Savings for Multi-Year Procurement in GPS



Source: Booz•Allen & Hamilton Analysis

* Present Value using 10-Year T Note Rate 4.9%, based on Office of Management and Budget Circular A-94

APS IIF has been split into APS IIF 1-12 and APS III. As a result the cost savings are not as significant as stated in the analysis; however, significant savings are still attainable.

of the industrial base is not an issue with the supplier; and considering legislation to authorize advance payments. Virtually all of these methods are within DoD's discretionary authority (see Exhibit 21).

Creating Incentives for the Defense Industrial Base to Rationalize Capacity

Despite the inefficiencies resulting from overcapacity, today there are disincentives to further rightsizing. As mentioned, Congress has mandated that contractors must show twice as much savings as cost reimbursement for plant rationalization to be funded. Within DoD, a contractor does not receive an award fee credit for downsizing. In fact, the opposite is true as current weighted guidelines for source selection reward the creation of new facilities. Finally, the government has required the defense industry to facilitize based upon the initial plan for program buys rather than a more realistic estimate based upon what the Defense procurement budget can accommodate. This disparity between initial ambitions and the reality of actual purchases is vividly underscored on Exhibit 15, SBIRS High Funding Delays and Program Changes. Only senior government executives can provide this macro view of what is realistic and therefore affordable. With more realistic estimates of actual program content, industry can do a better job of facilitizing to the proper level.

Living with Selected Monopolies

Within Government, the prevailing view is that monopolies are to be avoided. This view is well founded. Competition is obviously the best way to secure the lowest price and to ensure continued innovation. A problem surfaces when competition is no longer viable. What does the government do when there is not the business case for two or more competitors?

With the likely further downsizing of the defense industry, viable competition at the subsystem and component level may not always be possible, particularly for government-unique systems with limited production runs. This problem was recently encountered at the component level for several national security satellite systems, atomic clocks, large control moment gyros, traveling wave tube amplifiers, ultra low expansion coefficient glass and radiation-hardened parts—all are examples of low rate productions that cannot sustain two profitable competitors. This problem is likely to be compounded in the future as systems become more capable, leading to fewer programs and, as satellite lifetimes increase, resulting in longer gaps between programs. For some components there was a single U.S. source; for others, two or more inefficient sources. The inefficient contractors will not likely provide best price or innovation. They may also exit the market at crucial time frames in a systems development. When faced with two or more inefficient U.S. contractors the lessor of evils may be to form a long-term strategic partnership with a single U.S. supplier. Given the globalization of the defense industrial base, viable competition sometimes may be achieved by including selected foreign sources.

In cases where competition cannot be sustained and when the Government does not wish to support or rely upon offshore capabilities, national security executives should consider strategies for managing sole-source suppliers for development and production of specific components or capabilities. These "centers of excellence" would be regulated by policies to ensure best value to the Government, continued innovation and a fair rate of return for private investors. The Government should conduct an analysis of the industrial base with the objective of identifying those missions and subsystems for which a designated center is an appropriate option.

Sustaining a Spirit of Innovation

As pointed out earlier in this *Viewpoint*, government funding for research and development has declined and the independence of IRAD has eroded. These trends should be alarming to government officials from two perspectives. Although today the U.S.

has no peer competitor and is years ahead of any potential adversary, the reason for this is that the DoD invested in technology such as stealth, precision weapons, space systems and advanced sensing systems. Given the 15–20 year lead time from technology to production, will the U.S. still possess the relative qualitative advantage in the coming decades? The second by-product of a failure to invest in breakthrough technologies is the impact on recruiting and retaining top scientists and engineers for the defense industry.

The defense community should revitalize the independent or discretionary R&D program. In other words, put the "I" back in IRAD. A number of approaches should be considered such as precluding IRAD for specific programs (not too many years ago, using IRAD in this fashion was not allowed), precluding the use of IRAD after contract award; and tracking the levels of IRAD funding outside the Future Years Defense Plan (FYDP) to include total spent versus the real value. The emphasis of the analysis should be in measuring the "I," (independence), the "R," (research), and not the "D," (development).

III. Processes

Given the current and projected situation in the industry, there is a need to improve certain procurement processes. The areas that should be enhanced include considering industrial-base concerns during the acquisition process, developing mutually understood metrics and streamlining export controls.

Considering Industrial Base Issues in the Acquisition Process

Despite the contraction of the U.S. defense industry, industrial base factors are generally not considered in the acquisition planning of defense and intelligence systems. Individual procurements are handled independently and sequentially. Moreover, motivations are great for acquisition officials to focus on a specific program, as rewards are based on short-term considerations. Ironically, twenty or so years ago when the industry was far more robust and diverse, the potential effects on industry of major procurement decisions were routinely considered as part of the process.

We believe the current state of the industry mandates that the industrial base be an important factor in acquisition planning processes. To perform such assessments, the Government should first develop a database that illuminates where multi-source competition may be threatened at the weapon system and major sub-system levels. Such a database would complement current program office assessments of specific component development and production problems.

In the future, we believe industrial base considerations should be included in appropriate planning documents, such as the Defense Planning Guidance, the Intelligence Planning Guidance and Strategic Master Plans. The broad guidance then should be reflected in the up-front acquisition planning. For example, we believe industrial base considerations along with other cross-cutting factors such as interoperability and consistency with higher level architectures should be considered in a new program's Acquisition Strategy Plan (ASP). Industry should participate early on in development of the ASP. By considering industrial-base implications before choices are made and options foreclosed, national security acquisition executives can ensure strategies on down-selects (and bundling of production contracts) and support the goal of a sufficient and competitive industry.

Understanding Industry's Metrics

By and large, DoD is budget driven and the Department manages its programs by monitoring industry's performance against cost, schedule and capability specifications in a contract. Industry, by contrast, is price driven and uses a variety of metrics to evaluate financial performance, including return on assets, return on equity and share price appreciation. With the advent of the "New Economy" based on advanced computing and telecommunications technologies, managers of defense and aerospace firms must first show their shareholders and

directors that they can offer equal or superior value in terms of return on investment and assets. While such bottom-line considerations are now more critical than ever in shaping firms' decisions on bids and program management, DoD does not generally consider the aggregate financial health and performance of the industrial base in shaping its acquisition policies.

Program managers should continue to focus primarily on contract performance; the acquisition executives and legislators who oversee defense programs must be cognizant of important corporate financial metrics. In addition to considering publicly disclosed financial information on the overall health of firms, DoD should assess the financial health of specific defense manufacturing sectors.

Streamlining the Export Control Process

Export control of militarily critical technologies is critical to sustaining America's competitive advantage. However, current implementation of these controls is overly bureaucratic and thus inefficient. This inefficiency detracts from the competitiveness of U.S. firms in international aerospace & defense markets, particularly in areas where it is unclear that technologies are particularly sensitive or unique. The loss of markets has a secondary effect on the industrial base's sufficiency to meet future DoD requirements.

To be effective, export controls should be based on a clear understanding of the technologies that must be protected. Sensitive technologies can be described at the component level or as broadly as entire systems or engineering know-how. However, any decision to restrict transfers should be based on a compelling rationale of the need for restrictions. Policy makers also should have a firm understanding of potential foreign alternatives and the impact of unilateral U.S. restraints on the competitiveness of U.S. suppliers.

Once the Executive Branch and Congress form a consensus on the appropriate balance between technology protection and industrial competitiveness, the government should reengineer its license review process. We believe a revamped system should generally shift from today's transaction-based process (where each proposed transfer is subject to complete review) toward a process that distinguishes between varying levels of technology sensitivity and end users. Under this revamped system, transfers of capabilities that are widely available in the global marketplace to close allies would be processed with minimal delay. Stricter scrutiny would be maintained for transfers to nations who might transship to potential adversaries, as well as for technologies where the U.S. holds a substantial technological lead.

This reengineering of the export licensing process also should make greater use of information technology solutions. These systems would allow license examiners to access databases of critical technologies and applications, profiles of customers and end users, and information on past transactions.

Dealing with Human Relations Issues

In discussions with the industry's senior leadership, the No. 1 challenge identified was people. As in many other manufacturing sectors, the aerospace & defense workforce is aging and it is becoming increasingly difficult to recruit and retain top-flight talent. The causes are many: low

unemployment and a tight labor market for critical technical skills; the image of aerospace & defense industry as a slow-moving "smokestack industry" with relatively few technical challenges; and a cultural shift in other technology firms toward fluid career paths and open management styles.

The implications of this estrangement between technical talent and the defense industrial base are profound and therefore demand attention. In coping with the problem, DoD and Congress must recognize the relationship between funding breakthrough technologies and defense industry's ability to attract and keep their share of the best and the brightest.

While a renewed emphasis on technology development and demonstration may play the greatest role in attracting and retaining key talent, DoD also should support other incentives for key technical staff. These might include introducing performance rewards based upon mission metrics; encouraging the use of "reenlistment" bonuses; and reevaluating any intra-industry benchmarks that perpetuate non-competitive wage rates.

The government also should broaden the use of scholarship, intern, mentoring and award programs for aspiring scientists and engineers. It has been our experience that industry could improve their human relations management, planning and issue identification. A consistent theme in our research was that the company HR function often could not quantify the impact of personnel losses on productivity and mission success. The government should encourage and create incentives for companies to strengthen corporate HR functions.

In parallel, senior defense and intelligence policy makers should seek to enhance the knowledge and skills of the federal acquisition workforce. In addition to providing young officers and civilian engineers with experience on technical projects, training for mid- and senior-level officials should be reviewed and reinforce the importance of industrial base issues. Such training should include formal instruction in systems management courses as well as rotational assignments in industry and other interactions.

Summary

Although the U.S. Defense industry remains the world leader and the American armed forces are indisputably the best equipped, the industrial base is deteriorating. This decline is due to a variety of factors—among which are an erosion of the financial health of the industry and an increasing challenge to recruit and retain the top science and engineering talent.

The trends are negative and, if left unchecked, will eventually have an effect on national security. We are convinced that the action agenda which we have laid out in this *Viewpoint* is critical to preserving the world's preeminent defense industry.

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