The Future of the Defense-Related Industrial Base in the United States

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Scholars recognize that large and continuous defense budgets in the United States during the 1980s contributed to the demise of the Soviet state. One observer has noted that the ruin of the Soviet economy was "overwhelmingly due to their obsessive diversion of funds into military production."[1] Others, among them George Weigel[2] and Eugene V. Rostow[3] point to the "almost maniacal growth" of Soviet military spending as a very significant contributory cause of the Soviet collapse. It is germane to this discussion that all of these analyses occurred after, rather than in anticipation of, US investments in weaponry during the 1980s.

US annual defense budgets in the 1980s averaged $300 billion, peaking with the 1989 budget of almost $320 billion. Large outlays in the defense technology industrial base during the decade allowed DOD to acquire the advanced weapon systems needed for the essential edge in conventional deterrence. At the same time, these expenditures placed enormous stress on the Soviet economy and its industrial establishment as they sought to match the US level of investment in new technology and derivative advanced applications. The estimated 18,000 prime and subtier contractors in the US defense technology industrial base supplied required defense materiel while significantly advancing technologies and improving production processes. DOD's policy to assure redundancy and alternative sources among the suppliers of defense materiel combined with large research and development expenditures to produce weapon systems and other defense materiel of exceptional quality.[4]

Equally important, large expenditures within the US defense technology industrial base accelerated the incorporation of advanced technology and helped to create significant economies of scale in production. Large manufacturing facilities were often dedicated to individual weapon systems, leading to specialization and concentration that also advanced the learning curve among production personnel. DOD spending in the 1980s also encouraged significant research, development, and engineering activities by defense contractors and by various research establishments, laboratories, and academic institutions.

The federal government has been debating since the collapse of the Soviet Union the nature and size of the new threats that could pose a risk to US national security. No matter what threat we agree on, policies, plans, and budget programs will appear to assure an adequate supply of defense materiel for anticipated requirements. Regardless of specific positions on how much is enough, one outcome of the debate is already clear. The politics of change will continue to cause unprecedented reductions in the US defense technology industrial base.

This article examines two types of activities that address the future of the US defense-related industrial and technology base. The first consists of efforts by Congress and the Administration to introduce concepts, laws, and regulations that would maintain the defense technology industrial base and the industrial activities essential to US national security strategy. These include low-level production of defense goods, maintenance of manufacturing facilities with dual—civil and defense—capabilities, more productive use of US government owned and operated facilities, and introduction of "prototyping-plus" in defense procurement processes.[5] The second type reflects actions proposed or in progress among the large US defense contractors and their networks of suppliers which are resulting in decisions either to abandon or significantly restructure their defense-related activities.

These two movements are not mutually supportive; in fact they are often contradictory. Their evolution creates risks for managing the defense technology industrial base, primarily because the range and scope of the changes taking place generally are not apparent to those charged with national security emergency preparedness. Part of the risk lies in long-held assumptions about industry's capacity to respond in a national security emergency. Such assumptions are being invalidated daily, well out of sight of strategists and planners, as companies large and small leave defense business, shift to production for civilian markets, or downsize to an extent that precludes their responding rapidly in a crisis.

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Recent History

There is strong consensus that US national security must be based on military superiority achieved through a well-trained and well-equipped fighting force, supplied by an adequate defense technology industrial base. The wisdom of such a policy is illustrated by the outcome of the 1990-91 war with Iraq. Three general observations about that conflict are important for policies affecting the defense technology industrial base.

First, US preoccupation with global war made it difficult for logistics and industrial preparedness planners to cope with the very specific requirements of conventional conflict outside the NATO region. The complex deployment to a remote region and operations from a largely bare-base environment not only challenged many Cold War assumptions, they also foreshadowed our involvement in Somalia.

Second, the ad hoc coalition in the Gulf, fielded without extensive DOD planning and exercises, differed significantly from anticipated Southwest Asia contingencies. By January 1991, the Army had moved 42 percent of its helicopters and 57 percent of its armored vehicles (M1A1 Abrams and M2/M3 Bradleys) to the Gulf. At the same time the capacity to expand production of M1A1 or M2/M3 vehicles was marginal.[6]

Third, in spite of the very large defense outlays in the 1980s, relatively limited military actions in 1990 and 1991 produced shortages of some supplies and materiel. In some instances, DOD had to rely on foreign sources for some of the required materiel. Most of these shortages were the direct result of the overall relative decline in the defense technology industrial base, particularly in some critical industry sectors, such as electro-optics or special bearings. Although warned of such potential shortages,[7] DOD essentially ignored the status of the defense technology industrial base. The prevailing attitude was that significant levels of defense spending would guarantee the supply of defense materiel at the times required. That, of course, turned out to be an incorrect assumption.

DOD budget reductions will undoubtedly continue. Some predictions are in the range of $200 billion per year, with estimates as low as $180 billion later in the decade.[8] These much smaller budgets will significantly affect the size and health of the defense technology industrial base. Reductions will continue; firms that design, engineer, and manufacture defense products may decide—or be forced—to leave DOD's stable of prime and lower tier contractors. Concern over these defense technology industrial base adjustments has resulted in a series of policy proposals by Congress and the Administration. Industry itself has become an increasingly active participant in the debate.

The level of defense procurement directly affects research and development; the very important independent research and development activities are supported to a large extent by overhead charges in production contracts. When

large production runs were the rule, many companies willingly invested their own funds in independent research and development because there was a reasonable expectation of recovering their investment out of future profits from production. In effect, a significant portion of DOD's research and development during the Cold War was paid for by industry.

US defense budget reductions forecast equally significant changes in how the military services spend their money. The danger is that the services will attempt to maintain as large a force structure as possible through offsetting reductions in other categories of expense, such as maintenance and improvement of the defense-related industrial base. Somehow the essential skills in engineering, testing, prototyping, manufacturing, fielding, and maintaining defense materiel for the services must be preserved. A balance must develop among operating funds, sustained improvement of existing weapons and other materiel, and new production of technologically advanced defense systems. The dilemma for policymakers is quite clear: how to preserve, in the future, an adequate defense-related industrial base in the face of significant reductions in US defense expenditures.

Policy Issues

A number of strategies have been proposed to meet future US defense technology and industrial needs. All of them stress broad policy choices, such as the autonomy of the nation's defense-industrial sectors, competition among defense contractors, the degree of integration of defense and civilian industry, and the appropriate level of government intervention in the industrial base.[9]

Four sets of strategic options will continue to influence the debate over defense-industrial management. The options are expressed below as paired alternatives:

- continued low-rate production of defense materiel to retain minimal industrial capability or plant shutdown and reactivation when required
- a controlled degree of international interdependence or national autonomy in defense production
- a regulated arsenal approach to some production or more extensive reliance on the domestic civil sector and a market approach for production
- prototyping advanced technology weapon systems and defense materiel or longer low-level production cycles and inefficient sustained production

The various defense industrial sectors are positioned along a continuum reflected in the four policy choices. Retention of a competitive US defense technology and industrial base over time requires careful application of the policy options among the most important of the industry sectors involved in

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defense production. Application must include consideration of the strengths of suppliers and subtier manufacturers in each sector. In practice, none of these strategic options can be pursued to the complete exclusion of the others.

Low-Rate Production or Plant Shutdown and Reactivation

Continuation of low (or lower) levels of output might preserve the businesses, facilities, production lines, and teams of skilled employees that supplied defense materiel in the past. Analyses of DOD procurement plans, however, suggest that this policy alone will not be sufficient to maintain many defense-related industries. Future spending levels for defense materiel may be lower than the minimum required to maintain production of certain weapon systems. A contributing factor is the large production runs during the past decade which filled the inventory and met fielding requirements for a number of major US weapon systems.

Analysts cannot ignore the fact that in the late 1980s the production of M1A1 and M1A2 tanks and Apache helicopter missiles for the domestic inventory was discontinued. Foreign sales are the only remaining production requirement for these weapons. While a number of US manufacturers, such as McDonnell Douglass, anticipate significant foreign orders, it is not prudent to base US defense-related production capacity on the uncertain potential for exports of US weapon systems. Consequently, low-rate production has been effectively discounted as a useful policy for maintaining the US defense-related industrial base. Reactivation of defense-related plants would require one to three years of elapsed time for equipment and machinery restoration and training of the labor force—not an acceptable delay in the event of a national emergency.

Controlled International Interdependence or National Autonomy

This option acknowledges that the technology and industrial base is becoming globalized and that the cost of developing new weapons and other materiel systems continues to grow. A recent Defense Science Board study argued that the advent of industrial globalization created "an interdependence of allied nations for the technologies and even the components of defense

systems." The study also noted, "The days of Fortress America are past. We are, and will remain, dependent on foreign resources for critical components of our weapon systems. We cannot eliminate foreign dependency in this era of globalized defense industry."[10]

Proponents of international interdependence contend that it can create a more competitive environment, ultimately decreasing the price of military products; facilitate standardization and interoperability of weapons with allies; and assure access to the best technologies as new scientific developments take place around the world.

Cooperation with allies may be determined in part by the need for stronger controls on the proliferation of weapons and defense industrial capabilities. A recent report by the Office of Technology Assessment on the international arms trade examined the dilemma of the United States and its allies in choosing between arms exports to help maintain a viable defense production base, and export controls to reduce the flow of modern weapons and technology to potential trouble spots.[11] The study argued that the globalization of the arms industry and trends in defense technology suggest that unilateral action to reduce the proliferation of modern weapons and technology is bound to fail. If so, then closer defense industrial cooperation with sophisticated partners, such as our European allies and Japan, would provide access to new technologies while improving allied coordination and creating leverage for controlling the export of sensitive technologies.

Opponents of international coproduction programs propose a "Buy American" strategy as the best way to reserve limited defense procurement opportunities for US firms. They contend that foreign-sourcing could aggravate weaknesses within the US defense technology industrial base. Moreover, foreign-sourcing could impair our ability to respond in a crisis if foreign firms prove to be unresponsive to our requirements. Those who favor self-reliance argue that procuring most or all defense materiel from US sources would reduce the risk of supply cutoffs during a crisis, protect domestic suppliers of services and equipment from the threat of unfair foreign competition, and increase the demand for US defense products. The cumulative effect of those advantages, they insist, could increase US industrial productivity through larger production runs, which would also accelerate technology improvements.

Since most of our military systems are already purchased from US prime contractors, this strategy would have its greatest effect on subtier industries such as optics, fasteners, bearings, and electronics. The most relevant national security consideration related to international suppliers, however, is not total foreign content but vulnerability of critical US technologies or products.[12]

During interviews with more than 60 US defense industry executives regarding future collaboration to design and manufacture weapon systems, not a single executive supported increased interdependence with foreign sources. All declared that past DOD collaboration efforts (including coproduction arrange-

ments) had cost the US firms dearly in transferred technologies, engineering know-how, and loss of manufacturing processes to foreign industrial entities, without any compensating benefits. A large number of the executives identified foreign, particularly European Community, military equipment programs that are directly aimed at reducing their dependence on US arms and are competing with US producers for defense sales in world markets. From a national security perspective these views are unfortunate, because close cooperation with our allies in weapon design and production could benefit all.[13] They are, however, well founded in the differences between the ways that US and foreign firms, and their national governments, do business.

The US and European defense markets are dominated by policies that sound similar, but differ greatly in detail (see Figure 1). The disparities, derived from contrasting national policies regarding defense, address the increasing integration of national security and economic security.

United States	*Europe*
• A single market	• Fragmented, but integrating
• Domestic market still considered sufficient to sustain independent industry	• Domestic markets insufficient to sustain national industry
• Competitive procurement between US companies	• A mix of directed and competitive procurement
• Two or more competitors in each sector	• National champions in most sectors and often one European industrial alliance
• Arms-length government to industry relationship	• National treatment varies widely
• Funding revised annually	• Multi-year planning the norm
• Exports essential for some systems	• Exports essential
• Government to government collaboration is the exception	• Transnational collaboration is the norm through the life of the program

Figure 1. Contrasting Defense Cultures

There are a number of obstacles to US-European cooperation. The legal and regulatory mechanisms that generated these obstacles are constantly adjusting to fundamental changes in the character of the new defense market environment. The mechanisms are also changing as regional organizations evolve.

• *Controls on international trade, including tariff and non-tariff barriers.* While tariffs are no longer a major obstacle to defense trade, non-tariff barriers such as local content requirements, offsets, and national

preference bid adjustments are increasingly used to benefit one or another of the prospective partners in such arrangements. Import quotas and "anti-dumping" provisions also have been used to restrain trade, especially in the more general market. National policies and regulations governing control of defense projects, and laws like the US "Buy American" act and comparable laws in Europe, have frequently complicated cooperative ventures in defense production.

- *Technology transfer issues.* The transfer of technical knowledge and production capabilities has been a thorny transatlantic issue for companies as well as governments. Nothing has changed sufficiently in this regard to expect more cooperative behavior among companies involved in coproduction schemes.
- *Intellectual property rights.* Intellectual property rights—patents, copyrights, rights in data—are not treated uniformly in the United States and Europe. The differences continue to make it extremely difficult to improve cooperation.
- *Standardization and testing requirements.* Creation of a new Common Market—some less elaborate version of the original concept—may exacerbate, rather than simplify, the problems of creating uniform (or compatible) standards, qualifications, certifications, and testing for a wide range of products. US and European companies cooperating in defense manufacturing could face logistical constraints and cost penalties because of distinctly different national and regional standards.
- *Competition and antitrust guidelines.* The principal difference in cultures appears in national policies regarding competition. The United States encourages competition and the Europeans generally encourage stability at the expense of open competition. These views are embodied in national and regional antitrust and anticartel legislation and regulations.

A large number of US manufacturers have established joint ventures with foreign firms for the production of various civilian market products. It remains to be seen, in view of past constraints on such products and the increasing integration of national policies into European community-wide operating procedures, whether this strategy option offers any significant relief to US defense firms.

An Arsenal System or Integration into Non-defense Production

Some members of Congress, DOD officials, and other observers argue that the US defense technology industrial base lacks both the control and assured production of a government-owned arsenal system and the innovation and flexibility potentially available from private industry. They conclude that the current situation within our defense industrial sectors reflects the worst of all possible worlds. Some advocate a return to an arsenal system, while others prescribe greater integration with the civilian economy.

Future defense production requirements probably will be too limited to support competitive procurements from multiple defense firms. For many years, the United States maintained the defense technology industrial base through a system of government arsenals and close association with a small number of commercial producers. A modified "arsenal system," composed of a combination of government-owned facilities and sole-source private firms, might allow efficient development and manufacturing of military-unique equipment. Such a strategy would concentrate on establishing and maintaining a limited number of expert sources of weapons and equipment and would restrict competition for DOD contracts to those firms and public facilities with recognized skills.

Proponents of the modified arsenal strategy argue that it would allow the United States to develop and conserve needed expertise that could then be expanded in a crisis, improve the efficiency of contract bids and proposals, and increase the stability of production. Implementation of the arsenal strategy would require major changes in current procurement laws and in the philosophy of materiel acquisition. And while policies governing promotion of competition would have to be reexamined, competition could be maintained at acceptable levels under this alternative. Congress would also need to consider different ways of controlling costs and fostering innovation without full and open competition.

Industry executives consider the arsenal concept as equivalent to nationalization of the US defense industry and are very much opposed to such policy. Their arguments focus on the fact that this approach would significantly hamper innovative advances that have made US weapons superior to those of other nations.

Conversely, we could place greater reliance on integrating defense requirements into the civilian sector, buying civilian parts off the shelf, and using more civilian technology and procedures. Proponents of increased reliance on the civilian industrial base argue that it would lower the development and production costs of weapons and other military systems, result in an improved mobilization capability against a reconstituted global threat, and make improved technology available to defense in areas where civilian technology now leads military technology.

Prototyping Advanced Technology Systems or Long Low-level Production Cycles

Defense, congressional, and some industry leaders have recommended that a policy described as "prototyping-plus" be adopted to maintain the US defense-related industrial base. This would involve the continuous development of prototypes with limited production for operational and field testing in selected cases. In the event of a need to replace obsolete systems or the emergence of a new military requirement, some of the prototyped systems could be developed further for quantity production.

Prototyping refers to the development and testing of working models—from computer simulations through operational hardware—to explore advanced technology concepts and demonstrate specific design and operational objectives, thereby advancing technological content in the new weapon systems. The current acquisition process assumes that research and development will lead in most cases to a design to be produced in quantity within a specified period for immediate introduction into the operational inventory. This assumption severely constrains the number of technological options that can be explored during research and development as well as in design and production engineering. A prototyping strategy, in contrast, would explore a variety of system, subsystem, and component technology options without the assumption that development would proceed directly to quantity production, which would become the exception rather than the rule.

Greater reliance on prototyping at the expense of quantity production would have both benefits and costs. It would advance systems technology (systems design, not laboratory research and development), keep design teams intact, and support deployment of the most advanced equipment. But it would sacrifice engineering and manufacturing teams, hot production lines, and large-scale production. The prototyping-plus approach would avoid simply putting new technologies on the shelf, which could lead to atrophy of the manufacturing base. This variation of prototyping would maintain the US edge in defense technology for major systems (e.g., ships, aircraft, tanks) despite cuts in both current production and new program starts. Analyses of emerging military threats and computer simulations could identify new capabilities that might provide a clear performance advantage at an acceptable cost. A technology-demonstrator program could then begin without a formal military requirement or the assumption of an eventual procurement.

Enough operational prototypes would be produced to enable military customers to develop associated tactics and doctrines; perform reliability, maintenance, and live-fire testing; and provide feedback to the development team on improvements needed to fine-tune the system and compensate for operational shortcomings.

Limited production of prototypes also would provide some preliminary manufacturing data, increasing industry's ability to produce the system when needed, in sufficient quantity, and at a target cost. Since long production runs would not be available to improve poor designs, a prototyping-plus strategy would emphasize designing for producibility, moving forward production issues that currently are not addressed until much later in the development process. Thus, a prototyping-plus strategy would achieve a marriage of R&D and manufacturing, with the goal of supporting both.

Prototypes would preserve the potential to move into quantity production when needed, although only a fraction of all prototypes would enter the engineering and manufacturing development phase. A service would have to

demonstrate a compelling requirement to go to full production of a weapon system or other materiel item. The production contract could be either awarded to the same firm that designed the prototype, or opened up for competitive bid.

To hedge against uncertainties in both technology and the security environment, the number of prototyping programs should be large relative to the number of systems that enter quantity production. Even though most prototyping programs would not lead to a design that is produced in quantity, they still would yield useful information and technologies that eventually could be recycled into the next generation of systems or transferred to other programs.

Shifting to a prototyping-plus strategy would entail a fundamental cultural change in both the defense industry and the government acquisition community. It would require a restructuring of the materiel acquisition process away from the linear pipeline process culminating in production. A prototyping-plus strategy also would require restructuring in the defense industry to reduce capacity and create more flexible manufacturing practices, such as multiproduct assembly lines and adoption of the agile manufacturing techniques currently under development.[14] To this end, DOD would need to continue to support the development of innovative manufacturing processes and new materials.

The four strategy options available to those pondering the future of the defense technology industrial base may in time produce unanticipated variants. What will remain constant over time is the requirement to be able to respond in a crisis requiring the US to commit significant forces in support of national interests. Soon enough we will have to begin to invest in one or a combination of the foregoing strategy alternatives or derivatives of them.

Industry Responds to the Defense Drawdown

Neither DOD nor any other federal agency knows the precise composition of the US production base. The best estimates identify some 30 corporations that serve as prime contractors who integrate components into defense-related end products. Considerably less-exact estimates identify some 9000 to 15,000 industrial and service entities that serve as second, third, and lower tier subcontractors to the large system integrators. Figure 2, on page 72, identifies the top nine US industry sectors supplying DOD by the value of their 1990 defense output.

Over some 40 years, the defense industry has developed skills and procedures that differ significantly from those required and used in civilian markets. Competition within the defense industry differs from the private sector in that defense contractors essentially have only one customer. Conventional marketing skills involve volatile customer requirements, preferences, price elasticity, advertising and promotion, and related aspects of the commercial marketplace that are almost totally unknown to defense contractors.

A company that sells to DOD must manufacture products to the exacting specifications provided under strict MILSPEC and MILSTANDARD re-

such as these often anticipate that new ownership may introduce better management methods and an improvement in performance. It should be remembered, however, that defense markets for these companies' goods will be significantly reduced; anticipated profits may be unduly optimistic. The eventual contribution of such consolidations and acquisitions to a more capable defense technology industrial base remains to be seen.

One follow-on alternative is to sell recently purchased firms to the public. Again it is unclear whether the new buyers would be able to maintain the firm's defense-related capability. And a public sale may be difficult to arrange in light of declining defense markets. It should be noted that in the case of the Carlyle Group, this "merchant banker" has not been able to complete any of its six leveraged buyouts of defense firms by selling the firms back to the public.

- Martin Marietta's competition with the Northrop Corporation for the acquisition of the Grumman Corporation, the venerable Long Island military contractor, which Northrop ultimately "won," is another example of this trend. So is Martin Marietta's purchase of the General Dynamics Corporation's rocket division in 1994 and GE Aerospace in 1993.

There is no long tradition of successful defense conversion to the civilian market. Recent studies of conversion have helped defense industry leaders to become aware of the complexity and limitations of conversion initiatives.[15] The jury is out on the effects of divestitures and consolidations such as these on the defense technology industrial base.

Finally, foreign military sales sometimes seem to promise an attractive strategy for the maintenance of the defense-related industrial base in the United States. Foreign sales of US military systems have nearly quadrupled in the past seven years, from $6.5 billion in 1987 to more than $25 billion in 1993.[16] The 1990-91 Persian Gulf conflict established the superiority of US weapons, making them very attractive to foreign buyers. However, there are developments which may limit foreign military sales by the US defense industry. One expert in the field has noted:

> Picking up the slack by selling more weapons abroad is . . . unlikely. Demand for weapons in Europe, for example, is forecast to shrink by at least 15 percent over the next five years. What's more, Europe has its own national champions—Aerospatial in France, British Aerospace in the United Kingdom, Daimler-Benz in Germany, Alenia in Italy. They increasingly crowd out American competitors, especially since they too have excess capacity. And buyers in Asia and some third-world markets are nationalistic; US companies will find it difficult and expensive to make inroads and will also find more competition than ever from suppliers in Europe and the Commonwealth of Independent States.[17]

Competition for weapon system sales from foreign arms manufacturers has been formidable. Sale of M1A1 tanks to Saudi Arabia and Egypt had to best

the UK's Challenger; F-15 fighter sales had to beat the UK's Tornado. Even Russia's military has reorganized and revitalized its foreign sales processes. Spetsvneshtekhnika GTD (the State Foreign Economic Corporation for Export and Import of Armament and Military Equipment), in spite of its cumbersome title, is expanding sales of Russian military systems. It is not difficult for the Russians to do so in the light of the very low prices asked for some of their best military hardware, such as $20 million for an Su-27 fighter.

Conclusions

The federal government, with Congress and DOD in the lead, has proposed the prototyping-plus concept as the preferred strategy for maintaining our defense-related industrial base. US defense contractors, especially the large prime contractors, consider that strategy to be the least likely to succeed. The prime contractors have responded to continuing reductions in DOD contracts with a number of business strategies, ranging from monetization of some of their assets to increased foreign military sales. The strategies followed by our defense contractors are not fully in concert with policies recommended by the government. It is likely that some of the major US defense contractors will be forced to leave the defense business entirely.

In the case of military aircraft, there is consensus that by the year 2000 only two of the present five military aircraft firms will remain in business. Lockheed and McDonnell Douglass are the two most likely candidates to supply military aircraft in the 21st century. Certainly Lockheed's design and development work on the radar-evading F-22 aircraft and McDonnell Douglass's anticipated work on F/A-18E and F fighters, as well as continuation of C-17 production, should assure DOD that critical skills for developing military aircraft will be maintained.

Likewise the congressional decision to retain General Dynamics' New London, Connecticut, submarine-building facility as well as the Newport News Shipbuilding and Dry Dock Company's facilities assures continuation of the nation's submarine and carrier-building skills. Of course, the future monopoly position of both General Dynamics and Newport News will effectively destroy price competition for these important defense systems. That apparently is the cost of retaining suppliers of essential naval vessels.

General Dynamics, the principal current tank contractor, operates from government owned, company operated (GO-CO) facilities, located in Lima, Ohio. Appropriate DOD policies should assure continuation of this important entity under General Dynamics or other management.

The ability of lower tier defense contractors to remain in business through adjustments in method and programs after large reductions in DOD purchases is far less certain. Some of them will be forced to cease operations or will be sold for much less than their actual market value. This is particularly true when the contractor represents a relatively insignificant portion of a large

industrial corporation's business. Other lower tier defense contractors are adjusting by varying forms of conversion. Such conversion is a difficult undertaking; often the most obvious markets for converted product lines are filled with very capable and well-established competitors.

The willingness and ability of these lower tier defense contractors to continue to support defense production is questionable. DOD assumes that the chances for survival of some of them may be enhanced by modifying the military standards and regulations employed in acquiring defense materiel.[18] Others, firms that successfully convert to commercial markets, may become dual-use producers selling in the commercial markets as well as to DOD. However, DOD's efforts to ease military specification requirements and other acquisition regulations to encourage dual-use manufacturing appear to be fragmentary, lacking a comprehensive and sustained program approach.[19]

In the final analysis, we will get from the remnants of the defense industry exactly what we are prepared to pay for. Let us hope that the premium of this insurance policy continues to be paid when due.

NOTES

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3. Eugene V. Rostow, "Beginnings of the End," *TLS*, 14 May 1993, p. 8.
4. The paramount importance of technological quality in US weapons is discussed in some detail in Martin van Creveld, *Technology and War* (New York: Free Press, 1988).
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7. Jacques S. Gansler, *The Defense Industry* (Cambridge, Mass.: MIT Press, 1983) and *Affording Defense* (Cambridge, Mass.: MIT Press, 1989).
8. US Congress, Office of Technology Assessment, *Building Future Security*, OTA-ISC-530 (Washington: GPO, June 1992).
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11. US Congress, Office of Technology Assessment, *Global Arms Trade: Commerce in Advanced Military Technology and Weapons*, OTA-ISC-460 (Washington: GPO, June 1991), pp. 3-31.
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13. Ivars Gutmanis, "Changes in the Location of the United States Defense Industrial Base: Analyses of Causative Factors," *Geo Journal*, 31 (October 1992), 179-92.
14. On the topic of agility, see the article by Mike Austin, "Managing the US Defense Industrial Base: A Strategic Imperative," in this issue of *Parameters*, 24 (Summer 1994), 27-37.
15. An excellent analysis of these issues is presented in David Leech and Brian Dickson, "Challenges of Diversification For All Business: Industry-Level Analysis of Conversion and Integration Barriers" TASC, Annex I to *Adjusting to the Drawdown*, Report of the Defense Conversion Commission, Washington, D.C., 1992.
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18. See the Center for Strategic and International Studies, *Integrating Commercial and Military Technologies for National Strength*, Washington, March 1991.
19. "Out of Ivory Tower," *The Economist*, 3 February 1990.