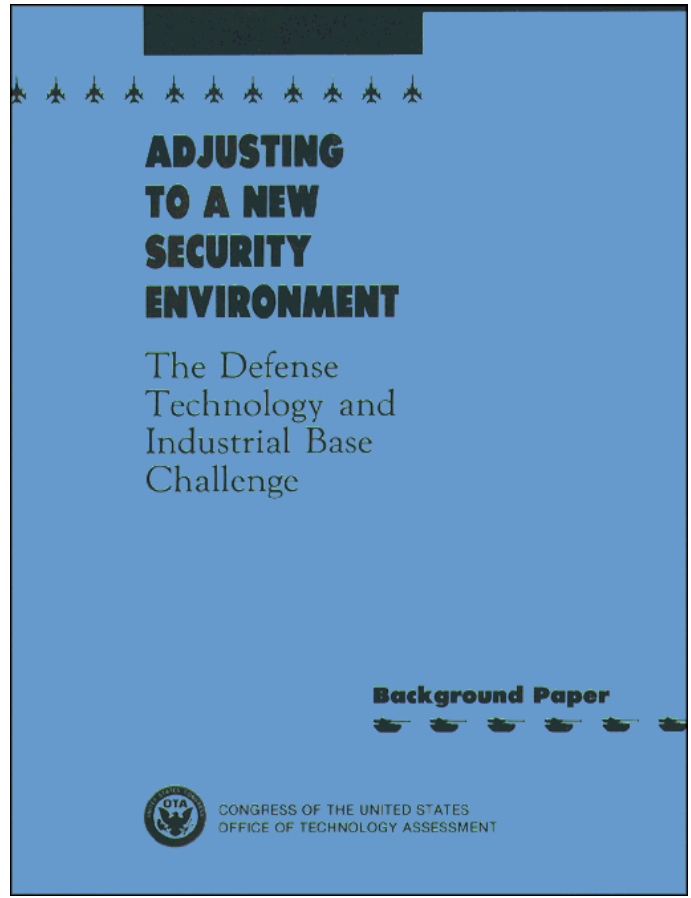
Adjusting to a New Security Environment: The Defense Technology and Industrial Base Challenge

February 1991

OTA-BP-ISC-79
NTIS order #PB91-163261





Recommended Citation:

U.S. Congress, Office of Technology Assessment, *Adjusting to a New Security Environment: The Defense Technology and Industrial Base Challenge—Background Paper,* OTA-BP-ISC-79 (Washington, DC: U.S. Government Printing Office, February 1991).

For sale by the Superintendent of Documents
U.S. Government Printing Office, Washington, DC 20402-9325
(order form can be found in the back of this report)

Foreword

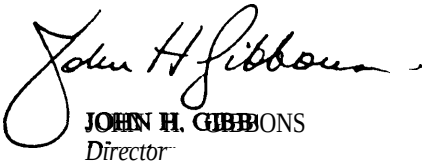
Dramatic political events in Eastern Europe, the Soviet Union, the Middle East, and elsewhere, as well as spiraling Federal budget deficits, have stimulated a fundamental re-assessment of America's national defense posture. The size, form, and purpose of the United States anneal forces are all being examined along with questions of how much defense the Nation needs and how much it can afford. While no clear answers have yet emerged, there is a consensus that-despite Operation Desert Storm-as long as positive trends in U.S.-Soviet relations continue, U.S. defense procurement during the coming decade will be much less than in the preceding one. As a result, the defense technology and industrial base that develops and produces our military systems is currently in flux, changing in both size and form. This base is a critical component of our national defense.

OTA has been asked by several congressional committees and individual Members of Congress to conduct an assessment of what form the future defense technology and industrial base might take; what form it ought to take; what government policies can do to draw these two together; and how the sweeping changes expected in the base can be managed to minimize adverse economic effects and ensure sufficient future technology and industrial capability to meet the Nation's needs. To set the context for this assessment, this background paper outlines the complex defense technology and industrial base challenges that confront the Nation in adjusting to a new security environment. It examines the role of the defense technology and industrial base in maintaining America's security, and the major factors affecting the country's evolving security posture.

These questions are complicated by a legacy of existing problems and unresolved issues related to the health and management of defense technology and industry, including the acceptable degree of foreign dependence and the desired integration of civil and military industry. While the United States has the opportunity to more fully integrate development and production in the civil and defense sectors, doing so will require difficult choices on how to manage defense production most efficiently in peacetime, crisis, and war. These decisions will force a review and revision of many current acquisition laws and practices.

The final report, to be delivered in the spring of 1992, will build on earlier OTA work to explore the strategies available to the Nation for maintaining an adequate defense technology and industrial base, and the policy options to support these strategies.

In undertaking this background paper, OTA sought information and advice from a broad spectrum of knowledgeable individuals and organizations whose contributions are gratefully acknowledged. As with all OTA studies, the content of this background paper is the sole responsibility of the Office of Technology Assessment and does not necessarily represent the views of our advisers and reviewers.



JOHN H. GIBBONS
Director

Adjusting to a New Security Environment: The Defense Technology and Industrial Base Challenge

Advisory Panel

Walter B. Slocombe, *Chair*
Caplin & Drysdale Chartered

Richard Bohlen
Senior Vice President, Operations
Rockwell International Corp.

Robert Calaway
President
Resources Management International, Inc.

Gordon Corlew
Vice President, Production Operations
AIL Systems Inc.

Jacques S. Gansler
Senior Vice President
The Analytic Sciences Corp.

Julius Harwood
Consultant

William W. Kaufmann
Professor
John F. Kennedy School of Government
Harvard University

General P.X. Kelley, USMC (Ret.)

James L. Koontz
President & CEO
Kingsbury Machine Tool Corp.

John Mearsheimer
Professor
Department of Political Science
University of Chicago

Thomas L. McNaugher
Senior Fellow
The Brookings Institution

William McNeill
Professor Emeritus
University of Chicago

Joseph Nye
Director
Center for International Affairs
Harvard University

Donald W. Putnam
Corporate Director
Contracts and Technical Analysis
General Dynamics Corp.

Jack Ruina
Professor of Electrical Engineering
Center for International Studies
Massachusetts Institute of Technology

Howard D. Samuel
President
Industrial Union Department AFL-C1O

Wickham Skinner
Professor Emeritus
Business Administration
Harvard University

James Solberg
Professor
Engineering Research Center
Purdue University

General William Y. Smith, USAF (Ret.)
President
Institute of Defense Analyses

Leonard Sullivan
Consultant
System Planning Corp.

Admiral Harry Train, USN (Ret.)
Division Manager
Strategic Research and Management Services Division
SAIC

General John W. Vessey, Jr., USA (Ret.)

Albert Wheelon
Consultant

Ex Officio:
William J. Perry
Chairman & CEO
Technology, Strategies & Alliances

NOTE: OTA appreciates and is grateful for the valuable assistance and thoughtful critiques provided by the advisory panel members. The panel does not, however, necessarily approve, disapprove, or endorse this report. OTA assumes full responsibility for the report and the accuracy of its contents.

OTA Project Staff
Adjusting to a New Security Environment: The Defense Technology and Industrial Base Challenge

Lionel S. Johns, *Assistant Director, OTA*
Energy, Materials, and International Security Division

Alan Shaw, *International Security and Commerce Program Manager*

Project Staff

Jack H. Nunn, *Project Director*

Ivan Oelrich

Jonathan B. Tucker

Contractor

David Novick

Administrative Staff

Jacqueline Boykin Madeline Gross Louise Staley

Overview

This backround paper outlines some of the difficult strategic issues that face the Nation as it seeks to maintain an adequate defense technology and industrial capability at a time of rapid, worldwide political, military and economic change. The defense technology and industrial base can be broadly defined as the combination of people, institutions, technological know-how, and production capacity used to develop, manufacture, and maintain the weapons and supporting equipment needed to achieve our national security objectives.

The recent diminution of the Soviet/Warsaw Pact military threat appears to offer the opportunity for significant reductions in the resources the Nation must allocate to national security, and the conversion of some portion of the U.S. defense technology and industrial base to nondefense activities. At the same time, Operation Desert Storm and the uncertain path of political reform in the Soviet Union highlight the need to preserve a base capable of supporting diverse U.S. national security objectives. Significant cuts in active forces, resulting in smaller inventories of military equipment and consumables, could increase the need for a rapid industrial response capability in a future crisis. A poorly managed industrial transition could make both the maintenance of capable smaller forces, and an industrial response to a crisis, difficult.

Despite the more than two thousand billion dollars spent on defense over the past decade and the impressive preliminary results of the high-technology weapon systems employed in the Gulf War, the current defense technology and industrial base has a number of serious weaknesses that could reduce its capacity to either develop and produce new weapon systems or to sustain U.S. forces in a future conflict. Cuts in defense spending since 1985 have faced many defense contractors with serious financial difficulties, causing them to downsize facilities, reduce investment in new technology and physical plant, eliminate critical personnel, and diversify into nondefense areas. In addition, the relative erosion of U.S. technological superiority in both the defense and civilian sectors has increased the Nation's dependence on foreign sources of supply, while weapons acquisition programs have been plagued with cost overruns and inadequate quality control. These weaknesses could have serious implications for U.S. national security. To deal with them and guide the future use of the Nation's base requires the development of a long-term defense technology and industrial strategy linked to operational military plans and broad national security objectives.

In planning for the future defense technology and industrial base, the Nation faces three critical tasks. The first is to determine the *size and nature* of the future base. The challenge is not only to downsize current capabilities to meet anticipated budget reductions, but to anticipate future weapons development needs and determine how best to utilize military and civilian scientific and technological capabilities, both foreign and domestic, to build the weapons required. The second task is how to *time* changes in the base, since it is far more difficult to reconstitute a technological or industrial capability than to reconstitute military forces whose equipment and source of supply remains intact. The challenge will be to match prudence in such reductions with the imperative to keep Federal expenses under control. The third task will be to reconsider the *overall organization, planning, and guidance* of the base. Maintaining g an adequate future base will require the revision of laws, regulations, and administrative guidance developed to facilitate access and to control costs during a period of rapid defense industrial expansion. With careful planning, the United States can devise and retain a scaled-down defense technology and industrial base that will support our national security objectives into the next century. The changes required to move to a new base will be extensive, however, and will take vision, time, and effort to implement.

Adjusting to a New Security Environment: The Defense Technology and Industrial Base Challenge

Introduction

The dramatic political and military changes underway in the Soviet Union and Eastern Europe are prompting major reassessments in U. S. national security planning. These trends appear to offer an opportunity for the United States to make reductions in defense spending far larger than any since the end of World War II. At the same time that the Soviet threat is diminishing, however, the Iraqi invasion of Kuwait and the U.S. military response have shown that the world remains a dangerous place and have provided a strong rationale for retaining a robust military capability. Defining how large that capability should be, and what roles it should perform, presents major challenges to national security planners.

The challenge is particularly great for those responsible for maintaining the U.S. defense technological and industrial base. Planners are challenged by uncertainties over: 1) *what* defense technology and industrial capabilities may be needed in the future; 2) *how the* future U.S. defense technology and industrial base should be postured in order to support our national security objectives; and 3) *when* defense technology and industrial reductions should best proceed. Timing is even more critical in this area than in manpower reductions, since the reconstitution of defense technology and industrial capabilities can take years and the speed and direction of change in the Soviet Union is uncertain.

Dealing with these uncertainties requires that the Nation consider fundamental questions, such as the extent to which the U.S. national security should depend on domestic technology and industrial capabilities, and who, in a free-market economy, has control of defense industrial changes. It is clear that the Nation can neither forecast all future defense technology and industrial base requirements nor manage all changes in the base. Nevertheless, it is prudent to make a rough assessment of future requirements in order to allocate our national resources more efficiently.

Assuming that large reductions in defense spending actually materialize, this will be the third major military demobilization for the United States in the 20th century. While there is something to be learned from the past, the present situation differs in important ways from the industrial demobilizations after World Wars I and II. One major difference is the widespread acknowledgment of the need to maintain a significant defense capability to deal with the security uncertainties of the future. Such a perception was lacking in the wake of America's successful military crusades in the two World Wars, when no foreign threats were immediately identified. As a result, U.S. military forces, and their supporting defense technology and industrial base, were hastily dismantled.[1]

A second difference is that the current demobilization comes at a time of strong international economic competition for the United States, rather than the American economic preeminence that characterized the end of World War II. This competition has raised concerns over the loss of jobs and technological expertise in America, the "hollowing-out' of U.S. manufacturing capability as production has moved offshore, and the prospect that the United States will lose the lead in critical areas of technology with national security implications as more scientific and technological advances take place outside our borders. Increasingly fierce international technological, industrial, and economic competition will have a major effect on the policies the United States must pursue to ensure an adequate defense technological and industrial base in the future. It may force greater reliance on technologies and industrial capabilities that exist in the civilian sector, potentially shifting the primary focus of the defense procurement process from deciding what military capability is desired to determiningg what weapons can be produced with available resources.

The Office of Technology Assessment (OTA) has been asked to examine the implications for the Nation's defense technology and industrial base of the changes in the international security environment, particularly in the Soviet Union and Eastern

[1] Although concerns over a potential threat from the Soviet Union were voiced as early as 1946, these concerns were not widely shared until the takeover of governments in Eastern Europe in 1947 and 1948. By then, much of the U.S. defense industrial base had been dismantled.

Europe, and to provide Congress with insights into steps that might be taken to: 1) ensure a transition to an adequate defense technology and industrial capability in the future; 2) apply assets not used for development and production of military systems to civil purposes; and 3) cushion, as much as possible, the economic impact of reductions in the defense technology and industrial base. To accomplish this task, OTA has undertaken an assessment that will result in a series of reports. This background paper outlines the general requirements of the defense technology and industrial base and the critical choices that confront the Nation as it modifies the structure of the base to meet future national security requirements. Specifically, this paper defines the elements of the defense technology and industrial base that will be examined, outlines the traditional functions of the base, assesses the current capabilities of the base to meet U.S. national security goals, sketches the range of expected national security requirements for the base, and outlines some of the policy options that the Nation should consider as it seeks to ensure a viable defense technology and industrial base in the future.

Definition of the Base

The defense technology and industrial base can be broadly defined as the combination of people, institutions, technological know-how, and production capacity used to develop and manufacture the weapons and supporting defense equipment needed to achieve our national security objectives.[2] It contains three functional elements:

1. a *technology base* that includes private industry laboratories and research facilities, university laboratories conducting defense research, government laboratories (e.g., those run by the National Aeronautics and Space Administration and the Departments of Energy, Commerce, and Defense), test centers, and the trained scientific and technical personnel to staff these facilities;
2. a *production base* composed of private industry as well as government enterprises (both government-owned and government-operated (GOGO) and government-owned and contractor-operated (GOCO)); and
3. a *maintenance base* consisting of government facilities (arsenals, depots, etc.) and private companies that maintain and repair equipment either at their own facilities or in the field.

The base includes a U.S. and Canadian component termed the North American Defense Industrial Base (NADIB), and a foreign, offshore component. Although the defense technological and industrial base is often discussed as if it were a separate identifiable entity, it is more accurately a subset of the larger national technology and industrial base and draws on that larger base to meet defense requirements. Even the large "prime" contractors and smaller second-tier defense firms principally dedicated to defense work (e.g., General Dynamics, McDonnell Douglas, Grumman, Loral, E-Systems) depend on hundreds to thousands of predominately civilian firms for components and technology. The same is true in research and development: dedicated defense laboratories rely on a wide range of nondefense research efforts, and technology flows back and forth between the military and civilian sectors. This interrelationship raises concerns about negative trends in the larger national technology and industrial base, whose health is ultimately key to maintaining national security. It is not enough for the larger national base to be capable of producing weapons through its defense-dedicated elements; it must also produce a sufficient output of high-quality goods and services to provide for the economic well-being of the American people, and enough surplus so that the Nation can afford an adequate national defense establishment.

An understanding of this interdependence between civilian and defense production was behind President Eisenhower's concern, during the early years of the cold war mobilization of technology and industry, about the well-being of the U.S. economy and the Nation's ability to meet a long-term military threat. In a 1955 letter to Secretary of Defense Charles E. Wilson, Eisenhower wrote that "the threat to [U. S.] security is a continuing and many-sided one-there is . . . no single critical 'danger date' and no single form of enemy action to which we can soundly gear our defense preparations. ' While military forces were important, the President

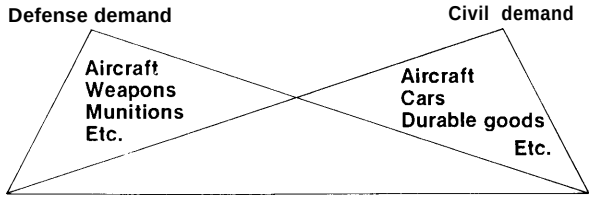
[2]This definition builds on one developed in OTA'S previous report, *The Defense Technology Base: Introduction and overview*, OTA-ISC-374 (Washington, DC: U.S. Government Printing Office, March 1988), p. 7.

President argued that "true security . . . must be founded on a strong and expanding economy. "3

This argument remains sound with respect to current concerns over the Nation's international industrial competitiveness. A healthy and robust technology and industrial base has allowed the United States over the past four decades to develop and deploy the wide range of military forces it has deemed essential for defense, devoting an average of around 6 percent of the GNP to the effort. Figure 1 illustrates the relationship of the defense and civil components of the base, with overlapping pyramids representing defense and civilian demand. While there is industrial integration at the lower levels (subtier producers of components and suppliers of raw materials), many studies have pointed out that this integration has been limited by specialized Department of Defense (DoD) procurement practices and stringent military specifications that often require the separate development and production of defense components even though they may be similar to those already available in the commercial sector.[4] Moreover, figure 1 does not illustrate the international component of the U.S. defense technology and industrial base, which draws increasingly on foreign-sourced components.[5] National security planners must understand how best to deal with these internal and external factors if they are to be successful in defense technology and industrial base planning.

The relative size of each demand pyramid at any given time is a function of the degree to which the country has mobilized its strength to deal with a perceived security threat. When threats to the country increase, defense demand draws goods and services away from civilian research projects and production, and toward military items. Conversely, in times of reduced threats, the demand on the Nation's industrial base shifts back toward the civilian sector. Of course, it is also possible for both pyramids to grow in response to the combination of an increased national security threat and positive economic trends, and for both to contract in response to the combination of a lessened threat and negative economic trends.

Figure 1—Defense and Civil Demand



End product	Aerospace, electronics (e.g., computers, telecommunications, software), shipbuilding, automotive, construction equipment, farm machinery, etc.
	o
Subtier	Forgings, castings, ball bearings, machine tools, robotics, semiconductors, semiconductor equipment, etc.
	o
Basic	Steel, petrochemicals, metals (e.g., aluminum, titanium, copper mining), ceramics, composite fibers, fiber optics, etc.
	⌂
Inputs	Raw materials, energy, capital, technology, scientific/skilled manpower, management

SOURCE: Roderick L. Vawter, *Foreign Dependency and Foreign Vulnerability: Part /, A Survey of the Literature* (Washington, DC: Mobilization Concepts Development Center, National Defense University, Ft. McNair, September 1986).

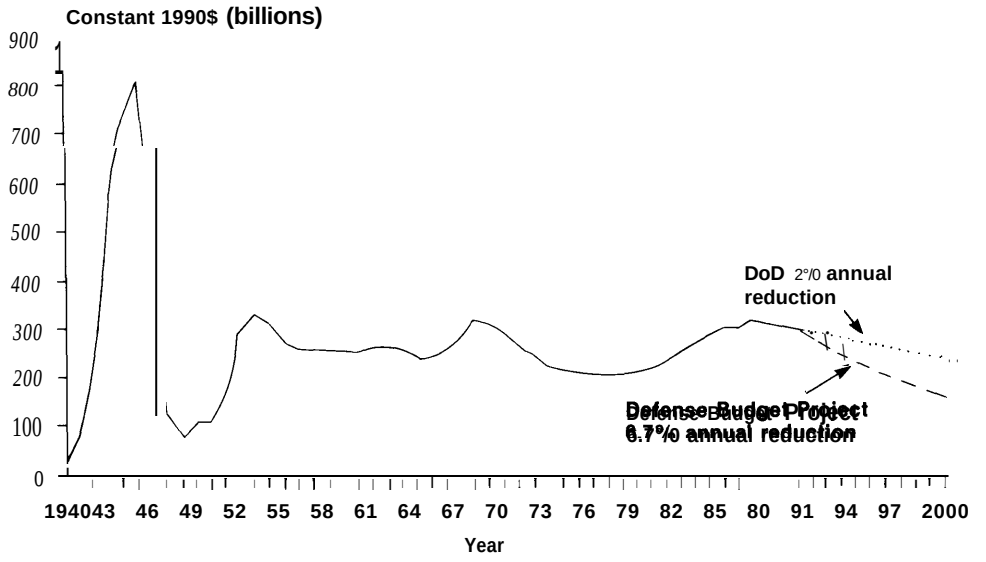
Since 1940, the United States has devoted substantial resources to national security (see figure 2). Because most of that resource allocation since 1950 has been in response to the perceived Soviet threat, the apparent decline in that threat should permit a major reduction in U.S. defense spending, thereby allowing the civilian demand pyramid to grow relative to defense demand. Still, other threats to U.S. security interests will continue to stimulate defense demand and will also affect the nature of the weapon systems required. Indeed, since the forces used to meet lesser military threats have often been derived from those directed against the Soviet military threat (e.g., the United States drew down its capabilities in Europe to fight against North Vietnam), the expected reduction in U.S. forces and defense spending may not be directly proportional to the perceived decline in the Soviet military threat.

[3]Letter from President Eisenhower to Secretary of Defense Charles E. Wilson, Jan. 5, 1955, in *Department of State Bulletin,* vol. 32, No. 810, Jan. 17, 1955.

[4]Office of the Under Secretary of Defense for Acquisition, *Find Report of The Defense Science Board 1986 Summer Study Use of Commercial Components in Military Equipment* (Washington DC: January 1987); and U.S. Congress, Office of Technology Assessment, *Holding the Edge: Maintaining the Defense Technology Base, OTA-ISC-420* (Washington, DC: U.S. Government Printing Office, April 1989).

[5]See U.S. Congress, Office of Technology Assessment *Arming Our Allies: Cooperation and Competition in Defense Technology,* OTA-ISC-449 (Washington, DC: U.S. Government Printing Office, May 1990), pp. 24-25.

Figure 2—U.S. Defense Spending



SOURCE: William Kaufmann, *Glasnost, Perestroika, and U.S. Defense* Spending (Washington, DC: The Brookings Institution, 1990) and *Restructuring* the *U.S. Military: Defense Needs in the 21st Century* (Washington, DC: Defense Budget Task Force of the Committee for National Security and the Defense Budget Project, 1990).

Moreover, future forces might have to be very different from the heavy armor divisions developed for Europe. Whatever the nature of the reduction, the challenge, as always, will be to provide for our national security without inordinately reducing national economic welfare.

Uses of the Base

The adequacy of the defense technology and industrial base can be measured against two broad criteria associated with its utilization. The first measure is the ability of the base to conceive of, develop, deploy, maintain, and upgrade modern weapon systems and supporting equipment in peacetime. The second measure is the ability of the base to respond rapidly to crisis or war with increased production of current materiel and/or the rapid development of new systems. Within these broad measures, the Nation's defense technology and industrial base has historically performed a number of tasks, with the relative importance of any one of them depending on the overall national security situation of the country at that time. Four tasks of special importance are listed in table 1.

The first task for the defense technological and industrial base has been that of *sustaining U.S. forces at war.* America's herculean effort in World War II, when the U.S. defense industrial base produced some 300,000 aircraft, over 1,000 major naval vessels, and 86,000 tanks, set the standard for this wartime support role.[6] The current concept of wartime support includes both the **surge** production of key systems in a crisis, and the subsequent longer term **mobilization** of industry to sustain a war effort.[7] Measuring the capability of the base to perform this task is a function of the scenario being considered. For example, a potential worldwide war against the Soviet Union would obviously be more demanding than a regional conflict in the Third World.

An important aspect of America's ability to provide wartime industrial support has been the degree to which such support is independent of other

[6] The Air Force Association and the USNI Military Data Base, *Lifeline in Danger: An Assessment of the United States Defense Industrial Base* (Arlington, VA: The Aerospace Education Foundation 1988), p. 1.

[7] See Roderick L. Vawter, *Industrial* Mobilization: The *Relevant History* (Washington DC: National Defense University, Ft. McNair, 1983). *Surge* is the term used within DoD to refer to the expansion of military production in peacetime without the declaration of a national emergency. *Mobilization* refers to the rapid expansion of military production to meet materiel needs in a war-fighting situation, and involves the declaration of a national emergency. Several types of mobilization are considered. *Full mobilization* refers to mobilization to fiil the existing or 'program force" structure. *Total mobilization* describes a mobilization effort that expands beyond the existing force structure to new forces.

Table I—Important Defense Technology and Industrial Base Tasks

- **Support U.S. wartime operations**
- **Develop high technology weapons**
- **Enhance deterrence**
- **Supply military equipment to allies**

SOURCE: Office of Technology Assessment, 1991.

nations. Concerns over dependence have been voiced since the early years of the Nation. Secretary of the Treasury Alexander Hamilton, for example, in a 1791 report to Congress, noted his desire to promote manufacturing that would "tend to render the United States independent of foreign nations for military and other essential supplies.' Hamilton's wish for defense industrial independence was a response to the colonies' shortages of materiel during the Revolutionary War. Maintaining an adequate degree of defense technological and industrial independence remains a matter of concern today, but it has become much more complex and, because of the globalization of technology and industry, may have costs (in terms of lack of access to the most advanced technology) that did not confront earlier generations. The Nation must therefore balance concerns over dependence on foreign sources that might lead to cutoff of supplies (such as occurred with some raw materials in World War II) against the reality that attempts to pursue a highly autonomous defense technology and industrial base could preclude access to new technologies and products, which increasingly are being developed abroad.

A second important task for the defense technology and industrial base has been the *development and production of high-quality defense materiel.* Defense research and development (R&D) was particularly critical during the cold war, when the United States sought to counter what was seen to be a quantitatively superior Soviet threat with qualitatively superior technology. For example, air-to-air missiles such as the Sidewinder, Sparrow, and Phoenix, and antitank missiles such as the TOW and Hellfire, were the result of years of research and development. In addition, U.S. strategic nuclear forces were developed and produced by a vast scientific and engineering complex that began with the Manhattan project and other scientific efforts of World War II and was greatly expanded in the 1950s and 1960s. Over the years, the United States has developed a panoply of strategic weapons (intercontinental ballistic missiles, stealth bombers, cruise missiles, high-yield nuclear warheads), as well as an array of space-based sensors and early-warning devices that have helped stabilize the nuclear balance and have greatly improved the verification of arms control treaties.

A third important task of the defense technology and industrial base has been the *enhancement of deterrence* as a result of the perceived capability of the United States to mobilize its technological and industrial strength for the rapid development and production of new military systems. The Nation's ability to mobilize massively was demonstrated frost by American production achievements in World War II, and further demonstrated by the rapid expansion of U.S. conventional and strategic forces in response to the Korean War and the growing Soviet strategic nuclear threat, and by the success of ambitious technological endeavors such as the Apollo space program. Although deterrence is difficult to measure, it is too important to be overlooked in an evaluation of the defense technology and industrial base.

A fourth important task of the Nation's defense technology and industrial base has been to *provide support for allies and Friendly nations. The* United States has been a prodigious producer of military materiel for allies, most notably during World War II.[9] More recently, the base provided materiel for allied use in both the Korean and Vietnam Wars, as well as conflicts in which the United States was not directly involved (Israel in the October 1973 war, and Great Britain in the Falkland Islands campaign of 1982). While the operation of the base in producing materiel for allies is much like that of supporting U.S. forces, there are sufficient differences to designate it a separate function. One difference is that support for allies can be controversial. If the United States is at war, supplying allies may require diverting production from U.S. forces; this happened during World War II and provoked numerous complaints from U.S. military command-

[8]Alexander Hamilton, "Report on Manufactures," reported in Martin C. Libicki, *What Makes Industries Strategic,* McNair Papers No. 5 (Washington, DC: National Defense University, Ft. McNair, 1989), p. 19.

[9]Robert W. Coakley and Richard M. Leighton, *Global Logistics and Strategy: 1943-1945 (Washington* DC: U.S. Army, Office of the Chief of Military History, 1968), p. 846. U.S. material support to allies during World Warn totaled almost $330 billion (1982 dollars).

ers. If the Nation is not at war, materiel assistance to allies may be hampered by peacetime constraints on rapid production (the United States, for example, took almost 4 years to reconstitute the military equipment that it provided Israel in 1973), and by political differences over whether and to whom we should supply arms. In addition, there are growing concerns that the transfer of modern weapons and technologies could ultimately present a threat to our own forces, particularly in the case of technologies needed for the development of ballistic missiles or weapons of mass destruction.

The United States has generally not considered potential allied needs in determining its defense industrial base surge and mobilization requirements. Exceptions to this policy have occurred in actual conflicts (the World Wars, Korea, and Vietnam), when supplying allies was considered militarily essential. Recently, U.S. arms producers have begun to view the foreign market as a means to maintain profitability at times of uncertainty in U.S. defense spending. Allied requirements are therefore playing a more important role in private industrys planning. Determining the extent to which the United States should plan to provide defense technology and industrial support for allies, or should rely on allied support to help meet our own materiel needs, is clearly critical to shaping our future defense industrial base policies.

It is likely that the four tasks of the defense technology and industrial base will continue to be important in the future, and others may be added to the list. Ultimately, U.S. defense technology and industrial base requirements will be determined by such factors as the nature of future military threats to the Nation and our own national security objectives, decisions on the military force structure and operations needed to achieve these objectives, and future scientific and technological developments with relevance to national security (including trends in the civil portion of the technology and industrial base). Unfortunately, a major difficulty for those making long-term decisions about the base is that the debate over future threats, force levels, and U.S. national security objectives has only just begun.

Future Threats and Force Levels

The Soviet threat (principally defined in military terms characterized by numbers of divisions, tanks, nuclear-armed missiles, and aircraft, etc.) has dominated the defense planning of the United States for the past four decades. A threat is composed of more than enemy capabilities; there must also be some assessment of intent to use those capabilities. One writer[10] has described perception of military threats in quasi-mathematical form as:

$$\text{Threat perception} = \text{estimated enemy capability} \times \text{estimated enemy intent to act}$$

During most of the cold war, Soviet military capability and hostile intent were evident to U.S. security planners. Today, however, the nature of the Soviet military threat appears very different than it did just 5 years ago. Although the Soviet Union's overall military power remains formidable, its ability to intervene militarily in Europe with conventional forces has eroded considerably, and its intentions seem less hostile. If such trends continue, the Soviet threat will be very different 5 years in the future. These changes are forcing a review of U.S. security objectives and a revision of the policies developed to achieve them.

Since the Nation's security objectives determine the size and types of military forces that are required, it is important to examine our security objectives explicitly and to understand the associated limits and tradeoffs. Some goals are simply not realistic or are in conflict with one another: the Nation can never achieve total economic autonomy, complete political independence, or absolute military security. As a result, tradeoffs are necessary. The nations of Western Europe, for example, have concluded that they must sacrifice some of their political autonomy by integrating their monetary and trade policies in order to achieve greater economic growth.

The most recent National Security Strategy announced by the President lists four basic national objectives: 1) ensuring the survival of the Nation as a politically independent entity; 2) promoting economic prosperity for America and the world; 3) maintaining a stable world order conducive to liberty; and 4) forging strong ties to allies and

[10] J. David Singer, "Threat-Perception and the Armament-Tension Dilemma," *Journal of Conflict Resolution*, vol. 2, No. 1, 1958, p. 94.

[11] *National Security Strategy of the United States* (Washington DC: The White House, March 1990), pp. 2-3.

like-minded nations throughout the world.[11] As President Eisenhower observed, the threats to the Nation have always had an economic component. While this component was often overlooked during the last two decades of the cold war, it will play a more prominent role in U.S. national security in the coming years. For the foreseeable future, however, attaining the four primary national-security objectives listed above will require military forces in addition to economic and diplomatic tools.

The current threats to the Nation are ambiguous. In the past, when the Soviets appeared to have both the capability-and, if unopposed, the intent-to invade and seize Western Europe (deemed vital to U.S. interests), or to attack the United States with strategic nuclear weapons, the military threat was relatively clear and the Nation could structure its forces to forestall those possibilities. The threats the Soviets posed outside Europe (subversion and support of indigenous revolutions in Asia, Africa, and Latin America) were less clear, and the Nation had difficulty sizing a force or creating a long-term policy to deal with them. Now that the Soviet conventional threat to Europe is much reduced in capability as well as intent, there is no clear-cut yardstick against which to measure U.S. forces. To the degree tensions between the United States and the Soviet Union have lessened, there is also a reduced threat of a Soviet strategic nuclear attack. Nevertheless, because the speed and ultimate nature of reform in the Soviet Union are uncertain (as evidenced by recent repression in the Baltic Republics), our national security plans must continue to hedge against this uncertainty.

Lacking a large, immediate Soviet threat, but facing a range of lesser threats, U.S. national security planners must cope with ambiguities similar to those faced by planners in the 1930s. At that time, the United States developed a series of color-coded plans to meet a variety of possible military contingencies. For example, Plan Orange, the Navy's preferred plan, anticipated a war against Japan in the Pacific; other plans anticipated attacks from Mexico and conflict with European powers. The Nation must again prepare for a spectrum of only dimly outlined threats, ranging from minor challenges to regional and global stability, to larger threats to U.S. economic welfare, and finally to the possibility of a new or resurgent threat to national survival. In designing the forces and operational plans to meet this array of potential threats, national security planners will have to make decisions on force structure and readiness, the degree of cooperation with allies, and the nature of armament-all of which will fundamentally affect the nature of the defense technology and industrial base. Because planners are constrained by available resources, they must also make tradeoffs among these factors. The nature of these tradeoffs, and the degree of risk they entail, will depend on the level of resource constraints.

Future U.S. forces will probably consist of some combination of active and reserve forces. While military planners generally prefer active forces, resource constraints may force them to rely increasingly on less expensive reserve forces. The "force mix" decided on will, in turn, constrain operational plans. The most demanding contingencies (such as a resurgent Soviet military threat) would require a large-scale military mobilization and expansion, which the Bush administration has termed the ''Reconstituted Force. Smaller operations such as Grenada and Panama, on the other hand, might be handled with the Administration's planned "Base Force,' consisting of active forces and ready reserves. The current crisis in the Middle East provides some insight into the size of the Base Force that might be required in the future, but it is only one planning scenario and only a single operation plan. A smaller future Base Force might not preclude U.S. action, but might require very different operations and levels of effort by our allies. Future force structure will therefore have to be based on judgments about the probability and scope of various contingencies.

As planners consider the size of future military forces, they must also consider the readiness and sustainability of those forces. There are obvious tradeoffs among these variables. High levels of readiness and sustainability require a major investment in training, spare parts, war reserve stocks of munitions, etc., yet these costs in turn reduce the size of the forces the Nation can field. An important task will be to determine an optimal tradeoff between size and sustainability. For example, by fielding a smaller force that can react quickly and is more sustainable in combat, the United States might be able to respond in a timely reamer to a military threat that, if allowed to develop over the time required to mobilize a larger U.S. force, would become much more difficult and costly to oppose.

Decisions on force structure, readiness, and sustainability will also depend on judgments about available warning. The changes in Eastern Europe have clearly increased the amount of warning that would be available in the event of a resurgent Soviet threat and conventional attack against Europe. Overall, force reductions by the Soviet Union and the demise of the Warsaw Pact as a viable military alliance have further increased warning time; indeed, the Soviets would probably have to fight their way through Poland and Hungary to invade Western Europe. To be useful, however, warning must be acted upon. Some have argued that the U.S. political system is so poor at responding to rising potential threats and acting on warning that the Nation should maintain high levels of military vigilance (and large active forces) at all times. Since it takes even longer for the defense industrial base to gear up in response to crisis or war, assumptions about warning and response times are particularly important.

The degree of interdependence with allies the United States decides to accept will also affect force structure, operational planning, and ultimately the defense technology and industrial base. Since the beginning of World War II, the Nation has pursued a strategy of cooperation with key allies in order to defend many of our most vital interests. Although the United States has maintained a secure and independent nuclear retaliatory force, it has chosen to forego the ability to conduct most major conventional military operations without allied, or host nation, support. Although the interventions in Panama and Grenada were unilateral actions, NATO's security guarantee of Western Europe could not have been undertaken by U.S. forces alone.

While interdependence conserves national resources and is therefore essential in today's world, it may also constrain U.S. ability to act in its own national interest, and increase security risks. Indeed, specific defense technology and industrial base concerns have been raised over future reliance on foreign military technology, foreign-sourced military components, and foreign-owned U.S. companies. Decisions about the extent of future U.S. cooperation with allies will impact on the Nation's defense industrial base needs in two ways: first, by determining the size of U.S. forces needed for various contingencies; and second, by affecting the potential foreign supply of weapons and components, and the quantity of weapons that the United States must supply to its allies.

A final military policy decision that will affect the requirements of the industrial base is the desired performance of future U.S. weapons systems. The United States has, as noted earlier, pursued a policy of maintaining qualitative superiority over potential adversaries in an attempt to offset quantitative superiority. American fighter aircraft, for example, are designed to have radar capable of acquiring targets at greater range than the adversary's aircraft, and are armed with sophisticated missiles capable of destroying targets at those longer ranges. As a result, a single U.S. fighter should be capable, in principle, of defeating several adversary aircraft. During World War II, however, the Nation pursued a different procurement strategy. Although excelling in critical defense technologies such as long-range bombers, radar, and the atomic bomb, the United States was renowned in that war not for the performance of its individual weapons but for their overwhelming numbers. It would therefore be possible for the Nation to reevaluate its current arms-procurement policy and follow a different course. Moreover, even if we continue to pursue a policy of maintaining performance superiority, the question of tradeoffs between quality and quantity will remain. A small, elite force may choose to rely on relatively few high-performance weapons, while a larger force composed of less well-trained personnel might value simplicity and reliability over sophistication and thus procure a larger number of less capable weapons. Whatever tradeoff is made between quantity and quality will affect the technology and industrial base.

A number of force-structure alternatives have already been proposed in the developing national security debate and are outlined in table 2. They provide examples of current thinking about future force structure and associated trends in the defense technology and industrial base. Embedded in these proposals are different assumptions about threats, available warning, weapons effectiveness, and interdependence with allies. While it is too early to make a decision on the exact size and composition of the future force, if the Soviet threat continues to decline, U.S. force levels may fall to somewhere between the 25-percent reductions proposed by the Bush administration in April 1990 and the much deeper cuts postulated by defense analyst William Kaufmann of the Brookings Institution.

The timing of Kaufmann's proposed reductions would be contingent on significant cuts in Soviet and

Table 2—Major Military Elements Under Several Proposed Defense Reductions

Forces	Current	CBO[f] "Alternative I"	CBO "Alternative V"	Kaufmann[i] "Case D"	Comm. for Nat. Sec. and Def. Budget Proj.	Admin.[k] 25% Force Reductions
Divisions[a]	(21/11)[b]	(19/1 1)	(12/8)	(10/1 1)	(10/10)[j]	22[1]
Carriers		14		6	9	12
Attack submarines	92[d]		72h			
Tactical Air Wings[a]	(27/13)[c]	(2%3)	(17/8)	(1%2)	(I2/12)[j]	25
Missile submarines	34e	23	17	17	17	*20*
ICBMs	1000	50 MX+500 SICBM	50 MX+500 MM-III	100 MM-III	Minuteman	*500*
Bombers	260[g]	97 B1+132 B2	23 B52+97 B1 +15 B2	41 B1	97 B1+15 B2	200

a (active/reserve)
b Army (18/10) + Marine (3/1) divisions—does not include nondivisional assets. See CBO, Security Needs, p. 3, Mil Bal, pp. 17,20.
c Air Force (24/12) + Marine (3/1) airwings. See CBO, p. *3* and MilBal, pp. 21-22.
[d]CBO, p. *46.*
[e]Mil Bal, p. 16.
f Minimum reductions to meet expected START& CFE limits.
9 MilBal, p. 16 (excludes FB-1 11s).
[h]CBO, p. 46.
Kaufmann, Table 32. Kaufmann calculates force levels in terms of "division equivalents."
J Excludes Marine forces.
k From OSD briefing, "Budget Impact of Illustrative 25% Force Reduction," June 1990.
Active and reserves were not broken out.

"CBO" refers to *Meeting New National Security Needs: Options for U.S. Military Forces in the 1990s,* Congressional Budget Office (February 1990).
"Kaufmann" refers to William Kaufmann, *Glasnost, Perestroika, and U.S. Defense Spending* (Washington, DC: The Brookings Institution, 1990).
"MilBal" refers to *The Military Balance,* 1989-1990 (London: International Institute for Strategic Studies, 1989).
"Comm. for Nat. Sec. & Def. Budget Proj.," refers to *Restructuring the U.S. Military: Defense Needs in the 21st Century* (Washington, DC: Defense Budget Task Force of the Committee for National Security and The Defense Budget Project, 1990).
SOURCE: Office of Technology Assessment, 1991.

Chinese forces, as well as arms control agreements covering conventional and nuclear forces. If such reductions occur, Kaufmann estimates a 1999 defense budget outlay of $160.0 billion and budget authority of $162.8 billion (both in 1990 dollars). Of these outlays, $37.8 billion is allocated for procurement (a reduction of more than 50 percent from 1990) and $24.5 billion for research, development, test, and evaluation (a reduction of more than 35 percent from 1990).[12] These projections, however uncertain, are comparable to estimates by other defense analysts and industry groups. For example, a study by the Committee for National Security and the Defense Budget Project also anticipates a 50 percent reduction in defense budgets by the turn of the century, while the Electronic Industries Association's annual 10-year forecast anticipates a one-third cut in budget authority .13

All of the alternatives in table 2 appear to include sufficient forces to deal with a wide range of contingencies, with the exception of a short-warning conflict against a major power. As the forces get smaller, however, there is less margin for error and more risk associated with regional military threats, and allied cooperation becomes more important from a military standpoint. The proposed cuts in forces also have major implications for the defense technology and industrial base, not only in terms of the funds available but also with respect to its organization and structure.

Implications for the Defense Technology and Industrial Base

While it appears that the four basic tasks outlined in table 1 will remain valid in the future, the transformed security environment and the resulting force reductions are likely to produce changes in emphasis among these tasks. Both the need for responsiveness and the Nation's ability to respond may evolve in a number of ways. An extended conflict with a major power (a resurgent Soviet threat or a new threat of the same magnitude) appears unlikely, and even if such a conflict were to occur, warning time would probably be far greater than previously anticipated. Most estimates of warning are in terms of several months to years, rather than the days to weeks of warning that drove previous planning. Conflict with smaller regional

[12]William Kaufmann, *Glasnost, Perestroika, and U.S. Defense Spending* (Washington, DC: The Brookings Institution, 1990), PP. 38-52.

[13]Electronics Industries Association *Defense Electronics Market Ten-Year Forecast, U.S. Department of Defense and National Aeronautics and Space Administration Budgets, FY 1991-FY 2000,* Oct. 16, 1990.

powers remains likely, however, and such contingencies might involve considerably less advance warning. Although the United States monitored the Iraqi military buildup for over a decade, the invasion of Kuwait appears to have caught the Nation by surprise because of a misjudgment of Iraq's intent rather than its capabilities.

Paradoxically, a reduction in the size of U.S. forces may actually increase the relative importance of the defense technology and industrial base for wartime contingencies. While the waning of the Soviet/Warsaw Pact threat could allow the United States to cut its active forces, it could simultaneously increase the requirement for industrial surge and mobilization capabilities because the Nation would have smaller inventories of materiel in its active forces and war reserves.[14] With smaller inventories, even a regional conflict might require a fairly rapid U.S. industrial response to ensure adequate supplies of ammunition and other consumables. In response to this problem, the defense community has developed the concept of "Graduated Mobilization Response' (GMR) to provide a more flexible means of ensuring the readiness of key defense industrial sectors in a crisis.[15] GMR has been described as 'an attempt to overcome the challenges a democracy faces anytime its leaders believe that more defense is needed. In order to take advantage of warning, one must have the ability to fashion a resource response appropriate to the provocation. ' '[16] Proponents argue that GMR would allow the United States to respond to a potential conflict by increasing production of spare parts for aircraft or activating selected munitions plants in advance of a general mobilization. Selective defense-industrial mobilization in a crisis might serve as a deterrent to aggression, while improving U.S. force readiness should war break out.

A number of critics have challenged the GMR concept, however. As noted earlier, some analysts question whether timely mobilization decisions are possible in a democracy. A second concern is that while early mobilization actions might help to deter a conflict, they could also send a signal of preemptive intent to a potential aggressor, raising tensions and possibly precipitating an attack. (This scenario would be of primary concern in the case of a major adversary capable of launching a massive preemptive strike that could disrupt U.S. mobilization.) Other critics have argued that environmental and other restrictions would prevent the opening of key munitions and other production facilities early in a crisis, before a national consensus on the need for such production has been established. These and other issues are currently being examined by national security planners. In any event, if the Nation reduces its forces and materiel inventories but maintains a broad range of national security interests, there will clearly be an increased need for flexibility in the use of the defense technology and industrial base. Careful planning and management of defense-industrial resources will therefore be essential in responding to future contingencies.[17]

The implications of force changes such as those outlined in table 2 for weapons development and acquisition in peacetime maybe even more profound than their impact on industrial responsiveness in crisis or war. Reduced defense budgets are expected to have a significant adverse impact on R&D and production. Although R&D appears to be protected in current budget projections, at least for the time being, it will still shrink in absolute terms. Weapons procurement cycles will slow down and upgrades may be favored over new systems. Since weapons procurement has traditionally paid for funding much of U.S. defense R&D, reductions in procurement will further reduce overall defense R&D. The U.S.

[14] A study by the Industrial College of the Armed Forces for the Policy Coordinating Committee on Emergency preparedness and Mobilization Planning, *National Security Emergency Preparedness Mobilization Policy Review* (Feb. 1, 1990), noted: "The future we have outlined (and are witnessing) will present new, more diverse, and more complex demands on U.S. national security than at any time since World War IL As traditional threats abate, new ones of various stripes already are taking their place. Resources will become more elusive, more dispersed, and thus more difficult to manage. The United States will come face to face with the global imperative for greater interdependence. Standing military capabilities will be scaled back for politically, economically, and militarily prudential reasons. As a result, mobilization will present itself as an increasingly important dimension of national security."

[15] Paul E. Taibl, *Graduated* Mobilization Response: *A Key Strategy of National Deterrent Strategy* (Washington, DC: Ft. McNair, Mobilization Concepts Development Center, National Defense University, 1988).

[16] Joseph Muckerman III, Director, Emergency Planning, Office of the Secretary of Defense, Department of Defense, December 1990.

[17] Jacques S. Gansler, *Affording Defense* (Cambridge, *MA: The MIT Press,* 1989), p. 264. Gansler notes that: "Unfortunately, numerous studies have shown that today there is little planning for a production surge in a crisis situation, or for the industrial mobilization that would be required to sustain an extended conflict in Central Europe. The studies have also confiied the lack of potential industrial responsiveness. Even during the extensive Reagan defense buildup, the focus was entirely upon 'force modernization'; little was spent on industrial preparedness."

defense industry has been anticipating reductions for several years, and companies have already taken steps to protect themselves. Many firms are leaving the defense market, while others are diversifying into nondefense areas. While these actions may make sense for the individual firms involved, collectively they may cause significant damage to the U.S. defense technology and industrial base. For example, when a large corporation divests its defense business, the result may be a financially weak spin-off firm that cannot afford to conduct in-house R&D or make the capital investments needed to maintain its productivity. Closing critical production or test facilities may also reduce the Nation's overall response capability. An even more serious consequence of cost-cutting measures could be the breakup of design teams, which embody the skills and systems-engineering know-how that underlie all of our high-technology weapons systems.

The future challenge to the technology and industrial base is not just how to maintain the capability to produce the forces we have developed in the past, but also how to continue developing the weapons of the future. The Department of Defense's Critical Technologies Plan and its recent report to Congress on critical defense industries[18] outline general areas of technology that DoD believes to be important for future weapons development. These areas, and others not yet identified, will in turn modify the future force structures and the operational concepts that are devised to deal with national security threats.

Current Condition and Trends in the Base

The future defense technology and industrial base will be shaped not only by U.S. security requirements and force structure, but also by broader technological and industrial trends, such as the growing internationalization of the base. In planning a transition to a future base, the Nation should understand the condition and trends of the current base and the Nation's ability to influence those trends. Concerns over the loss of critical U.S. technological and industrial capabilities have inspired a host of studies and prompted the Department of Defense to develop its Critical Technologies Plan. While action by the Federal Government can mitigate some of the negative effects of the globalization of defense technology, in many cases government policymakers can do little more than monitor trends and adapt national security plans to the realities of an increasingly global technology and industrial base.

The current U.S. defense technology and industrial base emerged during the cold war and was largely designed to support a military establishment sized and structured to deal with a formidable Soviet threat. This threat was two-pronged: 1) a potential aggression against Western Europe with massive ground and air attacks employing a high volume of conventional firepower and the potential use of theater nuclear weapons; and 2) a direct strategic nuclear threat to the continental United States, the deterrence of which required tactical warning and attack assessment and a secure second-strike capability. Although other military threats were recognized, the yardstick for measuring the adequacy of the U.S. defense technology and industrial base over the past four decades was the ability to balance the Soviet/Warsaw Pact threat. It was assumed that if the Nation was prepared to meet this principal threat, it could handle all lesser military threats. The result was a defense technology and industrial base oriented toward the development and production of high-technology weapons designed to defeat sophisticated Soviet equipment, and—in principle-large and responsive enough to support major sustained conventional operations against the Soviet Union. In fact, except for a period in the early to mid-1950s, the need for conventional sustainability (and an associated industrial responsiveness capability) was always controversial (many believed in a' 'come-as-you-are' war) and seldom fully funded. As a result, the U.S. defense industrial base might best be described as one that has provided a deterrence-oriented, high-technology force with little sustained logistics depth.

Beginning in the late 1970s, studies of the defense technology and industrial base revealed a number of shortcomings. One problem was the *high cost of military equipment* resulting from the growing isolation of the defense base from the civilian industrial base. The problem of cost escalation in

[18] ***TheDepartment*** *of Defense Critical Technologies Plan for the Committees on Armed Services,* *United States Congress, March 15, 1990; and U.S.* **Department of Defense,** *Report to Congress on the Defense Industrial Base: Critical Industries Planning,* **Assistant Secretary of Defense (Production and Logistics), Office of Industrial Base Assessment, October 1990.**

defense acquisition existed in the 1960s and 1970s, but it only became the focus of considerable public debate in the 1980s.[19] Studies blamed much of the problem on flawed acquisition policies that impeded efficient defense production, suppressed innovation, and interfered with good business practices.[20] The ability of the current base to provide affordable, high-quality military materiel continues to raise serious concerns, as was demonstrated by the recent cancellation of the A- 12 strike aircraft program after major cost overruns.

A second long-standing problem with the base has been *lack of industrial responsiveness. In the* late 1970s, a series of DoD mobilization exercises and studies revealed that the base would be incapable of adequately sustaining U.S. forces in a major conflict with the Soviet Union and Warsaw Pact.[21] These findings led to congressional hearings in 1980 that also called attention to the base's inability to surge and/or mobilize production of military materiel fast enough to meet planned expenditures of equipment and munitions stockpiles in a conventional war.[22] A host of studies designed to identify constraints and bottlenecks in defense production found that subtier producers had limited capacity, there were long leadtimes even in peacetime, portions of the industrial plant were obsolescent, and inefficiencies in the defense-acquisition process inhibited industrial responsiveness. The studies indicated that it would take many months to increase production of key items of equipment, and that while responsiveness might be enhanced through selected investment in the industrial base (e.g., buying long leadtime items or building excess capacity into production lines), such measures had not been funded.[23] Critics argued that the main reason for the deficiencies in the base was DoD's institutional preference for investing in force modernization and force readiness at the expense of industrial mobilization and force sustainability.[24]

Today, despite the waning of the Soviet threat, the war in the Persian Gulf demonstrates the continuing need for industrial responsiveness to lesser military threats. Before and during Operation Desert Storm, the United States has surged production of a number of defense items.[25] Thus, the industrial base was shown to be inadequate to deal with the hypothetical Soviet threat, and its ability to respond to lesser but real surge and mobilization requirements is currently being tested.

The 10-year debate over the defense technology and industrial base has raised concerns not only about wartime production, but also about the ability of the United States to maintain superiority in weapons technology. A 1988 Defense Science Board (DSB) study examining the state of the defense technology and industrial base concluded that the United States was "losing technological leadership in many areas."[26] Areas of particular concern were semiconductors and computers, both of which are considered the foundation of every defense system.[27] The DSB panel noted a number of reasons for these adverse trends. Some were the result of company actions (short-term concentration on profits, lack of attention to quality, lack of investment), others the fault of government actions (changes in tax rules, changes in progress payments, poor planning), and still others the consequence of the globalization of advanced technology, which was creating new sources of competition and fundamentally altering the world's economic and industrial structure.

---

[19] J. Ronald Fox with James L. Field, *The Defense Management Challenge: Weapons Acquisition* (Boston, MA: Harvard Business School Press, 1988), p. 33.

[20] Report to the Secretary of Defense by the Under Secretary of Defense (Acquisition), *Bolstering Defense Industrial Competitiveness* (Washington, DC: July 1988), p. vi.

[21] The first of these mobilization exercises, known as Exercise Nifty-Nugget, revealed production bottlenecks and shortfalls as well as general transportation and personnel inadequacies. These shortfalls were further documented in subsequent exercises and studies.

[22] U.S. Congress, House Armed Services Committee and the Panel on Defense Industrial Base, *Capability of U.S. Defense Industrial Base* (H.A.S.C. No. 96-69), December 1980.

[23] *The Industrial Responsiveness Analysis*, an industry mobilization exercise run in conjunction with JCS exercise PortCall 86, detailed many of the shortcomings and made specific recommendations for dealing with production constraints.

[24] Gansler, op. cit., footnote 17, p. *66.

[25] Caleb Baker and David Silverberg, "Missile Output Reaches War Rate," *Defense News*, Sept. 10, 1990.

[26] Office of the Under Secretary of Defense for Acquisition, *Final Report of the Defense Science Board 1988 Summer Study on the Defense Industrial and Technology Base*, vol. 1 (Washington, DC: October 1988), p. 13.

[27] Ibid., p. 14. Other technology sectors noted for particular concern were optics and *machine* tools.

An earlier OTA assessment noted some of these international trends:

> Not long ago, the United States was the undisputed technological leader of the world. U.S. military equipment was meaningfully and undeniably more sophisticated than that of the Soviet Union, and our allies sought American technology for their own defense efforts. American companies developed and sold high-technology products to a world that could not produce them competitively. Defense-related developments led American technology and often "spun-off" into the civilian sector, creating products and whole industries. This reinforced a U.S. defense posture based on using technological superiority to offset whatever advantages the Soviet Union and other potential adversaries might have.
>
> As we approach the 21st century, much has changed. The model of U.S. technology leading the world, with defense technology leading the United States, still retains some validity. But it is a diminishingly accurate image of reality. Soviet defense technology increasingly approaches our own, and sophisticated weapons appear in the hands of Third World nations not long after their introduction into Western and Soviet arsenals. At the same time, the U.S. military has been plagued with complex systems that do not work. Most are high-priced and take a long time to develop. Increasingly, leading edge technology comes from an internationalized, civilian-oriented economy, which puts a premium on exploiting technology as well as developing it.[28]

Such conclusions drove home the interrelationship of the defense and civil technology and industrial bases outlined in figure 1. The defense industry has long been dependent on civil industry: in the 19th century, a strong steel industry was a fundamental national security requirement for a great power. Today, a strong defense relies on a very broad section of the overall technology and industrial base. A 1988 DoD report[29] noted the increasing importance of civilian technology and industrial developments to defense, yet also found that government regulations and military specifications had increased the separation between defense and civilian manufacturing plants. As a result, just when the defense industrial base could make better use of civil technology, access to that technology had become more difficult. The report argued for a DoD investment strategy that would encourage the development and widespread introduction of dual-use product and process technologies, and increase the interaction between the defense and civilian bases. These recommendations were reinforced by the findings of the 1988 Defense Science Board study, which stressed not only the relationship between the defense industrial base and the larger national base but also the increasing globalization of the defense base.[30]

An underlying concern in all of these analyses has been the extent to which the U.S. Government can manage the defense technology and industrial base. The National Security Act of 1947 established a National Security Resources Board reporting to the President, and a Munitions Board and a Research and Development Board reporting to the Secretary of Defense. Over the years, this structure has evolved into a series of offices and organizations responsible for peacetime weapons acquisition and emergency resource allocation.[31] Dissatisfaction with DoD management of peacetime weapons acquisition prompted the Packard Commission to recommend the creation of a formal acquisition management structure that included an Under Secretary of Defense for Acquisition, service acquisition executives, and program executive officers.[32] This proposed structure was later implemented in an attempt to streamline the acquisition process and make it more efficient. Nevertheless, the management of both peacetime weapons acquisition and emergency resource planning and allocation have continued to be plagued by serious problems.

In the midst of the debate over the ability of the base to respond adequately in an emergency or to field technologically superior weapons, defense budgets peaked in FY 1985 and then began to fall (see figure 2). These reductions resulted from the

---

[28] U.S. Congress, Office of Technology Assessment, *Holding the Edge: Maintaining the Defense Technology Base,* Op. cit., footnote 4, P. 3.

[29] Report to the Secretary of Defense by the Under Secretary of Defense (Acquisition), Op. cit., footnote 20, P. v.

[30] Office of the Under Secretary of Defense for Acquisition op. cit., footnote 26, p. 11.

[31] Today, emergency resource planning for the nation is coordinated by the Federal Emergency Management Agency (FEMA). See Executive Order No. 12656, *Assignment of Emergency Preparedness Responsibilities,* November 1988. DoD weapons acquisition and wartime industrial resource allocation is under the control of the Under Secretary of Defense for Acquisition.

[32] Fox with Field, op. cit., footnote 19, p. 50. The Packard Commission's (president's Blue Ribbon Commission of Defense Management, chaired by David Packard) report, *A Quest for Excellence,* June 1986, was the basis for a number of DoD management changes.

growing U.S. budget deficit, the belief that the United States had redressed the military imbalance with the Soviet Union that had existed in the late 1970s, and disenchantment with the defense industry in the wake of a growing number of cost escalations in major programs and fraud charges against defense contractors.[33] The widespread perception of defense mismanagement also prompted Congress to draft hundreds of bills aimed at improving the defense acquisition process.[34]

The budget cuts had several effects on the U.S. defense industry. Although there was a considerable backlog in weapons orders, the financial community discounted the stock prices of defense contractors, sharply increasing their cost of capital. Individual defense fins, anticipating further cutbacks in defense spending and believing that they had been adversely affected by many laws and DoD directives in the mid-1980s,[35] began to take actions to shore up their financial positions and ensure their survival. Among the major defense contractors, some decided to continue concentrating on defense (e.g., General Dynamics), but others sought to diversify (Rockwell International and Raytheon) or to divest themselves of defense work (Ford and Honeywell). Similar changes took place among the smaller "subtier" producers of components, to which a defense prime contractor typically subcontracts between 40 and 60 percent of a weapon system.[36] By the late 1980s, the defense sector had become a "buyers' market" and firms were using creative approaches to rid themselves of defense contracts.[37] Many of those remaining in defense faced major financial problems and ended up writing off large losses.[38] These losses and growing company debt have resulted in the reported failure "not only to develop new defense technologies, but also to exploit the commercial applications of defense technology."[39]

As the Nation considers the nature of the future defense technology and industrial base, it is clear that despite the billions spent on defense over the last decade, the present base has a number of serious weaknesses. Although the base has produced some remarkable weapons and has strengths that should not be overlooked, such as extensive military R&D capabilities (facilities and personnel) and economies of scale, these assets are increasingly outweighed by the poor financial health of the defense industry, which has reduced investment in new technology and physical plants; the relative erosion of U.S. technological superiority, which has increased U.S. dependence on foreign sources of supply; the growing incidence of cost overruns and inadequate quality control; and the lack of an overall defense technology and industrial strategy linked to military strategy.

Future Challenges and Choices

In Summary if the Soviet threat continues to diminish along currently projected lines, the United States will be able to reduce its defense budget and force structure. While it is impossible to foresee the full extent of the change, a 30 to 50 percent reduction in budget authority over the next decade is not implausible. Reductions of this magnitude will result in significant changes in the defense technology and industrial base. Yet defense needs will clearly continue to exist, as evidenced by the current conflict in the Middle East. Preserving an adequate defense technology and industrial base in the face of competing defense and other economic demands, along with changes in weapons technology and in the global technology and industrial base, will present many challenges to national security decisionmakers.

As noted earlier, preserving the defense technology and industrial base has not been a high priority for the Nation even during periods of relatively high defense expenditures. The primary reason is that investing in a responsive industrial mobilization

[33] Ibid., pp. 34-37, 327-339.

[34] Ibid., p. N'.6'h 1984 Congress introduced more than 150 bills related to improving the defense acquisition process. In 1985, they introduced another 140 bills . . . In 1986 . . . more than 100 bills . . ."

[35] Some of the ...s that received the greatest industry attention included: lower progress payment rates, cost sharing on new development programs, special tooling investments, and tax law changes that reduce tax deferrals.

[36] Gansler, op. cit., footnote 17, p. 247.

[37] For example, Honeywell failed to sell its Defense and Marine Systems and instead created Alliant TechSystems, a tax-free spinoff. Emerson created ESCO Electronics Corp. *Paine Webber Aerospace Group*, October 1990, briefing paper.

[38] Philip Finnegan, "Defense Industry Forced To Write Off More Losses," *Defense News*, Jan. 15, 1990.

[39] Ibid. Wolfgang Demisch quoted in *Defense News*.

capacity almost always conflicts with the goal of efficient peacetime production, particularly in a fiscally constrained environment. There is a similar tradeoff between readiness and force modernization. As a result, investments in technology and industrial capability must provide sufficient short-term benefits to win support from a skeptical defense community. The challenge will be to balance the need to maintain ready forces with the longer term investments in the defense technology and industrial base required to support U.S. military strategy .40 Indeed, a reduction in the size of U.S. active forces and war-reserve materiel will most likely place greater stress on industrial responsiveness, forcing the country to make investments in industrial readiness and planning that it has heretofore been able to avoid.

The transition to a new defense industrial base must also cope with the internationalization of defense technology and industry and the increasing prominence of civilian high technologies with potential military applications ("dual-use" technologies). The challenge will be to develop a future base and a method of managing our defense resources that are flexible enough to adapt to these technological and industrial changes. The Nation will be further challenged by the fact that the defense technology and industrial base is under increasing financial stress. On the one hand, the government will be under pressure to act quickly if it is to have a positive effect on the outcome. On the other hand, it must proceed with caution, lest ill-considered solutions (such as rules that have worked to isolate the defense industry over the past two decades) make matters worse rather than better.

Probably the most difficult policy challenge derives from the fact that the "tools" for effecting change (such as tax policy and organizational and procedural changes) are relatively blunt, yet the requirements of the defense technology and industrial base are many and varied. First, the linkages among the defense base, the broader national civilian base, and the international technology and industrial base require taking a global perspective on what might at frost appear to be local decisions. Furthermore, only some of the problems of the base are amenable to legislative solutions. These problems also vary depending on industrial sector, size of firm, degree of foreign involvement, and current technological trends. While this complexity makes it difficult to formulate universal policies, good management practice argues against trying to develop individualized measures for each firm. The challenge for Congress will be to develop policies that are broad enough to be manageable, yet sufficiently tailored to be effective.

In planning for the future defense technology and industrial base, the Nation must make three critical choices. First, we must determine the *size and nature* of the future base. As a guide for such planning, it will be necessary to formulate a national defense strategy that provides a clear rationale for a future force structure. Even without such a strategy, some general statements can be made. As noted above, the base is already shrinking as a result of reduced defense budgets since 1985 and strategic decisions by individual U.S. defense contractors. Making greater use of civilian production and components could provide a way of slowing or even halting the decline. To this end, "military requirements" would increasingly be matched against what is available in the larger civil industrial base. In fact, the Nation might often turn the military requirements issue on its head by asking not what the defense community believes it requires, but rather what the technology and industrial community can provide.

The United States will also need to maintain vigorous R&D programs if it wishes to anticipate foreign developments and preserve its technological edge against a spectrum of potential adversaries in a world in which sophisticated military equipment has become widely available. The challenge in determining the size and nature of the future defense technology and industrial base is thus not only one of potentially downsizing current capabilities, but also of anticipating future weapons developments and of determining how best to utilize scientific and

---

[40]Craig Alderman, the Deputy Under Secretary of Defense for Policy, outlined how he saw this problem in a symposium on threats to the U.S. defense industrial base sponsored by the American Defense Preparedness Association, Dec. 11-12, 1986. Mr. Alderman noted that the key to sustaining a long conventional war was "to achieve the right balance between war reserve stocks and the industrial base capability, and this is a very tough cdl. . . . We have to be able to forge a very close link between our ability to surge and mobilize industry, and the operation plans, the strategies that we have out there. . . . We haven't impressed upon the warfighters, the CINCS, the JCS, that some of the strategies that you look at cannot be executable now with the current industrial base, and therefore if this is the case, you've got three choices. You either increase the effectiveness of the base, or you put more into war reserves, or you modify your strategy. ' Symposium *Proceedings, American* Defense Preparedness Association, pp. 31-328.

technological advances within the domestic civil sector, as well as abroad.

Another issue that must be kept in mind is the large gap between the requirements for peacetime replacement production and for wartime materiel production. This gap creates a dilemma for government planners desiring both peacetime efficiency and crisis responsiveness, since abase optimized for peacetime production would not have adequate surge and mobilization capacity to deal with a real emergency. Coping with the major differences between peacetime and wartime requirements will demand excellent planning, including the ability to create entirely new industrial capabilities on short notice.

In restructuring the defense technology and industrial base, there are a host of tradeoffs to consider, including:

1. increased reliance on the North American Defense Industrial Base v. greater interdependence with other allies and friendly powers;
2. increased reliance on civilian R&D and production and purchase of nondevelopmental items v. continued development of dedicated military equipment;
3. maintaining ''warm' production lines at low levels of production over long periods v. developing prototype equipment in a few copies and mothballing the production line; and
4. returning to a government-owned and operated arsenal system, or more sole-sourcing, v. retaining high levels of competition.

The second critical choice concerns *the timing of changes in the* U.S. defense technology and industrial base. Timing is important because it is more difficult and takes far longer to reconstitute a technological and/or industrial capability than to reconstitute military forces whose equipment remains intact. Thus, any drawdown of our supporting defense technical and industrial infrastructure should, in principle, follow our opponent's force structure drawdowns (including materiel destruction) by a prudent interval. Nevertheless, needed changes in the base, such as promoting the integration of military production into the civil sector, should be initiated quickly.

Reductions in defense spending should also be made selectively, with an eye to their impact on the defense technology and industrial base. Indiscriminate cuts in funding for current weapons systems, without regard for new requirements or alternative base structures, would result in the shutdown of production lines and the dispersal of skilled workers. Even reductions in such mundane items as rations could have severe implications for the Nation's ability to respond to a future crisis. Thus the challenge on decisions of timing will be to match prudence in reductions with the reality of the budget process. It will be particularly difficult to maintain a surge capability while reducing tiding.

The third critical choice will be to reconsider the *overall organization, planning, and guidance of the* defense technology and industrial base. In addition to developing a broad defense technology and industrial strategy to support our operational military strategy, it will also be necessary to review the utility of the laws, regulations, and administrative guidance developed to manage wartime responsiveness and peacetime procurement. There is a strong consensus among those who have studied the capabilities of the current base that many of these defense-procurement statutes will need to be modified if we are to maintain an adequate defense technology and industrial capability in a more fiscally constrained environment. The challenge here is to ensure that the right rules get changed.

In sum, with careful planning, the United States can retain a defense technology and industrial base that will support our national security objectives into the next century. The changes required to move to a new base will be extensive, however, and will take considerable time and effort to implement.