

Chapter 2

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The U.S. defense effort rests *on* a strong, broad, dynamic base of research and development. Government and private institutions, and civil and military establishments all contribute. But this defense technology base is also characterized by:

- a heavy burden of government rules, regulations, safeguards, and procedures that stifle the ability of the Department of Defense (DoD) to develop and exploit technology;
- the lack of an effective system for high-level planning and coordination; and
- the lack of a clear government policy and coherent strategy for dealing effectively with dynamic trends in the international high-technology economy.

To those who have followed defense industry, technology, and procurement, none of this will come as a surprise. These problems—and more—have been noted and studied for at least three decades. But despite repeated attempts to fix it, the system has remained resistant to major improvements. Indeed, the major problems have continued to worsen, although probably more slowly than if no measures had been taken.

The U.S. is not faced with a defense technology base that is in deep crisis. The Services and other defense activities fund a great diversity of research and development, run a large number of laboratories that do credible—and often outstanding—work, and successfully exploit that technology and technology developed elsewhere. But the process has a number of serious shortcomings that may be amenable to significant improvement. Moreover, important recent trends threaten to intensify these shortcomings and magnify their importance. U.S. leadership in high-technology industries that are vital to defense is eroding in the face of strong international competition. Budget restrictions predicted both by Congress and by the Administration will reduce funding for technology base activities at a time when the costs of research and development are increasing. And DoD's ability to compete successfully for key technical and managerial personnel is declining.

On top of all this, a heavy burden of rules and regulations impedes the development and exploitation

of technology and the successful transition of developments into fielded systems. The accumulated actions of past Congresses are a major contributor to the difficulties. Laws passed for a variety of good reasons, taken together, bog the system down. Lack of clear policy on the part of both Congress and the executive branch impedes the solving of important problems.

Virtually all the easy solutions have been tried. It is unlikely that any fruitful but painless approaches remain. Congress and the executive branch will have to face some hard choices. These include altering institutional arrangements that—despite their deficiencies—have become comfortable, and sacrificing existing goals in order to achieve more efficient development and exploitation of technology.

Based on the analysis in this report, OTA has identified seven basic issues that profoundly affect the welfare of the defense technology base. These are not specific action items, but rather broad agenda items that warrant congressional attention. For each of these there are many different choices as to what individual policy directions to take, and within those, a myriad of measures (and choices among measures) for implementation. Implementation is clearly important, for without any sense of how to implement a policy, it remains simply an abstraction. There are options that can be implemented only through legislation, because today the law forbids them or provides no way to make them happen. And there are options that can be implemented without changing the law—through executive action or changes in DoD's internal regulations. Congress can have a hand in effecting these sorts of changes by making its wishes known or by using its considerable powers of persuasion.

Chapters 7, 8, and 9 discuss various specific policy options.

ISSUE 1: Reforming the Defense Acquisition System

The defense acquisition system is a major contributor to the long delays in getting new technology into the field and erects formidable barriers to exploiting technology developed in the civilian sector. While

Congress did not intend the system to be slow, cumbersome, and inefficient, laws passed to foster goals other than efficient procurement have made it so.

The system has weathered many attempts at reform because its problems are rooted in several basic causes. It is dictated in part by our basic system of government which demands checks and balances on the expenditures of large amounts of public funds, provides for a tug and pull between the interests of the executive branch and those of Congress, and permits both branches to reevaluate programs yearly in light of changing factors and interests. But much of the problem can be traced to laws that Congress has enacted to curb abuses and to foster goals other than efficient procurement of defense equipment. Laws and regulations have been added to ensure:

- civilian control over military procurement,
- Administration control over Service activities,
- congressional control,
- protection of congressional constituent interests,
- environmental protection,
- fairness,
- competition,
- accountability,
- honesty,
- controllable business practices,
- minority interests,
 - › small business interests,
- protection against conflicts of interest, and
- prevention of large profits at taxpayer expense.

These many ends often conflict with each other and with the objective of quick and efficient procurement, which leads to compromises that can satisfy few, if any, completely. Thus, the consequences of achieving these other objectives have included high costs, long procurement times, inefficient production, and restricted access to technology.

To promote these and other goals, the government has developed business practices and criteria that differ markedly from those of the civilian market. Buyer and seller have an adversary relationship; accountability is stressed over efficiency and price; and the government insists on visibility into how its contractors conduct their business. Government imposes restrictions on profits, trade secrets,

and accounting procedures that are at variance with typical commercial practices. This discourages many innovative companies from seeking defense business.

History provides little hope that a few clever, relatively painless moves will be sufficient to make the system significantly more efficient while satisfying other goals. If Congress is serious about making the system work better, it will have to face some hard choices. One choice is to give efficient procurement greater emphasis over other goals. This would most likely mean that the system would become less fair, less competitive, less accountable, less responsive to minority and small business interests, etc. Another option would be for Congress to give up some of the power it has over major defense programs, or to curtail sharply some of the many centers of power within the executive branch. This would not necessarily make any particular program run better—two layers of management could be just as ineffective as 20—but it would remove major impediments. Instituting multi-year budgeting, which could also make programs run more quickly and smoothly, would likewise require both Congress and the executive branch to give up some power. Finally, Congress could loosen up the rules under which DoD conducts business, allowing business practices to move closer to those of the private sector. But inherent differences between government and private operations will always remain. For example, the government is accountable for the expenditure of public funds and is very sensitive to allegations of misuse. Where a business would be willing to absorb some pilfering if it were exceeded by the cost of prevention, the government is usually willing to spend whatever is necessary to prevent fraud.

Few such moves would come for free. For example, relaxing accountability rules could make it easier for companies to cheat the government. It may well be that, weighing all these factors together, Congress will decide that the current balance among all these interests is proper, and that inefficient defense procurement is an acceptable cost. While concerns for efficient procurement will push in the direction of loosening up the system, a need to respond to a recent history of procurement scandals, failed programs, and high-cost low-quality equipment will likely push in the opposite direction.

ISSUE 2: Independent Research and Development (IR&D) Recovery

Current law permits companies having contracts with DoD to bill to the government, as a cost of doing business, part of the cost of their internally generated R&D program. Industry generally believes that current rates of recovery are inadequate. Some think recovery rates are too high. DoD cannot seem to present a coherent position. IR&D recovery is not treated in this assessment, but it is very likely to be on the congressional agenda. Interested readers are referred to OTA's previous report *The Defense Technology Base: Introduction and Overview*.¹

ISSUE 3: Reforming the DoD Laboratory System

As a whole, the DoD laboratory system performs its function of supporting defense procurement. As a group, laboratory managers are capable and experienced and provide much of the corporate memory for technology base activities. But the system is vast, complicated, and uneven in performance. The structure of the system as a whole—the number, types, sizes, orientations, and institutional connections of the labs—may be restricting their utility and effectiveness. Moreover, the management system under which these government owned and operated facilities are run is rendering it increasingly difficult for them to function effectively. A long list of rules impedes their daily operations and makes them increasingly unable to compete for highly qualified scientists and engineers. In general, Congress can choose to:

- reform the system itself,
 - . order DoD to reform it according to congressional guidelines, or
 - . leave the job to DoD.

Whatever course Congress chooses, it is unlikely that the correct approach will be either simple or obvious.

There are three basic approaches to reforming lab management. The least disruptive would be to alter, within the current civil service system, the rules under which they operate. This could include:

- . extending the principal features of the *NOSC*/China Lake personnel experiment to other labs,

- . permitting the labs expedited procurement procedures for scientific equipment and services, and
- . providing multi-year funding.

Alternatively, Congress could decide that R&D is inherently different from other government activities, and that the labs should be allowed to operate differently from the rest of DoD. This might include permitting salaries for scientists and engineers to rise above current civil service ceilings and allowing the labs to build and modernize facilities by going outside the military construction process. The most radical approach would be to convert some or all of these facilities to government-owned, contractor-operated (GOCO) facilities, like the Energy Department National Laboratories. Conversion to GOCO could solve some of these problems, but would be no panacea.

Congress should also seriously consider altering the overall structure of the laboratory system. This could include closing some labs, consolidating others, shifting the internal make-up and missions of some, and creating new ones. Corporate research labs, like the Naval Research Laboratory, might be established for all the Services; or the in-house capabilities of many labs could be greatly improved. In the process, the system should get simpler, not more complicated. Greater integration of DoD labs with other government labs—reform of the overall government lab system—might also be considered. This could include forming research centers 'to spearhead major thrusts into areas of particular significance for both defense and commercial needs. These would be drastic steps requiring careful, detailed study and assessment of the individual labs before implementation. If done correctly, they could lead to greatly improved benefits from DoD R&D expenditures. If done carelessly, they could be counterproductive. At the heart of the process would be devising a system for evaluating the performance of the laboratories and their component parts. This ought to include the quality of work as well as its relevance to both identified Service needs and potential future advances.

Restructuring the lab system may be a necessary response to budget pressures that reduce funds

¹Released March 1988, report No. OTA-ISC-374. Available from the U.S. Government Printing Office, Washington, DC.

available to run them. Significant reductions could be accommodated by reducing all efforts proportionately, but this would reduce good work as well as bad. Other approaches are closing the least productive and useful labs or effecting a more extreme restructuring of the entire system to maximize performance and utility at a lower overall level of effort.

ISSUE 4: Reforming Strategic Planning of Research and Development Programs

Unlike many governments and large corporations, the Department of Defense does not have a central headquarters-level system for planning and coordinating its technology base programs. Planning is carried out by the Services, the defense agencies, and the Strategic Defense Initiative Organization (SDIO); coordination among similar projects is done at the laboratory level. This lack of central focus is repeated both higher up the chain—at the overall national level—and within the individual Services.² This is not necessarily bad. If centralization stifles unplanned innovation and healthy competition, fails to support Service needs, or results in decisionmaking by the uninformed, then it is counterproductive. However, lack of overall planning can lead to wasteful duplication of efforts, lack of critical mass to solve common problems, fractionated efforts, and inattention to areas that are on no component organization's agenda. It also risks failing to identify areas of common or overarching significance. If there is to be strategic planning and central coordination, it will have to be done by the Office of the Secretary of Defense (OSD). Congress should decide whether—many DoD studies have advocated—OSD ought to be given greater power (or encouraged to exercise the power the law already gives it) to plan, coordinate, and oversee technology base programs; or whether Service dominance should be supported and reinforced. More forcefully, Congress could order OSD to develop a strategic planning process to lead to a coordinated, department-wide technology base investment strategy.

As currently organized, OSD oversees Service technology base programs at one organizational level, DARPA at a second, and SDIO only at the highest level. This inhibits real coordination. More-

over, it leads to the lack of a high-level advocate within OSD exclusively for technology base programs, lowering the status of technology base programs within both DoD and Congress.

Strategic planning and program coordination are different from central management. The former refers to a strategic OSD planning function providing the ability to orchestrate the entire program. OSD could perform this planning role from a broad perspective over all the technology base activities that the individual Services do not have, but it would lack the detailed information and insight into the workings of specific programs necessary to manage them effectively. Planning and coordinating programs and then letting the extensive Service R&D organizations manage them is different from aggregating similar programs and managing them from OSD.

Congress could also define more clearly what its own role is. It seems unlikely that Congress can provide direction to the thousands of individual projects. Congress could actively involve itself in the strategic planning process or confine its activities to demanding that OSD produce and defend a strategic R&D plan.

ISSUE 5: Reforming Government Personnel Practices

Recruiting and retaining qualified scientists and engineers is a major problem for DoD laboratories. In the current sellers' market, government salaries and benefits for technically trained personnel are not generally competitive with either industry or universities. Many DoD labs have given up trying to recruit the best and the brightest. Loosening up the rigid civil service salary structure is a principal component of ideas to reform lab management, and being able to pay competitively—above civil service ceilings—is a major incentive for converting labs to GOCO status. Federal pay raises, if they are enacted and applied in any significant way to scientists and engineers, could substantially help the situation; alternatively, Congress could consider a separate pay scale for scientists and engineers more in line with industry and academia. This may not be a permanent problem, since the market for scientists

²The Services seem to exercise more influence over their components than OSD does over the Services.

and engineers tends to be cyclic. But until such time as it turns around, defense technology base efforts are being hurt by a system that cannot adjust to the market. It is also possible that this time the market will not turn around, that the current expansion in high-technology industry-coupled with demographic trends-will keep the supply short for along time to come. Congress may also want to consider efforts to increase the number of students in technical disciplines. Defense efforts are particularly hard hit by shortages because they mostly require U.S. citizens and can take little advantage of the large number of foreign graduate students in U.S. universities.³

Some observers see similar problems in attracting good managers of acquisition and technology base programs. People with the requisite skills and knowledge can command greater salaries in industry, and are reluctant to work for DoD. “Revolving door” rules are also a disincentive to government service. Congress may wish to consider reviewing salary levels. It may also be worthwhile for Congress to gain deeper insights into the inhibitory effects of other employment restrictions and reconsider them in this light.

ISSUE 6: Fostering Greater Coordination Between Defense and Civil Research and Development

National defense benefits from a vibrant civilian technology base. Civilian research provides another large source of technology that finds its way into defense systems, and effective civilian R&D underpins a strong economy that provides greater revenues for defense efforts. The ability of the military to achieve and maintain leading-edge technology will, in many cases, depend on the health of corresponding civilian industries. In a very general sense, economic security is a major component of national security; the ability of the United States to compete economically is intertwined with its ability to compete militarily.

The U.S. defense and civil sectors are not isolated from each other, but they are far from closely coupled. Two relatively separate sectors have evolved—

one military and the other commercial. The diffusion of civilian technology into defense systems is hampered, as is the availability for commercial purposes of technology developed in the military sector. Some of this is unavoidable: security often demands that some technology be kept under wraps. But much is the result of government business rules that erect barriers to commercial companies selling to DoD and of a weak, high-level technology policy apparatus.

Other industrialized nations—particularly in Western Europe and Japan-construct their technology efforts with a greater emphasis on economic development over military development than does the United States. They are increasingly demanding that military technology support commercial development whenever possible. In Japan, almost all technology is developed for commercial purposes, and some of it is then exploited for military uses. What is appropriate for these other nations is not necessarily good for the United States, since neither Japan nor any Western European nation aspires to be a superpower. However, these are the nations with which the United States is competing economically. We maybe able to benefit from making both military and civilian R&D do double duty.

There are several things Congress could do to foster greater symbiosis of civil and military technology. Steps could be taken to expand the availability for commercial exploitation of the vast amount of R&D done in DoD laboratories and under contract to DoD. Tying the Defense laboratories more closely to those of other agencies—for example by fostering exchanges of personnel or forming major research centers for dual-use technology-could benefit both military and civilian developments. Both the development of technology and its transition into engineering could be helped by movement of technical personnel between government and industry.

The acquisition system could be reformed to make it easier for DoD to do business with innovative companies in the commercial high-technology industries. Government regulations on profits, data

³The question of potential shortfalls in the future supply of Scientists and engineers is addressed in U.S. Congress, Office of Technology Assessment, *Educating Scientists and Engineers: Crude School to Crud School*, OTA-SET-377 (Washington, DC: U.S. Government Printing Office, June 1988); and U.S. Congress, Office of Technology Assessment, *Higher Education for Scientists and Engineers—Background Paper*, OTA-BP-SET-52 (Washington, DC: U.S. Government Printing Office, March 1989).

rights, and accounting procedures all discourage these companies from seeking defense business.

Congress may find it worthwhile to reconsider current mechanisms for setting technology policies at the highest levels of government. In particular, it may wish to provide for a high-level organization that would oversee and coordinate major government-sponsored R&D programs.

ISSUE 7: Dealing With International Trends in High-Technology Industry

The United States is failing to maintain a competitive commercial base for some technologies that are important for defense procurement. Long standing industrial and trade policies may have to be reformed if the United States is to maintain the industrial capacity necessary to support essential dual-use technologies.

Both Congress and DoD have been concerned about the movement of high-technology industries offshore. This has spawned several responses, including attempts to legislate that DoD buy almost exclusively from domestic suppliers. This approach would probably minimize foreign content in U.S. defense systems, but it attacks the symptom rather than the cause. It would have little effect on the ability of U.S. companies to compete effectively in the international marketplace—a key to having healthy, leading-edge companies here for DoD to buy from.

Having dual-use companies in the United States and available to DoD requires that they be sufficiently competitive on the world market to stay in business. Defense business alone is not usually big enough to keep them afloat. And creating captive companies that exist only on assured DoD business will almost certainly guarantee that technology falls behind the state of the art. Furthermore, cutting ourselves off from foreign technology will mean depriving our defense efforts of important technology that is not available here but possibly is available to the Soviets on the open market.

The United States will have to deal with two fundamental phenomena. First, high technology is a worldwide enterprise. The United States no longer has a monopoly on it. We can change our position relative to the rest of the world, but it is extremely

unlikely that we will regain the dominant position the United States once enjoyed. Second, individual companies and entire industries are becoming internationalized. It is becoming increasingly difficult (if not impossible) to define what an American company is. Plants in the United States are owned by foreign nationals or foreign-based corporations. And U.S. companies open plants in other nations. Moreover, international partnerships lead to foreign interests in U.S. ventures and partial U.S. ownership of foreign factories. Protecting U.S. interests and ensuring U.S. sources of supply are therefore not simple matters. This is complicated by the measures that other nations take to protect their companies and their home markets.

The United States has yet to begin to formulate a policy to deal with this situation, both with regard to defense procurement and as it relates to the future of the U.S. economy as a whole. Congress will be faced with decisions on how dependent on foreign sources DoD can be, which high-technology industries must be kept viable in the United States, how to maintain those industries, and how to protect U.S. defense needs as companies become internationalized. Congress will have to formulate policy with regard to foreign ownership of U.S. plants and foreign siting of U.S.-owned facilities—or encourage the Administration to do so.

The solution is almost certain to be found among the choices that lie between the two extremes of buying defense components only from U.S.-based and owned suppliers, and buying solely on the basis of getting the best deal. The former is likely to be incompatible with staying on the leading edge of technology, and the latter may well reduce the U.S. base of technology and manufacturing to a level that is insufficient in time of crisis if not in peacetime. These intermediate choices include buying from:

- U.S.-based foreign-owned companies,
- U.S.-owned companies regardless of location, and
- nearby sources (i.e., Canada or Mexico) regardless of ownership.

In formulating policy, the Nation will have to decide how important foreign ownership is and to what degree domestic siting of development and manufacture is necessary. That policy will have to take into account factors such as: international

patterns of trade, manufacturing, and corporate ownership; the costs and opportunities of maintaining domestic capabilities; existing relations with other nations; and the effects of policy choices on foreign relations. It is one thing to be interdependent with an allied nation, and quite another, as the oil shocks of the 1970s demonstrated, to be dependent on just any nation. Every nation ultimately presents a different case, but the spectrum ranges from Canada—which is adjacent, a NATO ally, and defined as part of the North American industrial base—through our European NATO partners, Japan, other European trading partners, and ultimately to nations with which our ties are very uncertain.

The intricacies of formulating policy are illustrated by the problems of trade in defense equipment with our NATO allies. The United States is pursuing multinational cooperation and integration of defense-

related development programs through vehicles such as the Nunn Amendment, both for political-military reasons and to promote sales for U.S. defense firms. But these actions will also lead to greater competition from European defense companies in the United States and abroad. Access to European technology will be offset by the diffusion of U.S. technology.

Policy decisions regarding foreign dependence for defense needs fall into the jurisdictions of DoD and the Armed Services Committees. But the broader issue of how the United States should deal with the international economic situation in order to achieve these and other goals will involve a much more diverse cast of players. Congress will have to decide both how it will approach the problem in a manageable way, and what restructuring might be necessary within the executive branch.