Marrying Commercial and Military Technologies:

A New Strategy for Maintaining Technological Supremacy

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In this article I will discuss why the past is not a bellwether for the future. I will describe why simple solutions, slight readjustments and conservative approaches will not allow us to sustain the technological advantage we have enjoyed since World War II.

INTRODUCTION

In a news conference shortly after Desert Storm was over, General H. Norman Schwarzkopf, Jr., USA, mused, "One of the things that has prevailed particularly in this battle is our technology.[1] "Invisible" airplanes, vision devices that turned night into day, airborne sensors that could detect and locate a single tank from hundreds of miles away and

1 Remarks on CNN television by Gen. H. Norman Schwarzkopf, commander in Chief, Desert Storm forces, February 27, 1991.

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the Patriot missile that could destroy an incoming missile—and more give credence to the conventional wisdom that our technological superiority wins wars, saves lives and puts us in good stead to deter any potential adversaries we may face. Moreover, the Desert Storm triumph and Warsaw Pact collapse could almost lull the United States into believing that maintaining our military technological advantage is merely a matter of continuing the course we have maintained over the past 30 years. Unfortunately, this conclusion is a myth that is demonstrably wrong on several counts.

Dose of Reality

Most of the systems that performed so impressively in Desert Storm were based on 15- to 20- year old technology. The laser guided bombs the Air Force used so spectacularly were only slightly different than those used against fixed targets during the latter stages of the Vietnam War over 20 years ago. The stealth technology in the F-117 is 15 years old and the Patriot, which took over 18 years to develop, contains mostly technology from the early 1970s (Gansler, 1992, p. 3).

"So what? If old technology is good enough, why get excited?" one might argue. The crux of the problem is that old technology is not good enough. Then Secretary of Defense Dick Cheney (1991), noted a few years ago that the world was on the verge of a revolution in military technology, with leading nations achieving major breakthroughs and smaller nations gaining access to weapons of mass destruction. The issue is not simply that another nation might outpace us, but rather that virtually any potential adversary may be able to purchase on the international arms market weapons that are as capable, and perhaps more capable, than our own. North Atlantic Treaty Organization (NATO) nations, Japan and other countries such as Sweden and Israel currently are on a par with, or have significant leads in, some niches of nine of the 20 critical technologies DoD identified in 1990 (Department of Commerce, 1990). All of these countries except Japan are significant exporters of arms to the Third World. In France and Israel the major focus of the defense industry is supplying foreign buyers. As the defense industries, particularly in the NATO countries, struggle to survive, we can expect to see increased pressures to export by the industries and their governments seeking to retain jobs.

Avoiding the "Oh-No" Factor

The accelerating trend for very rapid worldwide dissemination of the majority of arms technology is only part of the problem. The real possibility of technological surprise (the "Oh-No" factor) still exists. In testi-

mony before the Senate Appropriations Subcommittee on Defense, Stephen Conver (1991), then the Army's Assistant Secretary for Acquisition, testified that Army combat troops were surprised by the Iraqi night vision devices they found after the abortive attack on Khafji; they were unaware that Iraq possessed the technology for these devices. This "surprise" had no effect on the war's outcome, but others could have.

Future advancements in technology are difficult to forecast. As long as much defense-related science and technology work throughout the world continues to be done in secret, one can never be sure of the true state of our adversaries' technology (e.g., our misjudging the maturity of the Iraqi nuclear weapons program). One observer describes the hazards of technological surprise: "One never knows when one's own laboratories or the laboratories of a potential adversary will produce a new development that, if not adopted, countered, or both, can produce a decisive outcome in a future confrontation (Adelman & Augustine, 1990)."

Money Talks but "Big" Ideas Walk

The major reason why the technology lessons from Desert Storm should not give us comfort is that we are no longer funding defense science and technology (S&T) at the relative levels we were at the time most of the Desert Storm technologies were born. The DoD investment in S&T (6.1, 6.2 and 6.3A in "budget-speak") has declined sharply over the past 25 years, even as the overall defense total obligation authority has risen. Industry has tried, but has been unable to make up the difference (JCS, 1991). Current funding is slightly less than three percent of the defense budget. Conceivably one could argue for major increases in S&T funding but, with the continuing shrinkage in the defense budget over the next several years, such increases seem implausible. Optimists believe that S&T investment may hold constant or increase slightly, but the trend of the past 25 years will almost certainly continue. Even if a reversal in S&T funding should occur, the precipitous decline in the procurement budget coupled with the historically high cost of military advanced technology augurs against filling the operational inventory with advanced systems using the procurement methods of the past.

Developing a strategy for maintaining technological superiority in the face of declining budgets is not a simple problem because of the host of political, economic and technological factors that are at work. Nonetheless, one persistent theme of many of the thinkers who have looked at the problem is that DoD should increase its level of support for independent research and development (IR&D) as an essential ingredient in the overall strategy. At present, IR&D is largely in-house research that

companies do on their own initiative. Partial reimbursement (80 percent) comes indirectly when the government allows a portion of IR&D to be recovered as overhead on development and procurement contracts.

A 1988 Defense Science Board Study reported that "there is probably no other mechanism that is more effective in developing and inserting technology into defense systems than IR&D." Largely as a result of the effectiveness of IR&D, the political appeal of increasing R&D investment without direct increases in the R&D budget and defense industry lobbying, Congress agreed in the 1992 authorization to increase government support for IR&D from 80 to 100 percent by 1995. However, many industry executives concede that the change is unlikely to spur new investments. One report stated that companies in the here and now are reluctant to increase their overhead rates for fear they will lose out on competitive contracts to companies who are slashing R&D expenses. With procurement budgets expected to decline 25 to 33 percent over the next decade, many firms are reluctant to plow money back into what they see as a declining business (Washington Post, 1991). Even if the increased support were to stimulate investment, it is unclear whether the investments would be in the right areas.

A 1989 RAND study estimated that an additional $1M of DoD share of IR&D would, for the average company, stimulate 27 man-years of added development effort, eight man-years of applied research, but only about 0.6 man-years of basic research. This suggests that a company's propensity is to invest IR&D in areas where there is near-term payoff (i.e., in development programs) and to spurn investments with long term or uncertain payoffs. As industry profits come down, this propensity is likely to be exaggerated over the next decade to the detriment of technological innovation.

Time for a Dramatic Restructuring?

Some experts suggest that nothing short of a dramatic restructuring of the way DoD does business is required to maintain the technological advantages that we have enjoyed. Senator Jeff Bingaman, Dr. Jacques Gansler (1991) and others have called for a revolutionary strategy that marries commercial and military technology in order to leverage our overall national technology goals and to maintain military strength in an era of budget decline. They maintain that such measures as increasing DoD support of IR&D are merely "nibbling-around-the-edges" and that the marriage strategy "provides the best hope for addressing the problems of the defense industrial base; promises significant cost savings to the DoD at a time of budgetary crisis; ensures adequate surge capabilities to meet emergency military requirements; and, at the same time,

strengthens the science and technology base in the United States."

The purpose of this article is to examine critically this new strategy by discussing its rationale, describing its essential elements, and exploring some of its negatives and barriers. Finally, by drawing some conclusions from the research, I will suggest what implications adopting this strategy would have on the goal of providing the best capability in defense systems at the lowest possible cost and recommend a course for future action.

THE LOGIC FOR MARRIAGE— WE HAVE SO MUCH IN COMMON

Since World War II (WWII), the United States economy has been segmented into two discrete parts: defense and non-defense. The rationale was simple and compelling. First, the conventional wisdom goes, the military is a unique customer who buys products which, except for commodity-type items (e.g., clothing, fuel, and medical supplies), have no civilian equivalents. After all, there is little private demand for Patriot missiles, F-15 fighters or SSN-21 submarines! The technology that goes into these advanced major systems reinforces the view that the defense sector is a separate entity because of the differing requirements of the defense and commercial sectors.

One author illustrates the point by citing the Very High Speed Integrated Circuit (VHSIC) program, a DoD technology program that has been funded heavily and, in part, justified on the basis of having major commercial spillovers. When used within tactical weapons, VHSIC must withstand ambient temperatures of -65° F to 200° F, doses of ionizing radiation and severe physical and thermal shock. Such requirements, together with pressures to develop and field the technology rapidly, led to costly design features not relevant to commercial markets. The very features that make VHSIC distinctive appear to a commercial user to offer few benefits relative to price (Pascall & Lamson, 1991). The VHSIC example may be interpreted in a different way, however. That interpretation would be that the approach was doomed from the start because the requirement was over-stated and more reasonable requirements would have produced a technology with dual-use application.

We can now examine an alternative logic to the historical and conventional one—a logic which has, as fundamental premises, that, in general, military technology is no longer unique from that of the commercial sector and that continuing the segregation of the defense and non-defense sectors may soon erode our ability to field cutting-edge technologies and, ultimately, our national strength.

Military and Civilian Technologies—
Is One From the Wrong Side of the Track?

Proponents of integrating military and civilian technologies argue that, with few exceptions such as nuclear explosive and low observable technologies, defense technologies are not inherently different from commercial analogs. Gansler (1991), a principal proponent, claims that the materials, components and subsystems comprising major defense systems "often have commercial counterparts that are (1) less costly, (2) equal to and, in some cases, move advanced than their defense equivalents, and (3) capable of satisfying similar, or even more severe, environmental conditions." Substantial evidence supports Gansler's contention—at least as it would apply to the electronics industry. For instance, the Semiconductor Industry Association reports that a child's NINTENDO game may well have a more sophisticated processor than the latest generation of military equipment.[2]

The Defense Science Board (1989) points out that defense-unique electronic products, customized to meet DoD standards and specifications, are functionally equivalent and environmentally identical to products built with "ruggedized" commercial components to commercial specifications. The only differences are cost and reliability: the defense-unique products cost from 8 to 15 times more than the commercial counterparts and are less reliable. Yet another report cites the computer chip mounted on a car's engine block as being able to withstand vibrations, temperatures and shocks equal to those imposed on a chip mounted in a tank; the commercial chip is much cheaper, more reliable and years more advanced (Bingaman, et al, 1991). The defense electronics sector is indeed an important one that pervades the other high-tech sectors. For instance, 30 percent of the cost of an advanced fighter is made up of electronics. Some expect this to rise to more than 50 percent in future generations of new aircraft. Despite the major role of defense electronics, an obvious question is: What about the non-electronics segment of the industry?

Critical Technologies—A "Critical" Issue

Much attention has been given in recent years to the "critical technologies." The Departments of Defense and Commerce, and the National Critical Technologies Panel, have each listed technologies most critical to the Nation. Of the 20 technologies on the DoD list, only five have no counterpart on the Commerce list: high-energy-density materials,

2 Semiconductor Industry Association testimony before the Senate Armed Services Committee, June 7, 1990.

hypervelocity projectiles, pulsed power, signature control, and weapon system environment. The rest, including specific materials, manufacturing, information and communication, and biotechnologies appear common between the defense and non-defense sectors. Having such technological commonality need not imply that the applications are common. But, it does imply that congruence between military and commercial technology requirements is substantial and that there should be major opportunities to work dual-use technologies cooperatively, to use commercial buying practices, to integrate production facilities and to use the commercial sector for a wartime surge capability. So, why is DoD not aggressively exploiting these opportunities?

The answer is deceptively simple. The DoD has not yet gleaned that defense technologies are unique mainly *because of the manner in which the DoD procures them,* and not because there is any fundamental difference between the technologies.

So, Who Pays the House Payment?

Given the approximately $30-40 billion a year spent on R&D, how much contribution does it make to the overall economic good? Are there spin-offs? The issue is unresolved. From the end of WW II until the 1970s a significant portion of DoD research dollars were spent without requirements that the research have specific military application; other federal agencies did similar "no strings" research. This easy federal money produced a robust research infrastructure that was extremely productive as measured by the numbers of significant scientific papers, patents and even Nobel Prizes (Pascall & Lamson, 1991). The defense R&D dollars during this period produced some notable spin-offs into the civilian sector including commercial jet aircraft, computers, semiconductors, nuclear power, communication satellites and special-purpose materials like Teflon, Pyrex and Kevlar. However, since the 1970s, spin-offs of defense technologies into the commercial world have decreased dramatically. But, the 1986 Packard Commission underscored the paucity of contribution of military research to the overall economy by noting that DoD was a "net user" of commercial research (Gansler, 1989). Indeed, during the largest peacetime military buildup in our history in the 1980s the massive military expenditures did very little to seed any commercial markets (Bingaman, et al.).

Can Two Live as Cheaply as One?

Until recently we lacked definitive data on the direct financial benefits accruing from integrating defense with commercial technologies. A recent landmark study by the Center for Strategic and International Stud-

ies examined specific real-world cases to try to quantify potential savings. One case study looked at just the added personnel costs imposed on companies by having to administer defense procurement regulations. The study examined a company with annual commercial sales of $10 billion and defense sales of $4 billion; the company had a total workforce of 100,000 employees. The study found that the commercial divisions needed 8,500 people to administer the commercial sales, but needed 18,200 to oversee the defense sales. Extrapolated to equal level of sales, this means that the defense sales required six times as many people as the commercial ones. Applying the more efficient commercial administrative-to-sales ratio to the defense divisions would save approximately 9.4 million staff hours per year or about $750 million out of the $4 billion in annual sales.

If one were to multiply just those direct savings (and ignore the indirect savings in reduced government personnel, non-labor overhead, and parts and material costs) across a modest portion of defense purchases, the saving would be staggering: in tens of billions of dollars. In another case study IBM estimated estimated that 26 percent of the cost of the avionics processors it builds for DoD resulted from defense-unique requirements that added no value to the final product.

Moreover, the Office of Technology Assessment (OTA) notes that the 10 to 50 percent additional costs resulting from the existing regulatory maze of doing business with the DoD cannot possibly yield enough benefits to warrant the $15 billion to $75 billion extra that the regulations add to the defense budget (1989). A 1986 Defense Science Board study found that systems built with commercial components would have lower overall costs (by a factor of between two and eight times) and that if electronic systems used proven off-the-shelf components (which are procured in much higher quantities than defense-unique parts), DoD could buy them two to five times more rapidly. This shows a shift to commercial components would make a dramatic difference in cost, quality and schedule. In a time of declining budgets the fiscal arguments for the marriage are persuasive; but the broader economic arguments are even stronger.

We Just Grew Apart

The connectivity loss between the military and commercial sectors has little to do with the uniqueness of today's military technologies. For, as pointed out earlier, there are significant overlaps between militarily important technologies and those the Department of Commerce sees as critical to economic competitiveness. The underlying problems are a lack of cooperation between government and industry as well a widely

held belief (within government) that industry should not receive a "windfall" benefit by exploiting public investments for commercial purposes. This belief is in marked contrast to that of our major economic competitors who foster government and industry collaboration for macroeconomic benefit. One report cites Japan's Very Large Scale Integration Project as an example of government/industry cooperation which helped propel Japan from a non-player to a world leader in this key technology in less than ten years (Bingaman, et al.). The author goes on to state the dilemma as follows:

> America's defense needs do not necessarily complement its prerequisites for competitive economic development. By pursuing both goals at the same times, the U.S. is failing to make explicit the significant trade-offs involved when the exigencies of national security interfere with the requirements for successful economic competition. And, as a result, the U.S. is in danger of ceding to its economic rivals what it is apparently determined to deny its military rival at almost any cost-permanent competitive advantage across a variety of contested fronts.

Macroeconomic arguments are about money. But, the ultimate argument for merging the two sectors is not dollars and cents; it is an intuitive one that revolves around people.

We Just Don't Communicate!

At any one time throughout recent history the DoD has been responsible for employing between one-third and one-fourth of the nations' engineers and scientists (Gansler, 1989). The problem is that America has a finite pool of scientists and engineers with increasing difficulty of encouraging people to go into these fields. Often, geographic sectional bidding wars took place between the military and commercial sectors to attract the scarce talent. Defense historically won these wars—at least in *quantities* of people—by offering better salaries but the *best* people frequently have opted for the commercial sector because of its greater stability and growth potential.

Whatever the balance, the artificial schism splits and dilutes the talent pool. Even within the same company scientists and engineers are usually segregated in different divisions and different locations depending on whether they are doing military or commercial work; the results are that there is little or no communication between the engineers in the two sectors. Indeed, one industry manager in a large electronics firm notes that "people in our military and commercial divisions behave towards

one another as if they work for separate companies. They sometimes deliberately keep innovations from one another for fear they might have to share the glory."[3] The lack of linkage between the two sectors has a profound impact on both our national security and our economic competitiveness. As Bingaman, et al. notes:

> It is rightly said that technology transfer is a contact sport. Without shoulder-to-shoulder contact in the workplace, new ideas simply do not span the gaps from research to application to production as quickly. The fracture of the communications linkages between the commercial and military high technology sectors has profoundly damaged the nation's ability to innovate as rapidly as its competitors.

The fundamental question is not *whether* the military and civilian high-technology sectors need to be more closely integrated, but *how* to go about it. Some would argue that an evolutionary merger is already in process as companies attempt to expand from defense markets into commercial ones to try to offset the effects of the declining defense budgets. While such a one-sided integration may help the commercial sector, it provides little benefit to the military side.

The next sections will examine three strategies to encourage a true, *two-way* integration of the commercial and defense sectors: increased fostering of dual-use technologies, greater reliance on common, ruggedized equipment built to essentially commercial specifications, and more widespread use of integrated, flexible manufacturing.

DUAL-USE TECHNOLOGIES—TWO BIRDS WITH ONE STONE

Dual-use technologies are those that benefit both civilian and defense sectors. Until recently, dual-use technologies have been mostly a matter of serendipity. Now focus must shift so that DoD can deliberately target more R&D dollars toward dual-use technologies even if such targeting may be at the expense of maximum military performance. The DoD November 1991 Report to Congress on the Defense Industrial Base underscores the rationale for dual-use projects: "By working more closely with the civil sector in technology development, DoD can obtain increased access to a world-class commercial research base, maintain its pace of innovation despite decreased budgets, and leverage technology investments."

3 A December 1991 interview with David Welp, Vice President, defense Systems and Electronics Group, Texas Instruments, on attitudes of employees in the military and civilian workforces.

Some Sort of a Start

One prominent vehicle for promoting a broad range of dual-use technologies has been the Defense Manufacturing Technology (MANTECH) program. For example, the Defense Logistics Agency funds programs to automate the manufacture of uniforms, the Navy to improve shipbuilding technology, the Air Force to reduce the cost of engine repair, and the Army to speed the inspection of ammunition. Though some MANTECH projects have dual-use potential, there are frequent complaints that the benefits are not adequately diffused throughout industry (Office of Technology Assessment, 1991).

Another potential vehicle is the Advanced Projects Agency's Semiconductor Technology (SEMATECH) program, a government-industry consortium to get the United States into the race (with Japan) for the 64 megabit dynamic random access memory chip (Air Force Association Report, 1991). These programs can contribute significantly to the military-civilian marriage, but first there needs to be far-reaching changes in how such programs are funded and managed.

Where's the Meat?

The first needed change is one of priority as reflected in funding. Process-oriented defense technology programs have historically been of rather low priority in the DoD budget. For example, DoD requested only $265 million for MANTECH in the FY91 budget. Congress added $150 million to the DoD request and mandated that DoD submit a Manufacturing Technology Plan to establish priorities and a framework for process technology development (Office of Technology Assessment, 1991). The primary reason for this low priority is that DoD R&D investments have always emphasized the product over the process. Consequently, the lion's share of DoD R&D investments has traditionally gone to the end-product suppliers rather than to the parts and material manufacturers. However, the *process* rather than the product offers the greatest potential for leveraging between the two sectors. Congress appears willing to fund dual-use, process-oriented technology and supports such initiatives as SEMATECH, flexible and computer-aided manufacturing initiatives, the Millimeter Wave Monolithic Integrated Circuits program (Gansler, 1989). The focus must be changed by substantial increases in funding for process-oriented technologies. That these investments will undoubtedly come at the cost of lowering the investment in product-oriented technologies should pose little problem in an era when there is little threat-driven impetus for building new systems.

As Jacques Gansler notes, "...the concept of 'induced innovation' results in R&D objectives having a distinct influence on the evolution of

technology. Thus, specifying dual-use for the research program (versus defense only) is likely to influence which technology gets emphasized and how the technology evolves." In other words the free market responds to what DoD wants and can afford.

Everybody Else is Doing It; Why Can't We?

The second change is institutional: getting DoD away from the "ad-hocery" characterizing the present approach for encouraging dual-use technologies. Virtually, every industrialized country in the world (except the United States) has a government body with a specific charter to link the military and civilian industry. The United Kingdom has established a quasi-public firm called Defense Technology Enterprises, LTD., to transfer military technology to the civilian sector. France has a ministerial level council to address dual-purpose advanced research and has recently tripled the funding for that council. Italy has a Ministry for Coordination of Initiatives in Scientific and Technical Research (Office of Technology Assessment, 1989). Japan through its Ministry of International Trade and Industry has a highly effective program for marrying military and commercial technologies.

Just Some Office Space and a Few People

America might benefit from a powerful centralized office, but it is likely that it would be seen as too much government influence in the free market economy and that the military would reject it because of loss of control. So, the proposal here is to establish an office within the Office of the Secretary of Defense (OSD) to unite the fragmented efforts and to establish leadership in promoting dual-use technologies. A useful analogy would be OSD's Balanced Technology Initiative (BTI) office. The OSD established BTI a few years ago to exploit breakthrough technologies. There could be a parallel Dual-Use Technology Initiatives (DUTI) office with both the charter and the money to encourage dual-use technologies. Like BTI, DUTI would develop long-range strategies and provide start-up monies that the Services could supplement as the technologies began to mature. However, unlike BTI, DUTI should fund industry directly by forming a shared funding consortium, and by giving outright grants so that potential nondefense and small commercial firms would play. Funding should be significant (perhaps $500 million per year) to show the seriousness of DoD's intent. About half of the monies should go toward projects that would adapt predominantly commercial technologies to military application. The balance would go toward infant technologies where there is opportunity to create new human and physical resources as well as U.S. competitive advantages. The fact that fund-

ing for DUTI would be offset by decreases in military-unique technology funding would, over time, have the effect that the military systems that were bought would reflect the cost and quality parameters that the commercial world demands.

And, Removing the Administrative Nightmares

The final and most important change is to remove much of the government-mandated administrative nightmare that companies must endure if they do business with the government. The OTA identified the major impediments to marrying the civilian and military sectors and found the primary obstacles were government policies and practices including overly rigid requirements, audit and cost accounting rules, progress payment policies, the myriad of test and certification requirements, mandatory competition and rules forcing small and disadvantaged set-asides, among others.

The maze of rules deters many companies from bidding on any government R&D projects. For example, an executive of Hewlett-Packard comments: "Occasionally, in the past, a project might have been sufficiently intriguing technically to induce lab management to accept the administrative burden, but no more. Hewlett-Packard policy today is strictly no acceptance of government funding of R&D at any level over $100,000 (Bingaman et al.). Still other companies don't set limits, but maintain what are essentially separate companies (often labeled as a "group," "division" or "subsidiary") to deal with the defense world and its unique demands. Texas Instruments' Defense Systems and Electronics Group, for example, has its own research facilities. According to a company executive this is not so much because the government's products are unique as it is because its administrative requirements are.[4]

What is clearly needed is limited exemption from the administrative burden to encourage more commercial companies to participate in dual-use research projects and to encourage defense firms to draw on their commercial expertise. Without such exemptions there seems little hope that dual-use technology will prove an implementable strategy. This brings us to the second step of fostering greater military-civilian integration: buying commercially developed systems and components for military use.

FOR WANT OF A NAIL?—BUYING COMMERCIAL ITEMS

A dominant sense within DoD's acquisition establishment that commercial items will not withstand the rigors of military use even when ruggedized. Occasionally widely publicized horror stories reinforce this sense,

4 Interview with David Welp, Vice President, Texas Instruments.

such as a report that the Air Force was ridiculed for developing a costly fax machine with "excessive" specifications. However, the report goes on to say, in Desert Storm that fax machine "withstood blowing sand and kept transmitting target imagery while the casings melted off its commercial counterparts in the desert heat"(AFA).

What is interesting about this story (other than it attempts to prove the rule by citing the exception) is how it illustrates the vested interests that have been the major impediments to military use of commercial products. In my experience there is just as much resistance from the working-level government officials who develop and procure military equipment. To them it is not simply a matter of job security. Rather, the resistance comes from an institutional mindset traditionally emphasizing performance over cost—a mindset that causes a push for a few extra percentage points of performance and consequently eliminates commercially available options. The end-item user rarely is so biased, and only wants the equipment to perform as needed.

The good news is DoD is slowly procuring items using commercial item descriptions and non-government standards. In 1980, 6 percent of DoD's procurements fell into this category; by 1990, the figure had grown to 18 percent (Bingaman). In 1991, former Secretary Cheney noted the progress in converting to commercial specifications: "Not only does the Department intend to cancel or revise as many as 12,000 documents, it also intends to adopt thousands of non-governmental standards and write commercial item descriptions (nearly 5,000 of them have been adopted so far)." Now we must pursue a policy that will accelerate this trend and require purchasing commercial systemsas the *preferred* course. There must be a greater willingness to trade off non-critical requirements allowing commercial items rather than one-of-a-kind, customized ones.

Establishing policy must be accompanied by institutional pressures or an aggravating "forcing function" to cause real change to occur. Such pressures could come from establishing "commercial product advocates" throughout the Services' headquarters and buying agencies to provide "adult supervision" and mandatory coordination on all procurement actions. Importantly, these advocates should be engineers rather than contracts or administrative people. Non-technical people might unduly influenced by contrived technical explanations meant to justify the use of non-commercial components. The DoD's experience with competition advocates is an encouraging analogy.

How About a Test Drive?

Another useful step in expanding the military use of commercially available products would be the broader use of "buy-and-try." The ultimate

test of whether or not a commercial product has military utility is not whether it meets some specification or standard; rather, it is a judgement by the actual military user that comes from actually using the product. Unfortunately, current procurement rules discourage this approach by forcing sole-source justifications and specification of minimum requirements. These rules need to be selectively relaxed for a pilot program which would have money specifically for testing off-the-shelf commercial products or ruggedized derivatives with military utility.

Focusing on the Trees Instead of the Forest

For military-unique systems (e.g., fighter planes, submarines and tanks), where there are not commercial analogs, the problem is somewhat different. Expanded use of commercial items has enormous payoff, but it must be at the subsystem level where the prime contractor, not the government, is usually the direct buyer. Here there must be incentives that would motivate the prime contractor to prefer commercially available components over specially designed and built ones.

A vehicle for this incentive would be adapting the Value Engineering Change Proposal (VECP) program, normally applied during production to stimulate contractor cost-saving proposals by allowing the contractors to share in the money saved.

The DoD must tailor the VECP program by allowing prime contractors, *during development*, to submit proposals to relax government-specified requirements in order that the prime could use commercial components. These VECP proposals would be evaluated by an independent agency rather than the buying office. This "outside" agency role would dismay the government program manager, but is a critical step if the approach is to succeed. This approach would create institutional pressure within the buying offices to scrub requirements more thoroughly before procurement so that the primes would use commercial products more naturally.

Back to Basics

At this juncture it is important to reiterate a point made earlier in this paper; namely, that the motivation for using commercial items is primarily economic. Using commercial items can have the effect of giving equivalent or near-equivalent combat capability with lower cost to develop and produce than can ever be possible from using military-unique items. The end result is more bang for the buck—greater combat capability for the limited dollars available. This brings me to the third strategy for integrating the military and civilian sectors: adopting for military production the commercial concept of flexible, integrated manufacturing.

FLEXIBLE MANUFACTURING—GOING WITH THE FLOW

If the bulk of weapon makers are to survive, they must adopt a more flexible manufacturing approach. They must figure out ways to achieve high efficiency with low production rates and small production quantities or they will be casualties of downsizing.

A "Centsable" Approach

Flexible manufacturing" in defense production calls for a manufacturer to produce a mix of commercial and military products on the same production line. This is done efficiently by using computer integrated design and automated manufacturing equipment and the advantages are: (1) military item costs are lower from the economies of scale, (2) design upgrades may be incorporated more rapidly, and (3) effective technology transfer from the commercial to military products will occur because designers and builders of each one are working alongside. Dual-use factories are able to shift to full military manufacture in emergency. Commercial products benefit from the government state-of-the-art engineering talent and high-technology management skills. However logical it may be, making the change difficult.

Buggy Whip Makers Thought They Were Hot Stuff, Too

There are a host of legislative and regulatory impediments to flexible manufacturing. I have previously described some. However, the biggest impediment is not a legislative one; it is a cultural one. Large defense contractors think of themselves as just that—*producers* and *integrators* of large systems. The greatest advantage they bring to the commercial world is their managerial and systems-integration expertise. Some have begun adjusting to the changing defense market by aggressively moving into the commercial market. Others resist, citing the Lockheed L-1011 and Grumman's disastrous venture into mass transportation as lessons for what happens when defense firms enter commercial markets.

Entering the commercial market requires much more up-front emphasis on cost and "buildability" than defense firms are used to and learning how to market products in a multi-buyer, non-monopsonistic environment. Yet, despite these barriers, survival is a strong motivator for companies to make the plunge.

Let's Not "Kick the Can"

The technology for true flexible manufacturing is still immature and the basic concepts for it are evolving. Nonetheless, waiting until things "sort out" is not the answer. The OTA hits the nail on the head when it declares that, "...the [totally integrated factory] concept relies less on

computers and robots than on a new philosophical approach that emphasizes flexibility in meeting a wide variety of customer needs." The philosophical changes can begin now.

YES, THERE ARE SOME EXCEPTIONS

The concept of integrating the military and civilian industrial sectors does have its limits. We will always have military-unique areas (e. g., nuclear explosives, missile propellants, gun tubes, pulsed power and stealth technology) where integration is implausible. For these few, but critical, areas the government would have to maintain a defense-unique capability. This capability could reside in commercial firms where there would be a minimum cadre of engineering and production people segregated from the commercial world. An alternate approach would be to return to the arsenal system for these critical areas where DoD is the only customer

Under either approach (or some combination of the two approaches) the emphasis must be on having a limited number of sources and maintaining expertise. The DoD must monitor the rate of innovation, responsiveness, efficiency and priorities for these few sectors, recognizing that the normal advantages available from the multiple-source environment would be lacking.

TAKING A LESSON FROM THE DINOSAUR—A CONCLUSION

Marrying the civilian and military sectors and eliminating the largely artificial distinctions between them could have enormous advantages to both our national security and global competitiveness. Such an integration would require massive changes in how DoD does business and cultural changes within the defense industrial complex. These changes will not come easily because there are many vested interests at stake and a long history of evolutionary (vice revolutionary) adaptation. But, the logic is so compelling that we must quickly move away from the past and exploit the full available synergies. The marriage strategy is, according to the Center for Strategic and International Studies, the only one "that addresses the problems that plague the defense industrial base, yields significant cost savings to the government at a time of budgetary crisis, and, at the same time, strengthens the science and technology base in the United States." Such monumental changes will not happen overnight, but the first step to change is to recognize that it must happen.

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