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The Silence of the Labs

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Overview

Something important to the Nation's defense has vanished, yet the top Pentagon brass never noticed. Not the stuff of headlines, this loss would not arouse public concern, especially during these times of terrorist massacres, anthrax attacks, corporate scandal, and war. Nevertheless, like the miner's canary that is first to die with the rush of an ill wind, this loss is a warning.

In the span of 18 months, the Department of Defense (DOD) lost a key part of its 25-year-old ability to perform fiber optics research at the Naval Research Laboratory (NRL), the only site with this world-class defense capability. It was not time for DOD to exit this critical field. Urgent security needs not being met anywhere else were being addressed. Both the scale of the loss and the speed with which it occurred reveal a growing problem: the private sector's increasingly successful recruitment of the best scientists working for the DOD Defense Laboratories. While personnel losses are to be expected in any enterprise, public or private, this particular loss exposes the diminished DOD ability to retain the technical talent necessary to accomplish its mission.

The death of this "canary" sends warning that an ill wind is blowing for the Defense Laboratories.[1] Without reform, their loss of expertise will worsen, eventually to the point where it affects good government and poses significant risks to national security. Should this happen, the Nation will suffer what President Dwight Eisenhower called "a disastrous rise of misplaced power."

Before the Collapse

The Naval Research Laboratory (NRL) has been the Department of Defense (DOD) center of expertise for fiber optics research and development (R&D) for more than 2 decades. In 1977, it caught global interest with the world's first fiber optic acoustic sensor, an ultrasensitive device that can "hear with light."[2] Since this NRL breakthrough, these sensors can now also detect temperature variations, magnetic and electric fields, and vibration. For example, when buried in the ground, fiber sensors can monitor foot or vehicle traffic and transmit the information long distances without detection. The warfighting uses of fiber sensors are limited only by imagination, and their military impact, along with that of other NRL innovations in fiber optics, has been profound.

These innovations also got the attention of the private sector for potential commercial uses: NRL work in fiber optics has been applied to medical care, seismology, communications, robotics, traffic control, and the safety monitoring of bridges, dams, and aircraft. It is no surprise that NRL staff has been heavily recruited by industry.

Gone—*in 18 Months*

Industry began targeting NRL in 1999, but it was in 2000 that losses became severe enough to affect the laboratory's fiber optics research mission. Twenty of 26 researchers were hired away that year. Within 18 months, the collapse was complete.

The private sector offered salary increases from 50 to 100 percent, stock options, and new field offices for those unwilling to move. Higher compensation is not always enough to lure Government scientists and engineers away from public service, but, in this case, it was the biggest factor.

Over the years, NRL attracted talent *despite* industry ability to offer superior financial compensation. This success was achieved by maintaining sufficient tangible income and superior intangible benefits such as important work, reasonable autonomy, state-of-the-art equipment, and high-quality colleagues. However, bureaucracy has eroded these benefits (for example, long delays in facility modernization), and tangible income has become insufficient for attracting and retaining enough of the best. This takes us to a couple of common myths.

Myth: Average Is Good Enough. Hans Mark, former director for Defense Research and Engineering, once observed, "The presence of a few individuals of exceptional talent has been responsible for the success (and even the existence) of outstanding research and technology development organizations."[3] Some, however, do not believe that the Defense Laboratories require that level of quality. This has been the prevailing view among Government personnel specialists for some

time, and it is one reason why they have rejected most reforms. They might say that the NRL loss of 26 fiber optics researchers in 18 months is just the ebb and flow of normal business operations in a competitive field. They might also dismiss the significance of these losses by arguing that only an average of 1.5 researchers per month were lost.

But statistical averages protect the status quo by obscuring meaningful information. Peter Drucker, who has been called the most important management thinker of our time, has this to say on the subject: "Averages serve the purposes of the insurance company, but they are meaningless, indeed misleading, for personnel management decisions."[4] Averages hide the fact that NRL, and other Defense Laboratories, struggle to compete for and retain talent representative of the top 10 percent of the Nation's scientists and engineers. Averages also minimize the enormous impact of a single exceptionally talented researcher. Thus, when evaluating the fiber optics losses, it is best to consider a few key points.

- Quality is more important than quantity. A former president of the National Academy of Sciences noted, "In science, the best is vastly more important than the next best."[5] Among the NRL losses were five fellows of the Optical Society of America. One researcher had won the prestigious Institute of Navigation Thurlow Award for his work on the fiber optic gyroscope, now used on military platforms and in automobile navigation systems.
- The losses had major impacts on the small teams that play a critical role in innovation. The NRL losses took place within four research sections. A *section* is the smallest creative unit within larger organizational units. With a typical staff of four to eight researchers, attrition within the four sections ranged from 50 to 75 percent.
- High-quality scientists and engineers are not easily replaced. Studies show that the one-size-fits-all Federal personnel system is antiquated,[6] better suited to hire clerks than physicists. Replacing the NRL losses will not be done quickly, even in an economic downturn, because high-quality scientists and engineers are key to the competitiveness of high-tech industries.
- The losses leave a gap in a critical defense area. DOD lost a capability that now resides in industry, where it is used solely for commercial applications, which means that the Nation's capability to perform world-class fiber optics research for certain unique defense purposes no longer exists.

This last point merits emphasis. NRL performs work that no one else is doing, will do, or can do. This fact raises a second popular myth.

Myth: Industry Can Do It All. Industry will not take on the full range of necessary work because many areas hold limited opportunities for profit. Specialized defense technologies often have little or no applicability to commercial products. Unlike the situation during World War II, or even the Vietnam era, the DOD market is now often too small to justify a significant investment of scarce capital. For instance, Intel stopped making customized chips for the military because it was expensive and the volumes were too small.[7]

In addition, R&D is expensive, the time to achieve success is long, the work is often very risky, and the payoff (especially from research) is usually not immediate. This is unappealing to chief executive officers (CEOs) whose compensation is tied to the short term (such as stock prices and quarterly dividends). To cut costs and raise money, for example, Xerox sought co-owners for its Palo Alto Research Center, which is famous for helping to spark the computer revolution with the Ethernet, the mouse, and the point-and-click computer interface. Echoing the corporate focus on the short-term, *Business Week* stated that co-owners would demand that this "dream factory" work on "more practical, short-term business problems . . . and that's a good thing."[8] In the end, Xerox divested itself of the laboratory.

The record also does not support the notion that private laboratories by nature work faster, better, and cheaper than Government Laboratories. Consider two examples:

- In 1999, Lee Buchanan, then Assistant Secretary of the Navy for Research, Development, and Acquisition, went before Congress and identified eight technologies that had emerged from private and public laboratories to play a major role on the battlefield. Of those eight, four were NRL achievements, and a fifth received strong support from it.[9]
- After a joint National Aeronautics and Space Administration (NASA)/DOD study concluded that a collaborative space mission could test missile defense technologies and provide a significant science return, NRL was given responsibility for mission design, spacecraft engineering, test, and flight operations. In 1994, NRL put the satellite *Clementine* into lunar orbit, and the United States returned to the Moon for the first time since 1972. Built in less than one-half the time and for one-fifth the cost of similar space probes,[10] it was so simple to operate that its mission control center comprised eight engineers working in a warehouse in Alexandria, Virginia.[11]

The combat superiority of the U.S. military is preserved in part by long-term, defense-specific, high-risk work performed by NRL and other Defense Laboratories. A way must be found for the U.S. Government to recruit and retain the world-class scientists and engineers who are critical to the success of that work.

Some will no doubt say that the NRL losses are appropriate because Government talent is fair game to the highest bidder, as it is elsewhere in a free market economy. If the Government cannot compete, it should get out of the field. However, Government is not a business; its metrics and mission are different. Using the dynamics of the marketplace to rationalize losses of expertise ignores the enormous political and military costs that will result from the Government's loss of technical competence.

Political Costs

To understand the political costs of inaction, one must understand why DOD has laboratories in the first place. To be sure, their existence is not based on a unique ability to perform research and development. Instead, it is based on their unique position as technical agents of the U.S. Government, knowledgeable of military requirements, and responsible for acting in the Nation's interests. The Defense Laboratory meets this responsibility by performing three roles: *performer* of long-term, high-risk projects; *quick responder* in crises; and *yardstick*,[12] a term referring to the standard that it sets by providing authoritative, objective advice to governmental decisionmakers. This yardstick role is relevant to explaining political costs.

The Perry Report, endorsed by then Under Secretary of Defense for Research and Engineering, William Perry, spoke to the yardstick role by explaining that to be a smart buyer, the Federal Government must be able to choose among competing options offered by industrial producers. The need for profit makes each company an advocate of its

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own product, so, given those natural tendencies, the Government "requires internal technical capability of sufficient breadth, depth, and continuity to assure that the public interest is served."[13]

Conversely, deficient in-house expertise is what political scientist Harold Nieburg called "losing the yardstick." This condition becomes evident when the Government is forced to hire consultants to judge the work of its contractors. In other words, with its source of independent, objective technical expertise gone, the Federal Government is forced to rely on advice from sources not insulated from commercial pressures to make a profit.

To be a yardstick, a laboratory must be a competent performer. There is no "knowing" in the absence of "doing"; the two roles are intimately related. The following example shows how technical strength yields sound advice.

In 1993, after the Jet Propulsion Laboratory lost contact with the *Mars Observer*, the NASA administrator asked the NRL Director of Research to chair a panel to investigate the failure. The technical teams were composed largely (78 percent) of NRL personnel. When the laboratory delivered the findings to NASA, its report was lauded by the scientific press for its insight, thoroughness, and technical rigor. Though the report contained some criticism of the space agency's practices, it was strongly endorsed by NASA top management. Five days after its release, the NASA prime contractor for the missing spacecraft voluntarily returned $17 million and renounced claims for an additional $4 million in bonuses not yet received—a testimony to the competent objectivity of the NRL work.[14]

This shows how a healthy in-house laboratory system facilitates good government. On the other hand, an unhealthy system impairs it. That was the view of the National Commission on the Public Service.[15] Calling the growing problem in attracting and retaining high-quality civil servants a "quiet crisis," the commission warned that the problem "undermines the ability of government to respond effectively to the needs and aspirations of the American people, and ultimately damages the democratic process itself."[16]

Military Costs

President Harry Truman put it bluntly: "No aspect of military preparedness is more important than scientific research." He also warned, "No government adequately meets its responsibilities unless it generously and intelligently supports and encourages the work of science in university, industry, and in its own laboratories."[17] His remarks suggest that the success of tomorrow's military operations depend, in part, on the research and development performed today by the Defense Laboratories.

To test the validity of Truman's view, consider the consequences if NRL had not been able to attract exceptional personnel in past years. Key technologies would have been unavailable at the moment when the country needed them most. Three of them transformed the military by changing the way wars are fought. They also tipped the balance of power.

Decisive Technologies. The first modern U.S. radar was developed and fielded in time for duty in the great Pacific naval battles of World War II, contributing to victories at Coral Sea, Midway, and Guadalcanal.[18] The world's first intelligence satellite was launched at the height of the Cold War, reestablishing surveillance of the Soviet Union less than 2 months after the U–2, piloted by Air Force Captain Francis Gary Powers, was shot down.[19] NRL pioneered what became the global positioning system (GPS), the revolutionary navigation system that played a pivotal role in the Gulf War, by inventing key concepts and developing in partnership with industry and others the four satellite prototypes and first operational GPS satellite.[20]

Support for the warfighter continues. Among several new NRL innovations that saw action in Kosovo was Specific Emitter Identification technology,[21] which identifies any radar by its unique characteristics with such accuracy as to "fingerprint" it. In fact, it can distinguish between identical models produced off the same assembly line. The National Security Agency selected it as the national standard. Moreover, Coast Guard vessels, naval warships, and aircraft use it to support drug interdiction, enforce treaties, and monitor the movement of materials used in weapons of mass destruction.

Among the most classified NRL programs, there very likely are new capabilities to bring to bear in the war on terrorism. Hints of this are seen in the emergence of unclassified technologies such as Dragon Eye. Carried by U.S. marines in a backpack, it is a hand-launched, four-pound miniature surveillance plane with the radar signature of a bird. It was featured in a *Popular Science* article about new antiterrorism tools.

Of course, NRL does not have a monopoly on success. For instance, CL–20, described as the world's most powerful nonnuclear explosive, was invented by the Navy's China Lake Laboratory.[22] But to better dramatize the importance of the other Defense Laboratories, consider their joint impact on Operation *Desert Storm.* In the first hours of the Gulf War, antiradiation missiles—a type of missile invented by the China Lake Laboratory—took out Iraqi air defense batteries to help establish American air superiority. In the war's last days, the arrival of the GBU–28 bomb put the formerly secure command bunkers of Iraq, and probably Saddam Hussein himself, at risk. The Air Force Research Laboratory (AFRL) and the Army's Watervliet Arsenal developed this bunker buster with contractor support.[23]

The Army's Night Vision Laboratory developed dazzling night-vision technologies, and the Army Research Laboratory (ARL) led development of the world's most effective tank ammunition, the Silver Bullet. ARL got key contributions from the Navy's Indian Head Laboratory and the Department of Energy Laboratories. Night vision devices and the Silver Bullet were fielded on the most lethal weapon of Operation *Desert Storm*—the M1A1 main battle tank. Any doubt about that is dispelled by the testimony of a captured Iraqi commander: "On 17 January, I started with 39 tanks. After 38 days of aerial attacks, I had 32, but in less than 20 minutes with the M1A1, I had zero."[24]

More recently there is the success of the Indian Head Laboratory in developing the thermobaric bomb. This is a classic example of how the Defense Laboratory's strength as a performer enables it to satisfy its role as a quick responder in crises. In fact, the Perry Report found that "a cadre of highly skilled in-house specialists can best respond to situations of this nature."

Crisis Response. After September 11, 2001, the thermobaric bomb was rushed into development for use against al Qaeda and Taliban forces holed up in Afghanistan's mountain caves and tunnels. The weapon was ready in only 67 days. When detonated, it generates extremely high, sustained blast pressures and temperatures

in confined spaces. According to a former Government official, "The capability to produce the explosive for those weapons existed only at the Indian Head facility. . . . No private firm had the ability to produce thermobaric weapons."[25]

Defense Laboratories have helped make the U.S. military the most formidable fighting force in the world, proving President Truman right for placing high value on the Government's own laboratories. But the status quo imperils their future. Something must be done—but what?

Reinvention Was Not the Answer . . .

Instead of pursuing reform, the National Performance Review (NPR) encouraged incremental improvements, commonly called *reinvention*. But the Defense Laboratories lost ground on the big goal of the NPR: *decentralization of authority*. Throughout the reinvention years, DOD and Navy policies designed to save money through *centralization* were the norm. The Defense Laboratories lost authority and are less able to manage their resources than at any time prior to NPR.

For example, after decades of on-site operation, NRL no longer has its own personnel office. This function is now performed 140 miles away at a regional site serving many Navy organizations, most of which have nothing to do with research and development. This change has been roundly criticized. In *Civilian Workforce 2020*, the National Academy of Public Administration called the Navy "a victim of a failed strategy to achieve staff savings" by restructuring its personnel operations in a "dysfunctional" manner.

The results of reinvention were disappointing, which prompted Peter Drucker to say, "In any institution other than the federal government, the changes being trumpeted as reinventions would not even be announced . . . they are the kinds of things a hospital expects floor nurses to do on their own . . . without getting much praise, let alone extra rewards."[26]

Three realities led to the meager results: bureaucratic power is jealously guarded and not freely distributed; accountability is diffused, such that no one office or person may be held responsible for inaction; and *making* government *work* was less desirable than *outsourcing* government *work*.

. . . Neither Was Defense Reform

Large-scale corporate corruption led President John Kennedy to launch his Commission on Government R&D Contracting, which featured some of Government's heaviest hitters.[27] This Commission endorsed the importance of the in-house Laboratories and with firm words warned that "No matter how heavily the government relies on private contracting, *it should never lose a strong internal competence in research and development*."[28]

But since the mid-1990s, preserving that strong internal competence has taken a back seat to outsourcing government jobs. By 1998, the goal was to offer up 229,000 jobs for competition—three times the number studied in the previous 17 years. The Defense Reform Initiative (DRI) was that plan's champion. Although DRI was disbanded after the change in administration in 2000, the last 6 years have seen about 220,000 job competitions—and more are planned. The Army has announced plans for over 210,000 competitions, many of them technology jobs. The former DRI director, now president of an association of Federal contractors whose web site advertises its "direct access"[29] to DOD decisionmakers, praised the initiative.[30]

The push to outsource has been strong, partly because opportunities for savings do exist. But the General Accounting Office (GAO) and others caution that savings are gained by outsourcing functions in highly competitive markets, such as property maintenance. The case for outsourcing research and development, on the other hand, is weak and appears to be founded on two more myths.

Myth: Outsourcing Guarantees Savings of 30 to 40 Percent. Two Defense Science Board (DSB) reports made this claim in 1996, and it became the touchstone for outsourcing advocates. But there are three reasons why the claim is dubious. First, the private sector has experienced mixed results. Coopers and Lybrand reported that only half of the firms surveyed achieved savings.[21] Second, the GAO and DOD Program Analysis and Evaluation (PA&E) Office found the DSB estimate of $6 billion in annual savings to be overstated by as much as $4 billion.[32] Third, academic experts have very different conclusions. Ann Markusen, of the University of Minnesota and also a senior fellow at the Council on Foreign Relations and chair of the AAAS Committee on Science, Engineering, and Public Policy, testified to GAO that "there is no solid evidence that outsourcing has lowered costs in the longer term . . . advocates have not buttressed their case with hard evidence."[31]

Myth: Laboratory Outsourcing Lags behind Force Cuts. Advocates of outsourcing argue that cuts in Defense Laboratory infrastructure since 1990 have not matched cuts in force structure. They claim one way to redress this perceived imbalance is to outsource more work. But using 1990 as the baseline ignores the fact that the laboratories began contracting more of their work long before force cuts began. DOD data[34] show Navy Laboratories outsourced 50 percent of research, development, testing, and evaluation (RDT&E) in 2000, up from 26 percent in 1969. Army Laboratories outsourced 65 percent, up from 38 percent. Actual levels are higher because these data do not include operating functions, such as automated data processing support.

What explains the persistent appeal of a coin-operated government? One reason is that a great deal of money is at issue. DOD already outsources more money to contractors than the combined military spending of Russia, China, and the seven "rogues" (North Korea, Iraq, Iran, Libya, Sudan, Syria, and Cuba).[35] Dollars can affect thinking. Upton Sinclair, author of *The Jungle,* expressed this well: "It is difficult to get a man to understand something when his salary depends upon his not understanding it."

. . . But Solutions Exist

Solutions will vary among Defense Laboratories because of their different missions, but four reforms could improve things significantly, three of which can be implemented today.

Problem: There is a perception that DOD does not have the authority to fix its personnel systems. However, with Section 1114 of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2001, Congress gave DOD the authority of the Office of Personnel Management in matters affecting its personnel demonstration projects. Two years later, it remains unimplemented.

Solution: Use Section 1114 to waive the limit on the number of scientists and engineers within the highest pay bands of the Defense Laboratories and permit their parent commands to establish such positions. This would improve the retention of outstanding talent by permitting the management of these positions according to project needs and funding.

Problem: There is great resistance to personnel reforms that are not "cost neutral." However, sometimes it is necessary to pay more for excellence. Perhaps the investment that society is willing to make on entertainment can lend a useful perspective. The payroll for the New York Yankees 40-man roster is 5 percent greater than that for the 1,575 scientists and engineers at NRL. This is not to suggest that Government scientists be offered million-dollar contracts, but paying a more competitive salary to a small number of exceptionally talented individuals would serve the Nation's defense interests.

Solution: Raise the top salary of the Laboratories' highest pay bands to that of Executive Level II. The best Defense Laboratories need the ability to fix basic pay of up to 10 percent of their scientists and engineers at levels more comparable to the private sector. This can be done with the authority granted by Section 1114. There is also a precedent: The Internal Revenue Service can pay up to 40 employees as much as that earned by the Vice President, which is still $40,000 more than what is suggested under this proposal.

Problem: Some perceive that hiring delays are avoided only by sacrificing merit principles. This cannot be true because 28 agencies are exempt from the competitive examining process of Title 5. In fact, by using "special hiring authorities," half of all new Federal employees did not go through the competitive process in FY97.

Solution: Grant the three corporate Defense Laboratories "direct appointment authority without competition." This would let NRL, ARL, and AFRL make immediate offers for positions for which candidates are few and in high demand, cutting the process by as much as 5 weeks. Because these laboratories recruit for such highly specialized skills, there are not the large numbers of applicants for which competitive recruitment rules make sense. And it can be done in a way that ensures the best people are selected.

Problem: Construction funding for the Defense Laboratories has declined steadily over the last 30 years. Again, by way of comparison, both Yankee Stadium and NRL opened their gates in 1923. In 1973, Yankee Stadium underwent a 3-year, $160-million renovation. By contrast, over the last 30 years, NRL received a total of $25 million (in 1973 dollars)—less than *one-sixth* of the investment in Yankee Stadium over a period 10 times longer. Military construction funding has not always been so limited. In the 1960s, NRL received $33.3 million, an amount equivalent to $111 million in current dollars. That sum would be impossible to get today. Meanwhile, New York City has considered spending $800 million for a new stadium.

Solution: Allow NRL and other working capital fund laboratories to manage their Capital Purchases Program (CPP) for infrastructure revitalization. The CPP gives them the ability to invest in capital assets using overhead funds. But the Navy Comptroller considers the dollar amount and year of availability as statutory limitations. Legislation is required to change this, but there are precedents. The Postal Service and St. Lawrence Seaway Development Corporation use overhead funds generated from sales to acquire, construct, and maintain their own facilities and property.

The basic point is that the problems have solutions, which begs the question, why has so little been done?

An Ill Wind Is Blowing

In 1915, Thomas Edison urged the U.S. Government to "maintain a great research laboratory." Later, as Assistant Secretary of the Navy, Franklin Roosevelt helped make that idea, and NRL, a reality. Both Edison and Roosevelt believed that strong government competence in research and development was important, as did President Truman after science helped win World War II.

For over 40 years after that war, scores of studies continually affirmed the importance of the Laboratories. Among those conducting or endorsing these studies were two Secretaries of Defense (Harold Brown and William Perry), two giants of industry (David Packard and Robert Galvin), and two Nobel laureates (John Bardeen [co-inventor of the transistor] and Charles Townes [inventor of the laser]).

Over the years, problem areas were increasingly noted by studies, but the goal was always to *fix* them. The value of the Laboratories was never in question. For example, the 1987 DSB stated, "This nation has long been well served by defense laboratories in innovative research and in support of national emergencies . . . *the quality of the laboratories and their technical leadership are of supreme importance to DOD*."[36]

Unfortunately, Edison's idea is under assault. In 1996, a negative view emerged abruptly in a DSB report that advocated outsourcing Defense Laboratory work to universities and industry. This report—the same one that the GAO and DOD PA&E found had overstated potential savings by $4 billion—proposed that "those DOD laboratory facilities which are still required after their programs move to university/industry locations, could be privatized . . . *it is quite likely that private industry would compete heavily to obtain the DOD laboratories*, *particularly if they come fully equipped*."[37]

So in 9 years time, the Laboratories went from being considered of "supreme importance" to being proposed for sale, "fully equipped," to the highest bidder. Not long after the 1996 study, an industry CEO (and member of the Defense Reform Task Force) made a case to Congress that savings could be realized through personnel cuts. He said, "DOD should be more ruthless about cutting defense labs."[38] Given that DOD has cut 36 percent of its Laboratory personnel since 1990, with Navy Laboratories down by 43 percent,[39] one can only wonder what a more ruthless approach would produce.

What explains this negative view? Markusen offers a clue by stating in her GAO testimony that the DSB study was "heavily populated by large defense contractors." She concludes that the evidence supporting the DSB claims is inadequate and that the "enthusiasm for privatizing national security is premature and largely driven by commercial concerns and lobbying." But, why did the negative viewpoint appear when it did?

Follow the Money

The change occurred after the Soviet Union collapsed. Without a clear and present danger to enforce restraint, irresistible political and economic urges were unleashed on a shrinking Pentagon budget. At the same time, few production lines were closed despite industry mergers.[40] Remaining excess capacity created an incentive

to pull funding from the public sector, an incentive that increases as dependency on Defense dollars grows. Some contractors are very dependent—according to *Defense News*, General Dynamics' dependence has reached 100 percent. Current security threats are unlikely to restore a restraining influence on the budget. With a shapeless terror threat, the gold rush may be relentless.

As Defense Laboratories transfer their innovations to industry for production, they help to increase the profitability of the contractors. When ARL transferred the Silver Bullet, General Dynamics produced more than 250,000 of them,[41] which it sold back to the Army for a profit. That was an example of healthy public-private cooperation that capitalized on the strengths of each while providing for the common defense. There are many other examples, including NRL transfer of GPS technology, which helped create a commercial market exceeding $15 billion. Some innovations have gone straight into the nondefense economy, such as the NRL discovery of the excimer laser, the tool that made LASIK eye surgery possible and helped create a billion-dollar industry.[42]

Despite their value to industry profitability while performing only 12 percent of DOD research and development, the Laboratories have become a target. Cost efficiency is the pretext to move their work into the private sector, which may explain the name given to a fifth round of base closures: the Efficient Facilities Initiative. This round in 2005 could be large. In a recent speech, a DOD official indicated that up to 25 percent of military infrastructure could be considered excess to its needs.[43] His audience was an attentive National Association of Installation Developers. Now, how does DOD measure excess?

Closure by Arithmetic

Excess capacity is a simple concept when applied to most installations, such as naval stations, air bases, hospitals, and test centers. Fewer ships need less berthing, fewer aircraft need less hangar space, fewer personnel need fewer hospital beds, and reduced weapons procurement equals less test range use. But unlike conventional bases, there is no direct relationship between size of the force and that of Laboratory infrastructure (for example, buildings, roads, and utilities). If there were such a relationship, the Navy would not have resorted to a surrogate metric (that is, work-years) for capacity during the 1995 Base Realignment and Closure (BRAC) round.

In the Navy process, each Laboratory's maximum capacity equaled its peak number of work-years performed in any single year from 1986 to 1994, years chosen because they spanned the Reagan buildup and the Gulf War. Individual Laboratory peaks were then summed to yield the full capacity of Navy Laboratory infrastructure. Next, the sum of their projected work-years for FY97 was subtracted from full capacity. The difference was excess capacity. Evidence indicates that the methodology was flawed.

First, it unrealistically treated scientists and engineers as interchangeable, conveyable, replicable items—such as hospital beds and hangar space—regardless of their position, education, and professional accomplishment. Literally unable to distinguish between a technician and a Nobel laureate, the computer model moved scientists and engineers from one Laboratory to another, much the way guests are assigned to hotel rooms.

Second, the surrogate metric counted only in-house work-years, which means contractor work-years were excluded. This was not an oversight. Contractor numbers are notoriously hard to verify. With the high stakes of a BRAC, this raises the risk of fraud or, almost as bad, of rumors of it. Nevertheless, contractors perform about half of Navy RDT&E, and a great many of them work at the Laboratories and use their infrastructure. Therefore, the metric provided an incomplete picture, yielding inaccurate conclusions. Using the above hotel analogy, this is like counting only guests who occupy even-numbered rooms.

Third, Laboratories considered for closure were determined by coupling the surrogate metric with *military value*, a metric heavily weighted in favor of sites with test ranges. Test ranges are critical assets, some irreplaceable, but the weights militated against those Laboratories performing high levels of basic and applied research, the work that creates tomorrow's warfighting capabilities.

In one case, the three flaws combined to yield what would have been a grave mistake. The process led to considering closure of the Indian Head Laboratory, an East coast site, to move its workload to a West coast site with a test range. Since most scientists and engineers do not relocate with the work, closing it would have devastated a center of critical expertise. That would have cost lives. Only Indian Head had the ability to develop the thermobaric warhead, sparing U.S. troops the bloody prospect of tunnel-to-tunnel combat in Afghanistan. Closure by arithmetic does not work well for Laboratories.

Performance Is Everything

Robert Frosch, former vice president of GM Research Laboratories, observed that in research and development "you cannot measure the future; the only thing you can measure is past performance."[44] From this comment and from the lesson of the near-blunder on Indian Head, we should conclude that the only viable metric for evaluating a Laboratory is track record (that is, mission success both in terms of warfighting impact and contributions to science and technology). Demonstrated effectiveness in meeting national security interests is even more critical with our country at war. So why not judge Laboratory performance during BRAC–05? We judge professional sports teams by their records. Why treat national security less seriously than athletic competition?

BRAC is like a scalpel. In the hands of a surgeon, it can bring health. Ensuring that it does will be important not only for the Laboratories but for the private sector as well. There is a high level of productive collaboration between the Laboratories and industry, which is in the Nation's interest. Mutual respect exists in this key relationship. For instance, in a 1998 letter supporting the NRL nomination for the National Medal of Technology, Norman Augustine (CEO of Lockheed Martin), said, "I know from experience that there are few other institutions—public or private—which have had a greater impact on American life in the 20th century, both in terms of military needs and civilian uses."[45]

Unfortunately, after the Cold War, the Laboratories have been increasingly viewed as illegitimate competition, not as necessary partners to industry and academia.

Breaking the Yardstick

One of the latest expressions against preserving a strong internal technical competence was a DSB report issued in October 2000. It proposed the services hire scientists and engineers from the private sector under contract "from universities, industry and non-profits for a majority of the professional staffs of the defense laboratories."[46] This solution is dangerous for three reasons.

First, it breaks the yardstick. To be a smart buyer, the Government requires objective technical advice. Relying on advice from those not insulated from commercial interests is a disturbing prospect, especially in light of the Wall Street ethics meltdown. The potential for corruption and capture of public interests are two reasons why independent analysts have not shared DSB enthusiasm for privatization.

Second, it will degrade the ability of the Defense Laboratory as a performer. The reason for this is simple and best summed up by Timothy Coffey, the former NRL Director of Research: "You cannot run a world-class laboratory with someone else's workforce." It is doubtful that top nongovernmental laboratories, such as Lucent and the MIT Lincoln Laboratory, would choose to operate as the DSB proposed.

Third, as shown above, solutions exist that do not require one to destroy the Defense Laboratory to save it. The terrorist attack on the Pentagon offers a symbolically compelling case in point. Battling fires only a couple of corridors from the DSB office, firefighters smothered the flames with firefighting foam, an agent used on Navy carriers and by airports worldwide. NRL invented it after fires claimed more than 160 lives aboard the USS *Forrestal* and USS *Enterprise*.[47]

Stifling Innovation

Working together, American technical creativity and bureaucratic skill have achieved great things. They took the world to the Moon, tamed infectious diseases, and helped win the Cold War. Now they must rise to meet the challenge of terrorism.

When used inappropriately, however, administrative rules can stifle innovation. Over time, the Laboratories have been increasingly burdened with counterproductive policies and procedures. Whenever Congress authorizes reform, such as Section 1114, which gives DOD unprecedented personnel authorities, action is stymied. The same is true for Section 245 of the FY00 NDAA and Section 246 of the FY99 NDAA, both of which granted authorities to waive burdensome regulations. All three initiatives were blocked, prompting seven senators from the Senate Armed Services Committee to write a letter to the Secretary of Defense voicing their dissatisfaction with the DOD and its "apparent absence of intention or commitment . . . to take full advantage of the authorities."[48]

Efforts to respond to terrorism have also produced counterproductive rules. After the September attacks, a draft directive for a new research protection regime was issued. It met criticism from Congress, academia, industry, the Defense Advanced Research Projects Agency, and the services that the directive would stifle defense research and thereby weaken national security; conflict with long-standing national policy; go beyond measures used throughout the Cold War; and wastefully duplicate an existing intelligence database.[49] After that reaction, DOD narrowed the directive's scope to protect only information already protected by existing mechanisms, such as classification and export controls. DOD also exempted universities and industry, where most defense research is performed, from the redundant rules.[50] Predictably, plans call for afflicting the Laboratories with them.

It is tempting to blame bureaucracy alone, but doing so would miss the real problem. Bureaucracy cannot stymie Congress for years. And alone, it cannot thwart the proposals of national leaders, such as Brown, Perry, Packard, Galvin, Bardeen, and Townes—leaders who built industries, invented devices that revolutionized the way we live, and made decisions of world-shaping importance. Something stronger gives it a free hand to smother the Laboratories. It is something that we were warned about more than 4 decades ago.

Eisenhower's Warning

A Chinese proverb holds that the possibility of progress begins when one calls a problem by its right name. Evidence suggests that "unwarranted influence" is the right name of this problem. In his farewell address, President Eisenhower warned us to "guard against the acquisition of unwarranted influence" and "the disastrous rise of misplaced power." But we have let down our guard. Economic and political interests have come together in a way that is eroding the Government's will to support its Defense Laboratories. This union is what makes retaining high-quality talent, building new facilities, and eliminating burdensome bureaucracy so hard to achieve. This union is eating at the heart of the in-house system. And this union promises a slow death for it.

The goal of unwarranted influence is misplaced power—that is, power pulled away from the Pentagon acquisition commands and into corporate boardrooms. Historically, the commands have held the power, ensuring that decisionmaking remained an inherently governmental function. But that depends on an in-house yardstick that enables the commands to choose intelligently among competing technologies offered by contractors. An eroded Laboratory system breaks the yardstick. Without it, the commands will cede de facto decisionmaking authority to the private sector. When the commands are forced to hire private consultants to judge the work of private contractors, unwarranted influence achieves its aim.

To succeed, unwarranted influence requires only indifference toward the Defense Laboratory's plight. President Eisenhower seems to alert us to such apathy by insisting in his farewell to "take nothing for granted."

A Darkening Future

Should present trends continue, the Defense Laboratory will lose its competence as a performer of long-term, high-risk work. When that happens, the risks to future military operations will grow because its abilities to provide for America's defense and respond quickly to crises will have passed quietly into history. Lost competence will also still the Pentagon's strongest voice for independent, authoritative technical advice. The yardstick will be broken. The Nation's interests will have been traded for corporate interests, with public service sold for private gain.

From that moment on, to use Hamlet's final words . . . the rest is silence. Our country's future takes a darker path, one marked by the silence of the labs.

Notes

[1] *Laboratories* is used as a generic term for organizations performing research and development. While the subject is the Defense Laboratories, the focus is on the Naval Research Laboratory, with which the author has substantial personal knowledge.

[2] U.S. Patent No. 4,162,397 to J.A. Bucaro, H.D. Dardy, and E.F. Carome, "Fiber Optic Acoustic Sensor" (July 1979).

[3] Hans Mark and Arnold Levine, *The Management of Research Institutions* (Washington, DC: Scientific and Technical Information Branch, National Aeronautics and Space Administration, 1984).

[4] Peter F. Drucker, *The Effective Executive* (London: Heinemann, 1967).

[5] The top 10 to 15 percent of scientists contribute about half the papers published; see Paul D. Allison, J. Scott Long, and Tad K. Krauze, "Cumulative Advantage and Inequality in Science," *American Sociological Review* 47, no. 5 (October 1982), 615–625.

[6] Naval Personnel Task Force (July 2000); Acquisition 2005 Task Force, "Shaping the Civilian Acquisition Workforce of the Future," (October 2000); Wexford Group, "DoD Laboratory S&E Workforce Framework of HR Features for the Alternative Personnel System," (September 2002).

[7] Kathy Chen, "Pentagon Finds Fewer Firms Want to Do Military R&D," *Wall Street Journal*, October 22, 1999, A20.

[8] P. Coy, "Research Labs Get Real . . . It's About Time," *Business Week*, November 6, 2000.

[9] Testimony before the Subcommittee on Emerging Threats and Capabilities of the Senate Armed Services Committee, April 20, 1999.

[10] Excerpt from certificate accompanying the 1995 Stellar Award given to the *Clementine* development team.

[11] Excerpt from *Discover Magazine* Award for Technological Innovation (1995).

[12] Harold L. Nieburg, *In the Name of Science* (Chicago: Quadrangle Books, 1966).

[13] William J. Perry, *Required In-House Capabilities for Department of Defense Research, Development, Test and Evaluation* (Washington, DC: Department of Defense, 1980).

[14] Cited in justification for the 1994 Presidential Rank of Distinguished Executive Award to Timothy Coffey.

[15] Among the distinguished public servants on the commission were former President Gerald R. Ford, former Secretaries of Defense Robert S. McNamara and Elliot Richardson, and Secretary of Defense Donald H. Rumsfeld.

[16] National Commission on the Public Service, "Rebuilding the Public Service" (1989).

[17] President Harry S. Truman, Message to Congress on December 19, 1945, and September 6, 1945.

[18] Ernest J. King, *U.S. Navy at War: 1941–1945* (Washington, DC: Department of the Navy, 1946).

[19] The NRL *GRAB I* was launched on June 22, 1960.

[20] U.S. Patent No. 3,789,409, "Navigation System Using Satellites and Passive Ranging Techniques" (January 1974), was awarded to Roger Easton of NRL for the key concept. For its pioneering contributions, NRL was named to the Space Technology Hall of Fame and awarded the Collier Trophy.

[21] SEI was featured in Buchanan's testimony to Congress.

[22] Cordant Technologies News Release, "Thiokol to Turn Powerful Explosives Material into Production Material," June 13, 1999.

[23] Federation of American Scientists Web Site, accessed at <http://www.fas.org/man/dod-101/sys/smart/gbu-28.htm>.

[24] Comment by Iraqi Battalion Commander captured by U.S. 2d Armored Cavalry Regiment on April 16, 1991.

[25] James Colvard, "The Numbers Game," GovExec.com, "Federal Focus," May 13, 2002, accessed at <http://207.27.3.29/dailyfed/0502/051302ff.htm>.

[26] Peter F. Drucker, "Really Reinventing Government," *The Atlantic Monthly* (February 1995).

[27] Panel members included the Secretary of Defense, the NASA administrator, the President's science adviser, and the director of the Bureau of the Budget.

[28] Report to the President of the United States on Government R&D Contracting, April 1962.

[29] Professional Services Council Web site, accessed at <http://www.pscouncil.org/2day/aboutpsc.htm>.

[30] Jason Peckenpaugh, "Hundreds of Thousands of Army Employees Could Face Outsourcing," GovExec.com, "Daily Briefing," October 4, 2002, accessed at <http://207.27.3.29/dailyfed/1002/100402p1.htm>.

[31] Michael L. Marshall and J. Eric Hazell, "Outsourcing R&D—Panacea or Pipe Dream?" U.S. Naval Institute *Proceedings* 126, no. 10 (October 2000).

[32] United States General Accounting Office, *Outsourcing DOD Logistics* (1997).

[33] Ann R. Markusen, "The Case Against Privatizing National Security," June 2001, accessed online at <http://www.gao.gov/a76panel/fortherecord/amarkusenpaper.pdf >.

[34] DOD In-House RDT&E Activities Reports.

[35] From the Center for Defense Information.

[36] Defense Science Board, *Technology Base Management* (Washington, DC: DTIC no. ADA 188560, 1987).

[37] Defense Science Board, *Achieving an Innovative Support Structure for 21st Century Military Superiority* (Washington, DC: 1996), accessed at <http://www.acq.osd.mil/dsb/achievinganinnovative.pdf>.

[38] Testimony before the House National Security Committee on Defense Reform and H.R. 1778, June 17, 1997.

[39] Defense Manpower Data Center.

[40] Harvey M. Sapolsky and Eugene Gholz, "Private Arsenals: America's Post-Cold War Burden," in *Arming the Future: A Defense Industry for the 21st Century*, ed. Ann R. Markusen and Sean S. Costigan (Washington, DC: Council on Foreign Relations Press, 1999).

[41] General Dynamics Web site, accessed at <http://www.rocket.com/lca.html>.

[42] Stuart Searles and George Hart of NRL received the prestigious Rank Prize for Opto-electronics for this achievement in 1992.

[43] Terry Joyce, "Many Base Closures Anticipated in 2005," *The Post and Courier* (Charleston, SC), August 7, 2002, 1B.

[44] Robert A. Frosch, "The Customer for R&D Is Always Wrong!" *Research Technology Management* (November/December 1996).

[45] Another letter came from Robert Galvin (chair of the Executive Committee of Motorola, Inc.) saying, "NRL is the equivalent of the most significant technology jewel in our country." However, the Department of Commerce, administrator of the award, rejected the NRL nomination because it considers Government Laboratories ineligible for the *national* medal.

[46] Defense Science Board, *Efficient Utilization of Defense Laboratories* (October 2000).

[47] The Society of Fire Protection Engineers awarded (posthumously) its prestigious Guise Medal to NRL's Edwin Jablonski.

[48] United States Senate, letter dated August 1, 2002.

[49] David Malakoff, "Pentagon Proposal Worries Researchers," *Science* 296 (May 3, 2002); Mary Leonard, "Pentagon Drops Attempt to Keep Research Quiet," *Boston Globe*, May 9, 2002, A3; and Don J. DeYoung, "Proposed Security Controls on Defense Research," April 2, 2002, accessed at <http://www.fas.org/sgp/othergov/deyoung.html>.

[50] DOD Directive 5200.39, "Research and Technology Protection within the Department of Defense" (Draft, November 22, 2002).

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