



Sparks fly during production of mine resistant ambush protected vehicle

DOD (Cherie A. Thurby)

America's Endangered

Arsenal of Democracy

By M. THOMAS DAVIS *and* NATHANIEL C. FICK

Colonel M. Thomas Davis, USA (Ret.), is Vice President for Strategic Planning at General Dynamics Corporation. Nathaniel C. Fick is Chief Executive Officer of the Center for a New American Security.

January 2011 marked the 50th anniversary of two of the most memorable Presidential addresses in American history. The more famous speech is John F. Kennedy's inaugural address of January 20, 1961, with its crisp cadence and ringing request that Americans "ask not what your country can do for you—ask what you can do for your country." The second speech is Dwight D. Eisenhower's Farewell Address delivered 3 days earlier. Like the man himself, Eisenhower's tone was measured, efficient, and businesslike. It is most remembered for his caution that "in the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist."

President Eisenhower likely never imagined that this one passage would be so long remembered. Yet because of its tenor, and the fact that Eisenhower himself was a product of the complex he warned about, the American public has subsequently held a lingering suspicion of the influence of the Nation's defense sector, an exaggerated impression of its size, and an insufficient understanding of the vital role it plays in national security.

Years earlier, President Franklin D. Roosevelt had referred to America's ability to build "more ships, more guns, more planes—more of everything" as the free world's "arsenal of democracy." Now commonly referred to as the defense industrial base (DIB), this arsenal has helped the United States emerge victorious in many of its wars, including the Civil War, World War I, World War II, and the Cold War. Though it usually escapes mention, elsewhere in his farewell speech President Eisenhower recognized the value of the DIB when he stated, "A vital element in keeping the peace is our military establishment. Our arms must be mighty, ready for instant action, so that no potential aggressor may be tempted to risk his own destruction."

Today, the DIB continues to be a vital strategic asset and an important source of advantage for the United States. As Barry Watts, the former Director of the Pentagon's Office of Program Analysis and Evaluation (PA&E), has written, if a nation had to choose a defense industrial base to serve its national interests, "the American military-industrial complex would surely be the one most people and nations would choose." It is, after all, the complex that not only has



World War II poster for National Association of Manufacturers promotes industry

provided military equipment that is often the world standard, but also has stimulated the development of many technologies that are now a major component of modern American life, including high-performance jet aircraft, satellite communications, the Global Positioning System (GPS), high-speed computers, and even the Internet. Additionally, American aerospace and defense create the largest foreign trade surplus of any manufacturing sector, and constitute the second-largest export sector behind only agriculture.

Over the years, the DIB has indisputably given the United States a major strategic advantage, particularly since the massive mobilization required for World War II. The question today is whether that will continue in the years ahead. As a senior government

official recently noted, "Having a vibrant, capable defense industrial base is not a God-given right." The DIB is under stress as the American manufacturing base erodes, the vital engineering skills it requires become scarce, and tightening budgets reduce cash flows. Systemic flaws in U.S. military procurement processes, as well as past missteps by the DIB itself, have also contributed to the overall endangerment of America's arsenal of democracy during an age when rapid fielding of high-tech military equipment against nimble adversaries will increasingly determine whether the United States wins or loses wars. A primary national security challenge of the coming decade will be sustaining the arsenal of democracy so it is both viable and responsive to the needs of the Nation.

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Origins of Power

Throughout its history, the United States has enjoyed several significant strategic advantages. Foremost are the oceans that shielded both coasts once the Nation achieved continental size, enabling the United States to ignore the threat of major invasion that was a constant concern of European nations. Moreover, with its vast size spanning the North American continent, the United States benefited from enormous natural resources, which were used by an industrious population that grew rapidly thanks to large-scale immigration. Geography, bountiful resources, and a large and diverse population define the natural elements of American strategic advantage, and they laid the basis for other traits—such as representative government, an innovative economy, and a robust higher education system—that developed over time into enduring U.S. strategic assets.

An equally important U.S. advantage has been the Nation's historical ability to transform its resources and ingenuity into usable military power. Indeed, the roots of America's DIB can be traced to the Nation's earliest years. The decision by President George Washington in 1794 to build a Navy was a pivotal early step. Warships, then as now, were costly and represented much of what resided on the outer edge of the technological frontier. There was considerable debate in Congress over the need for a Navy to protect American commerce from threats such as piracy and the confrontational tactics of major trading nations. And as always, concerns over projected costs and the national debt figured prominently in lawmakers' debates.

The Navy's first six frigates were among the best designed and constructed warships of their day, offering an impressive combination of speed, maneuverability, and firepower. They were well and professionally crewed, and in the War of 1812 performed stunningly well against a British fleet that was over 100 times larger. Despite this record, which has now become a part of our national heritage, there

was a spirited debate over the ships' design before and during their construction. They suffered from significant cost and schedule overruns, and they were the subject of considerable congressional scrutiny. Over their long history of active service, more than once they were allowed to fall into disrepair only to be reconstituted, and were the focus of several unsuccessful efforts to develop cheaper alternatives. In other words, the ships weathered many of the trials that still face major weapons systems today. The sometimes torturous challenges of procuring military equipment are deeply rooted in U.S. history.

Understanding the DIB

The modern defense industry is different from both its earlier incarnations and its commercial counterparts today. As the corporate behavior of the American DIB has developed in ways similar to that of other manufacturing entities, it has assumed a shape quite different from the one existing during the Eisenhower administration.

Today's DIB exists primarily as publicly owned private companies. As Ashton Carter, Under Secretary of Defense for Acquisition, Technology, and Logistics (AT&L), recently commented, "I have a title that suggests otherwise, but the truth is I don't build anything." This evolution away from a reliance on production facilities owned and operated by the government to the modern corporate-based industrial capability occurred mainly during the post-World War II and Cold War periods. It happened because the government wished to take advantage of the technological innovation and production efficiencies of the competitive private sector. Moreover, in the later decades of the 20th century, this shift found significant support in a political ideology favoring smaller government and a reliance on the private sector.

Although the DIB shares common traits with many other American manufacturing enterprises, there are clear differences. During a discussion in 1992 with a Russian academic charged by the Boris Yeltsin government with finding ways to convert the old Soviet military-industrial complex to commercial production, a former Pentagon official who had spent considerable time working with and in American industry offered a succinct summary of the distinction: "You have to understand," he urged, "that a defense industry is quite different from a commercial industry in very important ways. First, an

automobile manufacturer builds a car and hopes it can sell it; a naval ship builder sells a ship and hopes it can build it. Second, a commercial manufacturer generally aspires to sell a million things with a hundred parts; a defense manufacturer generally aspires to sell a hundred things with a million parts."

An understandable tension exists between today's major defense suppliers and their governmental military customers. While both are determined to ensure that the Armed Forces in the field have the most modern, high-quality, and reliable equipment possible, both also have their unique responsibilities: as suppliers to their shareholders, and as customers to the taxpayers. Corporations are in business to earn a profit. The financial condition of defense firms is of interest to defense customers, but it is not a primary interest. Thomas Rabaut, the former chief executive officer (CEO) of United Defense, once commented that he had to strike a balance among three competing communities: "A customer who thinks my prices are a bit too high. Highly skilled employees who feel their paychecks are a bit too small. And shareholders who feel their dividends are a bit too low."

This dilemma is, of course, faced by senior executives in businesses with a commercial focus, but the additional challenge for defense industries is with the customer. Whereas commercial firms have millions of customers, the DIB in many cases has only one: the U.S. Government. In essence, this is a monopsonistic market where one buyer chooses between many sellers. As in any monopsony, the sole buyer has tremendous leverage in setting terms to its numerous competing suppliers. The suppliers are largely left with the difficult choice of meeting demanding conditions or exiting the market, and over the past two decades many have chosen the latter.

Cuts and Consolidation

The period between 1992 and 1998 saw the cancellation or contraction of numerous large defense programs such as the B-2 bomber and the *Seawolf*-class submarine. After the Soviet Union collapsed, the defense procurement account was cut by over 40 percent as both national and defense priorities shifted significantly in the new post-Cold War security environment. This reprioritization meant that there would not be sufficient work to sustain the efforts of the nearly 30 large defense firms comprising the DIB, a

point driven home by Defense Secretary William Perry in a 1993 meeting with defense company executives, commonly known as “the last supper.” The result was an industry consolidation that lasted nearly a decade, with many firms selling out to others, merging, or simply exiting the defense business. Many facilities were closed and others sold, with the end result being that these 30 firms consolidated into 5—the companies now comprising the foundation of the American DIB: Boeing, General Dynamics, Lockheed Martin, Northrop Grumman, and Raytheon.

A major force in this effort was Norm Augustine, the legendary CEO of Martin Marietta who became the Chairman and CEO of Lockheed Martin when Martin Marietta and Lockheed merged. Although this evolution changed the defense industrial landscape and its competitive composition, Augustine believes the overall results have been positive: “I’d rather have a few strong companies than a whole bunch of weak companies,” he commented, adding that “as a buyer, I prefer five competitors, but I can live with two. And if I’m a seller, I don’t want to compete against a weak company that’s desperate for business. Weak companies do irrational things.”

The DIB of today is smaller not only in numerical size but also in economic scope relative to the U.S. economy overall. The defense industry President Eisenhower referenced in January 1961 was sprawling. During his tenure in office, defense spending ranged between 9 percent and 13 percent of gross domestic product (today it is about 4 percent). Nearly 60 percent of the Nation’s industrial research and development (R&D) was invested in the defense sector (today it is less than 10 percent). The defense industry was then the largest industrial sector of the U.S. economy, larger than automobiles, steel, or oil. Today, in contrast, the annual revenue of the major oil companies is nearly four times that of the major defense firms. Even in their current state, the top-tier automobile companies generate more than twice the revenue of their aerospace and defense counterparts. Only the American steel industry, a faint shadow of its previous size, is smaller than the aerospace and defense sector. To draw an even more dramatic comparison, the annual combined revenue of the five largest American defense firms is only slightly greater than half that of Wal-Mart, even when counting Boeing’s commercial aircraft

sales, which account for about half of its corporate revenue. While the defense sector is still large, profitable, and influential, it is far from the economic power it was in President Eisenhower’s time.

Evolving Requirements

The modern DIB is not only much smaller in size, but it also produces a much smaller and enormously more sophisticated product line. Over 12 million Americans served in uniform during World War II, approximately 9 times the number on Active duty today. The war rapidly mobilized a citizen military, which was mirrored by the rapid and massive mobilization of the existing industrial base. Many commercial firms were pressed into the war effort, including aircraft manufacturers such as Boeing and Convair, and automobile companies such as Chrysler and Ford Motor Company. Large serial runs of items that could be produced simultaneously on only slightly retooled commercial assembly lines, such as Chrysler’s production of the M4 Sherman tank powered by a Ford V8 engine, were the preferred production method. During the course of the war, Chrysler produced about 40,000 M4 tanks, of which about 30,000 went to Europe where they faced—and overwhelmed—2,000 larger and more sophisticated German tanks. In the case of aircraft, just to provide one illustrative example, the Ford assembly plant at Willow Run, Michigan, produced 8,635 B-24 Liberator bombers, turning out 1 aircraft every 55 minutes at its peak.

Such serial runs no longer exist. Today’s defense industry looks less like Ford and more like Ferrari. Major items of equipment are highly sophisticated, extraordinarily complex to manufacture, and have little in common with commercial products other than the incorporation wherever feasible of selected commercial components, mainly electronics. In the 3 years between 1942 and 1945, American industry produced over 200,000 military aircraft to support the Services in World War II. Between 2001 and 2004, the first 3 years of the current period of conflict, the modern

defense industry produced fewer than 250—a 99.9 percent reduction.

One major reason for this change is clear: with the abandonment of conscription and the transition to the all-volunteer force in the early 1970s, smaller numbers of volunteer Servicemembers had to be much better and more elaborately equipped than their predecessors. A Soldier on duty today in Afghanistan will likely go on patrol wearing nearly \$20,000 worth of equipment: a sophisticated automatic rifle, an advanced night vision device, lightweight but effective body armor, a ballistically protective Kevlar helmet, and a cutting edge communications suite allowing him to receive and transmit real-time information. By comparison, his World War II counterpart carried about \$200 in basic gear.

Today’s infantryman must cover a much larger space on the battlefield. He must be more selective about the targets he engages in order to avoid costly civilian casualties. He must have tremendous situational awareness, knowing exactly where he and his buddies are, coupled with an accurate idea of where the enemy is. And he must be able to share what he sees while accessing complex external combat assets such as aircraft, artillery, and drones—each capable of delivering precision-guided munitions. Some of this capability can be derived from commercial off-the-shelf items, but most cannot. What works well in a living room or at a campground may lack the ruggedness to operate reliably when lives hang in the balance in rough terrain and extreme weather.

During nearly a decade of war, American Armed Forces have put uncommonly heavy demands on their equipment. As one senior officer commented regarding the Army wheeled vehicle fleet, “Nearly every truck we have is grossed out and worn out,” meaning these vehicles are carrying considerably more weight because of the addition of various types of armor, and have been driven many miles beyond their expected usage rates. The peacetime Army of the 1990s, for instance, attempted to fund its tank fleet to drive 800 miles per year, believing that that

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U.S. Navy (Sarah Burford)

USNS *Washington Chambers* is launched into San Diego Bay during ceremony at General Dynamics National Steel and Shipbuilding Company

operating level was sufficient to exercise the equipment and keep the crews trained to readiness standards. Some of the Army's major combat vehicles in Iraq have been driven as much as 100 miles per day, or about 36,000 miles per year. Imagine the implications of driving a fully loaded automobile such distances over difficult, largely unimproved roads. The debate is already raging over how much of the equipment deployed to Iraq and Afghanistan needs to be returned to American repair depots and, of the equipment returned, how much should be retrofitted to the most modern configurations and how much should just be replaced. However this is eventually resolved, it will be an enormous and costly effort.

Given these requirements for success in modern conflicts, it is not surprising that even as the numbers of men and women in the Armed Forces have fallen, the costs of equipping them on a per capita basis have increased significantly. Whereas once only a relatively small number of American military units were truly high-tech, now nearly all are. Moreover, as the information revolution

unleashed by the Internet and globalization have combined to make it easier for potential American adversaries to acquire deadly, high-tech capabilities at low cost, the U.S. military is constantly scrambling to keep up with the innovations of our adversaries, both actual and potential.

Persistent Challenges

The steady erosion of the American manufacturing base is painfully obvious in many parts of the country. In 1950, 1 in 3 jobs in the U.S. economy involved manufacturing. Now that number is 1 in 10, with the national security industrial sector accounting for only 15 percent of total manufacturing jobs. In other words, only about 1 out of every 70 workers in the United States is now involved in aerospace and defense. The jobs they perform are high-skilled and technically challenging, yet like those in the American manufacturing base itself, these defense jobs are starting to evaporate despite the consolidation of the industry. Since the first quarter of 2009, over 40,000 jobs in the defense industry have been lost. Although positions

requiring similar experience exist in other parts of the commercial sector, the specific skills of the defense industry can be quite different. For instance, a welder working on a building superstructure does not use the same techniques or adhere to the same standards as a welder assembling the hull of a submarine that will house a nuclear reactor, carry several 455-kiloton nuclear warheads, and operate in a wide range of inhospitable conditions.

There is also a decreasing pool of scientists and engineers possessing the primary skills that underpin the industry. Of science and engineering doctoral degrees awarded by U.S. universities in 2007, over 40 percent went to noncitizens who were either permanent residents or temporary visa holders. This proportion is expected to grow: the number of science and engineering doctorates awarded to noncitizens increased by 43 percent between 2003 and 2007. The legendary firms of Silicon Valley that have led the Nation into the information age can take full advantage of this pool of talented people. But since most sensitive defense jobs require security clearances, they cannot be filled by non-U.S. citizens.



World War II-era P-38F Lightning and modern F-35 Lightning II displayed at Lockheed Martin facility

U.S. Navy (D. Keith Simmons)

As American manufacturing and engineering jobs have moved overseas, and as the general interest in science, technology, engineering, and mathematics (STEM) education has decayed, a vicious cycle emerges that raises serious questions about whether the skills necessary to maintain a vibrant defense manufacturing base are likely to exist in the future workforce. The British discovered this problem a few years ago when they began designing the *Astute*-class submarine to replace the existing *Swiftsure*- and *Trafalgar*-class boats, the first of which are nearly 40 years old. Having neither designed nor built a submarine for nearly two decades, and struggling to master modern computer-assisted design techniques, the British discovered that many of the engineering and design skills essential to submarine production were simply not available in Britain. The premier U.S. submarine design yard, Electric Boat of Groton, Connecticut, was brought in to assist, and worked for over 3 years with British engineering teams in stabilizing and refining the design. Should the United States face such a circumstance because of lost capability, the only other country able to offer similar assistance would be China—an unlikely partnership. This is why the 2010 National Security Strategy called for a renewed commitment to science and technology to help advance U.S. national security priorities.

Enduring flaws in U.S. Government procurement processes also pose enormous challenges. The United States is trying to protect

itself today with a defense acquisition system offering industrial-age performance. The Government Accountability Office (GAO) found that the suite of 96 major defense acquisition programs was a combined \$296 billion over budget in 2008. In contrast, the suite of 75 programs was only \$43 billion over budget in 2000. Total overruns increased by 588 percent in 8 years. In 2008, the average delay in delivering initial capabilities for major weapons systems was 22 months, a holdup that adds to development timelines, which can take decades. Too often, these cost and time overruns are due to government's lack of clarity about what it wants coupled with an endless series of costly and time-consuming change orders. In short, too often government is not an ideal customer. These cost overruns and schedule slippages threaten to consume budgetary resources that are already expected to be in shorter supply as the United States redeploys its combat forces from Afghanistan and Iraq.

But at times, the DIB has struggled with its own demons. Ensuring quality control in complex products and services has always been a challenge, and it continues to vex military customers and suppliers today. For example, missile defense components provided recently to the U.S. Government have come under intense scrutiny by Pentagon officials. The Pentagon's Missile Defense Agency decided to penalize contractors for delivering parts that did not meet quality control standards. "I am withholding funding because

I don't see the level of scrutiny and the level of culture necessary for the precision work that's required," explained Lieutenant General Patrick J. O'Reilly. David Altwegg, the agency's executive director, added that government officials "continue to be disappointed in the quality that we are receiving from our prime contractors and their subcontractors." Given the prominent role played by the Obama administration's revamped "Phased Adaptive Approach" missile defense scheme in thwarting the budding Iranian missile threat, these ongoing quality control problems constitute a clear and present danger to U.S. national security.

Performance and behavioral shortcomings can have lingering effects. In the recent past, a 22-year-old arms dealer secured a contract with the Army and then provided unreliable and obsolete ammunition to Afghan forces. Earlier, and more seriously, a corrupt government acquisition official steered numerous high-value contracts to a major supplier and then sought jobs there for herself and her family. Procurement scandals such as these are infrequent, but they cast a pall over the entire DIB. Such corruption looks especially bad to the public when combined with reports of defense industry lobbying expenditures. While the DIB today may not be the one President Eisenhower warned about in terms of size or activity, it does sometimes exhibit the problems of quality control and corporate behavior he cautioned against.

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Future Security Requirements

Technological advancement and globalization are making it easier for state and non-state actors to acquire deadly capabilities that threaten Americans at home and abroad. For example, cyberattackers today can launch synchronized, dispersed, and untraceable assaults against U.S. military and civilian networks with little more than a laptop and an Internet connection. The U.S. Government faces an inherent disadvantage in defending against such attacks because cumbersome bureaucracies struggle to observe, orient, decide, and act as quickly as smaller, more decentralized adversaries. America's vulnerability to nimble, adaptable enemies exists not only at the high-tech end of the conflict spectrum, but also in so-called low-end operations such as irregular warfare and counterterrorism.

For instance, the U.S. military's slow initial response to the tactical challenge posed by improvised explosive devices almost doomed America's entire strategic war effort in Iraq. The conflicts in Afghanistan and Iraq have often demonstrated that the Pentagon's acquisition processes complicate efforts to provide rapidly needed battlefield capabilities if doing so runs counter to bureaucratic business as usual. The Pentagon was eventually successful in quickly fielding a large number of Mine Resistant Ambush Protected (MRAP) trucks for our forces in Iraq, but that effort was greatly facilitated by the unambiguous support of the Secretary of Defense, a large and rapidly approved congressional appropriation, and existing vehicle designs deemed suitable for the requirement. The MRAP example shows what industry can do when conditions are right and some of the normal acquisition steps, such as extensive and elaborate testing, are either waived or abbreviated.

Preparing for the immediate future, however, requires rapid adaptation. Policymakers must develop processes that rapidly identify emerging threats, consistently generate high-quality solutions, and expeditiously reorient toward agreed-upon priorities. In this regard, the 2010 Quadrennial Defense

Review (QDR) was encouraging. First, it devoted two pages to discussing the need for a healthy industrial base—in itself a positive development because previous QDRs did not even mention the subject. Second, it concluded that the Pentagon must “build the agile, adaptive, and innovative structures capable of quickly identifying emerging gaps and adjusting program and budgetary priorities to rapidly field capabilities that will mitigate those gaps.” In pursuing these objectives, the cooperation of the Defense Department with a healthy, competitive, and dynamic DIB is absolutely essential.

There is much work to be done. The U.S. Navy is smaller today than at any time since 1916, when the United States was just discovering its global role and embracing its emerging strategic importance. Though the U.S. fleet remains dominant, the Nation retains vital interests around the globe, and no matter how able our frontline combatants are, they can only be in one place at a time. In addition, the challenges of nuclear proliferation only increase the demand for sea-based missile defense for U.S. forces and those of our allies. Despite these concerns, the Navy's 30-year shipbuilding plan released this past spring includes fewer ships than the one before. After its release, Northrop Grumman, the largest supplier of naval ships to the Pentagon, announced the closure of one of its major shipyards, the Avondale facility in New Orleans. Without serious rethinking of the current shipbuilding plan, along with more program stability so shipbuilding programs do not continue to suffer from cost and schedule overruns, further “rationalization” of the shipbuilding industrial base may be necessary at the very time more and newer ships are required to meet the threats of emerging nuclear states, regional instability, humanitarian relief, or—as we have seen recently—piracy.

Restoring America's Endangered Arsenal of Democracy

The U.S. military, Pentagon civil servants, and the DIB are all part of a unique partnership that brings the power and resources of the United States to bear when it is called for. If mishandled, defense acquisition processes can waste taxpayer dollars, delay the procurement of equipment that U.S. troops need, and undermine public trust in the Government. These broader

consequences diminish American military effectiveness and thereby invite disregard for and aggression toward the United States and its core interests. Strengthening the relationship between the U.S. Government and the DIB, as well as enabling the continued vitality of the DIB itself, is no longer just about saving taxpayer dollars or increasing industry revenues. It has become a national security imperative.

The U.S. Government has taken steps in recent years to improve acquisition practices within the Pentagon. Noteworthy reforms include passage of the Weapons Systems Acquisition Reform Act of 2009 and Defense Secretary Robert M. Gates's ongoing campaign to reduce spending on underperforming and lower priority weapons systems, along with his focus on certain administrative costs. These valuable improvements, however, are only a start. The Defense Department needs to take additional steps including adding greater discipline to its requirements process, more fully evaluating systems from a full life-cycle ownership perspective rather than a 1-year budget viewpoint, and rebuilding a solid partnership relationship with industry. On this last point, Secretary Gates and Under Secretary Carter have initiated a significant outreach to senior industry leaders, but another senior officer recently confessed he was nervous about meeting with industry representatives because he was concerned about “violating some law somehow.” This reticence must be overcome if the mutual objective of providing the best possible technologies to our deployed forces is to be met.

President Eisenhower was right to warn against unwarranted influence by the DIB. However, the DIB also continues to represent a vital strategic asset that provides the United States with an enormous advantage over those who would seek to do us harm. Sustaining the health of America's arsenal of democracy today—while continuing to monitor relentlessly for waste and underperformance—will maximize U.S. national security in dealing with a complex world during tough economic times. The modern American industrial base retains its capacity for innovation, creativity, efficiency, and responsiveness in getting needed capabilities into the hands of our Servicemembers. Preserving these qualities, and the strategic advantage they provide, is a matter of enduring national importance. **JFQ**