

Defense Investment: Finding the Right Balance

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America's elected officials will have to make some difficult decisions over the coming months and years. Our nation's growing debt burden must be reduced in order for our country to enjoy the prosperity and growth that it has in the past. Every nook and cranny in the budget— including entitlements that have been considered sacred and other popular programs that have supported citizens from every walk of life—will now be on the table. The choices may be stark, but the questions predictable: Do we cut? Do we trim? How critical are these programs to our safety and security?

The defense budget is certainly being scrutinized. While the Defense Department is taking significant steps to be more efficient, undoubtedly it will be asked to do more. With two wars ongoing, peacekeeping and humanitarian missions across the globe and 1.5 million men and women in uniform, its responsibilities are immense. Americans can be proud that the products used by men and women in uniform are the best in the world, produced by an industry that takes great pride in its responsibility to protect and advance our warfighters. These systems provide our military with an unparalleled battlefield advantage, part of our philosophy of engagement since World War II.

However, as this paper shows, the investment accounts—including procurement and research and development—are often cut first when the defense budget comes under fire. On the surface, they are the easy reductions that do not involve urgent present needs as do personnel, force structure, benefits, or operations and maintenance. But as this report shows, with a worldwide mission and in the absence of more service members, our force must be better empowered by technology. The investment accounts not only support current operations—as we are witnessing every day—they also provide the future capabilities needed to address threats that may emerge and ensure that our forces will always have the tactical advantage that technological superiority provides. Americans will not accept less.

Prepared by AIA's National Security Council, this paper looks at historical spending in the investment accounts and the ebb and flow of spending since the 1970s. It concludes that our nation and its military members pay a large price when we decrease spending on procurement and R&D. We hope that these conclusions will help today's officials make the right decisions that will keep our troops safe while maintaining a healthy defense industrial base for the future.



Marion C. Blakey
President and Chief Executive Officer

EXECUTIVE SUMMARY

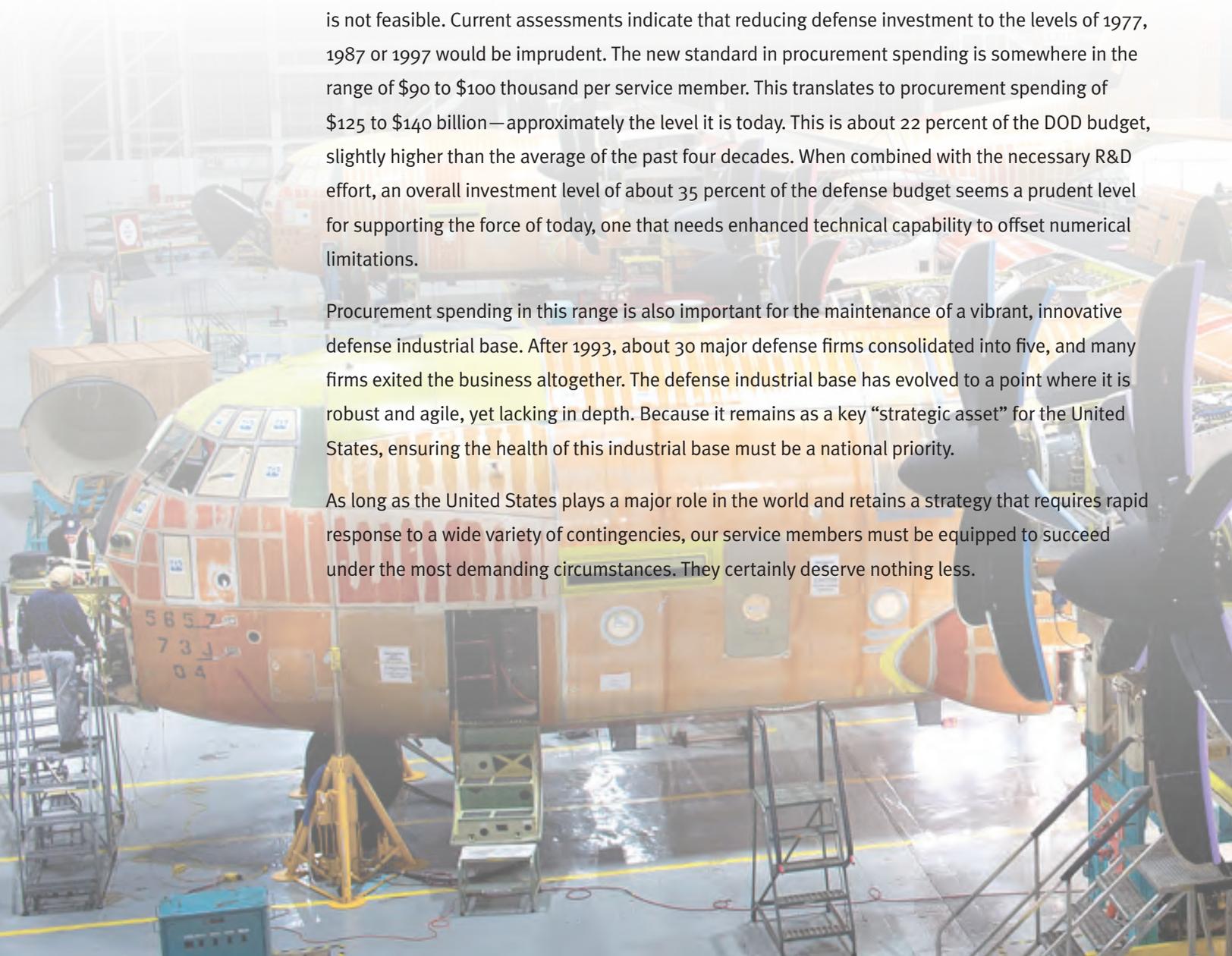
Forty years ago, Alain C. Enthoven and K. Wayne Smith asked that ever-vexing question about defense expenditures, “How Much Is Enough?”¹ With a smaller armed force than we have had for a half-century that is heavily deployed in Iraq and Afghanistan, we must ensure that we make up in technological capability what we lack in numbers.

We can seek answers to “How Much Is Enough?” by comparing our present situation with our recent past. Our current circumstances are rather distinct from those of the early 1970s, the mid- 1980s or the early 1990s. Unlike the early 1970s, the nation today is committed to ensuring that our armed forces are equipped for mission success. Unlike the mid-1980s, we have not completed a major recapitalization effort, nor is there an anticipated period of lessened tensions that will allow us to reduce our efforts. Unlike the early 1990s, we do not have the luxury of significantly reducing the end strength and force structure of the armed forces, thereby significantly reducing the defense budget. Nor do we have a large capital stock accumulated over the past decade.

Procurement is historically the major source of reductions when defense budgets shrink. Today, this is not feasible. Current assessments indicate that reducing defense investment to the levels of 1977, 1987 or 1997 would be imprudent. The new standard in procurement spending is somewhere in the range of \$90 to \$100 thousand per service member. This translates to procurement spending of \$125 to \$140 billion—approximately the level it is today. This is about 22 percent of the DOD budget, slightly higher than the average of the past four decades. When combined with the necessary R&D effort, an overall investment level of about 35 percent of the defense budget seems a prudent level for supporting the force of today, one that needs enhanced technical capability to offset numerical limitations.

Procurement spending in this range is also important for the maintenance of a vibrant, innovative defense industrial base. After 1993, about 30 major defense firms consolidated into five, and many firms exited the business altogether. The defense industrial base has evolved to a point where it is robust and agile, yet lacking in depth. Because it remains as a key “strategic asset” for the United States, ensuring the health of this industrial base must be a national priority.

As long as the United States plays a major role in the world and retains a strategy that requires rapid response to a wide variety of contingencies, our service members must be equipped to succeed under the most demanding circumstances. They certainly deserve nothing less.



Introduction

Forty years have passed since Alain C. Enthoven and K. Wayne Smith posed their ever-vexing question about defense expenditures, “How Much Is Enough?” Despite the authors’ now legendary efforts to explore this subject and their service in the Pentagon establishing Defense Secretary Robert McNamara’s Office of Systems Analysis, the definitive answer to the question remains as elusive as ever. The fundamental challenge is that answering “How Much Is Enough” very much depends on two other clearly related questions: “To Do What?” and “To What End?”

Congress mandated the Quadrennial Defense Review to help answer the questions of “To Do What?” and “To What End?” so that national decision makers could better address the issue of “How Much Is Enough?” The QDR has forced the Defense Department to lay out its position on the first two questions, and while there are many who disagree with the conclusions in the QDR, a rough consensus has emerged about the current and future security environment. There is no such consensus about what we need to succeed in that security environment and no consensus at all about “How Much Is Enough?”

A fundamental problem in addressing the issue of defense spending is the lack of universally accepted and understood metrics. In most commercial activities, metrics are relatively common and widely understood. Publicly held corporations release quarterly statistics that indicate how much money was taken in, how much was spent on operations and new capital, how much went into servicing existing debt and how much cash flow was generated. There are reports on revenue growth or decline in various business units within the corporation, a delineation of the markets the corporation is addressing and an assessment of whether the market space is growing and the portion of it that has been captured. Internally, compound annual growth rates are calculated and management teams review and evaluate the prospects for the coming quarter, the full year or often even the coming decade. Collecting and analyzing such meaningful information is a fundamental responsibility and activity of management—as one observer noted, “You can’t manage what you can’t measure.”



Figuring It Out

Of course, the Defense Department has metrics, but they tend to be more explanatory than predictive and generally focus on two relatively simple items: how much was in the budget (budget authority), and how much was spent (outlays). If conflict breaks out somewhere in the world and we get involved, one can make certain judgments on the quality of our military contribution. For some, the performance of our forces may justify the money spent on manpower, basing, equipment and training. They will declare our efforts a success because of past investments in some capability or bemoan our failings because of shortfalls elsewhere. Others will argue that had our forces been crafted and postured to offer greater deterrence, no conflict would have occurred in the first place—declaring past efforts a misallocation of resources. Still others will dive deeper into the issue and declare that the portion of the force that met the immediate challenge clearly proved its worth—while another portion of the force that was not deployed in the immediate case was clearly little more than an expensive luxury.

In other words, measures of success in the defense establishment are numerous, debatable and debated, simultaneously allowing for finite measurement in certain categories while remaining frustratingly vague in others. A report by the Business Executives for National Security in November 2000 identified a lack of uniform performance metrics within DOD as an issue.² Some progress has been made, but the effort needs to continue with increased energy.

Clearly, DOD needs a standard by which to measure its investment in equipment modernization against amounts spent for manpower costs and operations and maintenance. Maintaining a predictable level of investment has become a challenge as manpower costs have risen over the past four decades despite a decline in the numbers of service men and women. In addition, O&M accounts have seen a steady rise driven by ongoing military operations and rapid growth in other areas such as health care. In certain periods, such as the mid-1970s, when the investment accounts significantly decreased, the result was harmful to the overall defense efforts. By contrast, the impact on our forces was relatively small during the mid-1990s, when the investment accounts were also substantially reduced. But with a smaller armed force than we have had for a half-century, we must take care to ensure that we make up in technological capability what we lack in numbers. This is a difficult balance—one that must be carefully considered and thoughtfully managed. Recent history suggests that devoting about 20 percent of the defense budget to system procurement keeps our forces well-armed and ready and keeps the defense industrial base that supports them innovative and vibrant.

Affordability

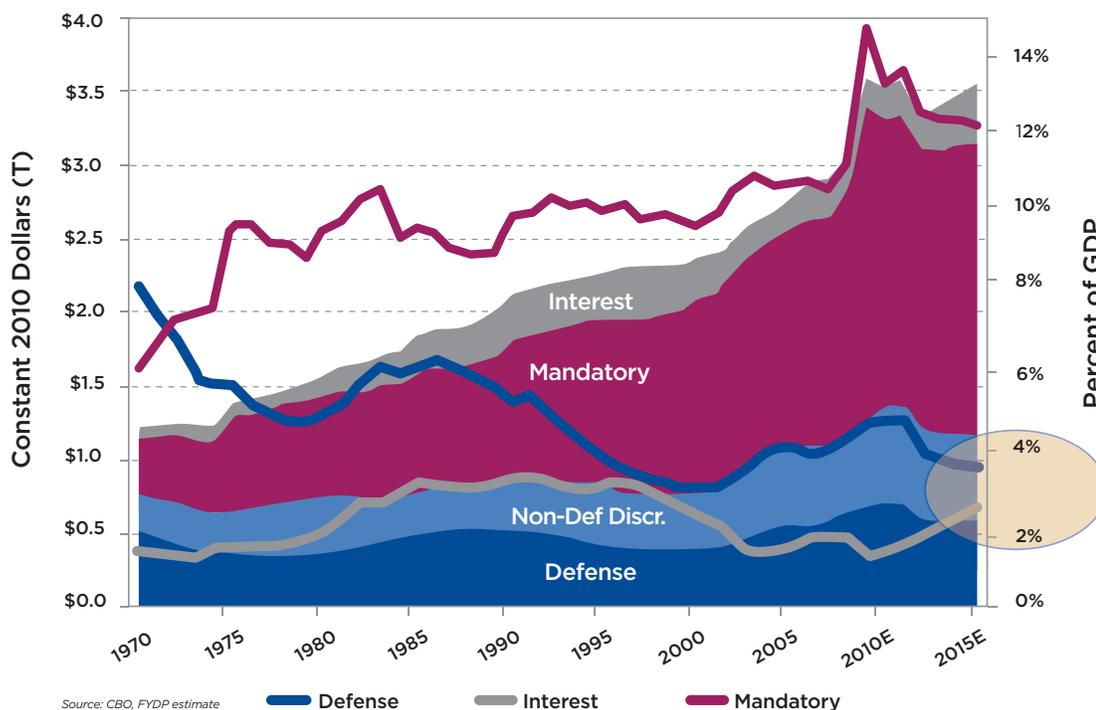
Another intriguing question regarding defense resources is: what is “affordable?” With a current base budget of more than \$550 billion, anything costing less is technically “affordable.” However, when

one sets aside service members salaries and the fixed costs of housing and other infrastructure, an area emerges that can be described as “discretionary.” Finding the balance between “mandatory” and “discretionary” portions of the budget is still more art than science. In short, the variables inherent in defense budgeting are numerous, finding the right balance is highly judgmental and situational, and the correct distribution of effort will remain an elusive target.

That leaves us with the challenge of determining useful budgetary metrics by combining factors we can reasonably discern about the future and comparing them with outcomes from the past.

A necessary first step that many have attempted over the years is to determine the overall level of defense expenditure that the country can “afford.” A look back at the distribution of federal expenditures over the past 40 years shows some interesting patterns (see Chart 1). In 1970, as the nation was beginning to withdraw from a frustrating experience in Vietnam, total government spending in constant 2010 dollars was about \$1 trillion. Defense spending accounted for about a third of this amount and represented about 8 percent of the nation’s gross domestic product. Mandatory spending on social programs represented about 6 percent of GDP. By 1980, defense spending had been significantly reduced—falling to less than 6 percent of GDP—while mandatory spending on social programs rose sharply to more than 10 percent of GDP. Current projections of future budget allocations show that mandatory spending will continue to rise while defense spending will continue its general decline—pressured in a significant way by interest payments on the national debt.

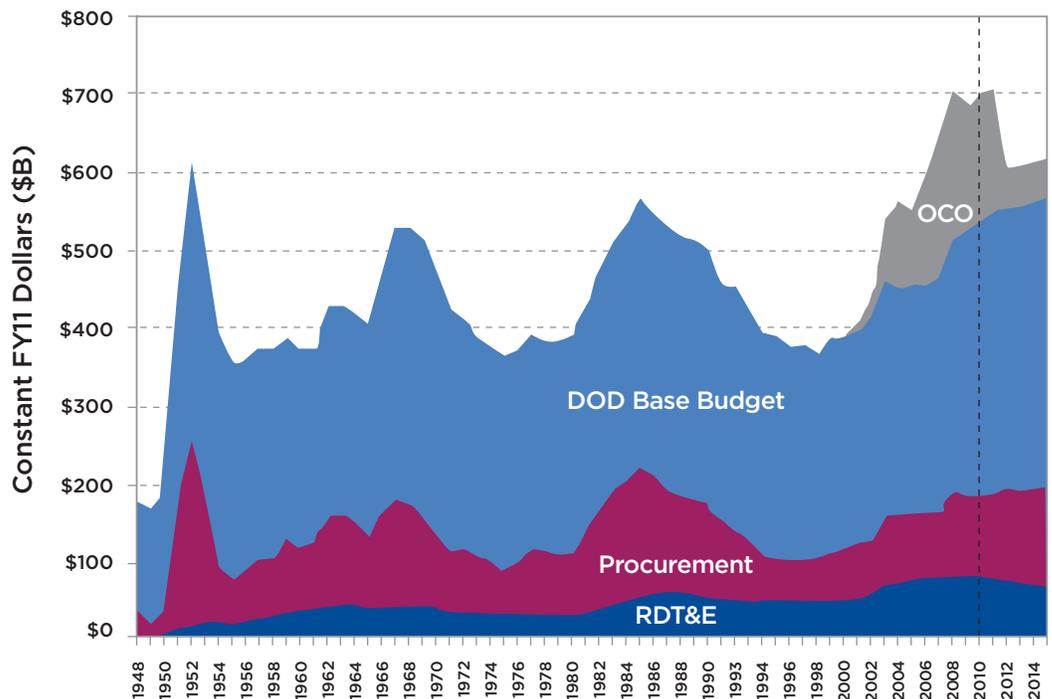
Chart 1: Federal Spending History



In historical context, the 1970s were a difficult period for the U.S. armed forces. In 1980, Army Chief of Staff Gen. Edward C. Meyer famously observed that the nation had a “hollow Army.” The armed forces were caught between converging forces that were difficult to control. Manpower costs grew steadily while the Pentagon sought to implement the change to an all-volunteer force, refocus its efforts after Vietnam from irregular to conventional warfare and address what was seen as a growing challenge from the Soviet Union. Fears that the military was increasingly unable to meet emerging national security needs grew with the fall of the Shah of Iran in February 1979 and the Soviet invasion of Afghanistan in December of the same year. Those fears were greatly exacerbated in April 1980 when a complex mission to rescue American hostages seized by the Iranian revolutionary government ended in failure at a place now known as “Desert One.”

The readiness of American military forces became a major issue in the presidential campaign of 1980. The election of President Ronald Reagan began a new era in defense budgeting that was to last five years. To address the recruiting challenge, Reagan increased military pay and established other incentives for service. Combined with new entry standards and a greatly expanded recruiting force, the AVF began to attract quality recruits in sufficient numbers. Force readiness steadily improved while measures of performance increased. But the “Reagan buildup,” as it was commonly called, was primarily a buildup in equipment. The procurement accounts of all services increased sharply. While manpower levels of the active force remained steady at about 2.2 million and pay accounts increased by nearly 40 percent, procurement more than doubled (see Chart 2).

Chart 2: DOD Budget 1948 - 2015



Source: DOD

During this period, the Army significantly modernized its force—fielding what it called the “Big Five:” the AH-64 Apache attack helicopter, the UH-60 Blackhawk utility helicopter, the M-1 Abrams battle tank, the M-2/3 Bradley fighting vehicle and the Patriot air defense missile system. The Navy began an aggressive program to expand the fleet to 600 ships and returned four World War II-era battleships to active duty while simultaneously fielding the F-14 Tomcat fighter, *Los Angeles*-class attack submarines and *Ohio*-class ballistic missile submarines. The Air Force expanded fielding of the F-15 and F-16 fighters and the B-1B bomber, accelerated development of stealth aircraft with the B-2 bomber and the F-117 fighter-bomber and began a large modernization of its ballistic missile force. Across the Defense Department, great effort was invested in the Strategic Defense Initiative—commonly referred to at the time as “Star Wars”—intended to establish a defensive shield against ballistic missile attack. From 1980 to 1985, procurement accounts claimed an unprecedented 30 percent of the defense budget—nearly double the low point reached in 1975.

The strategic focus of this effort was the belief that the American industrial base was considerably more innovative and efficient than its Soviet counterpart; any effort by Moscow to match the effort would greatly strain the Soviet economy. That eventually proved true, but the defense program also placed great pressure on the American budget—which saw deficit spending increase to 6 percent of GDP by 1985. Bipartisan concern over this deficit and the accession to power in the Soviet Union of General Secretary Mikhail Gorbachev combined to bring the Reagan buildup to an end. Nonetheless, during that time many key programs that had been on the drawing board in the Carter administration entered production, often in large numbers. Although the end of procurement growth in 1985 meant that several programs were either cancelled or curtailed, the effort provided a modernized capital stock that was impressively displayed by President George H. W. Bush in Operation Desert Storm six years later.

Preceding its collapse in 1991, warming relations with the Soviet Union allowed the Reagan and Bush administrations to continue reducing procurement spending and to initiate a drawdown of American force structure. Between 1991 and 2000, the number of active duty service personnel was reduced by a third while procurement was reduced even more (see Chart 3). Reduced defense spending allowed the nation to focus on certain domestic needs funded by a “Peace Dividend,” which included a “procurement holiday.” Frequently during this period, American armed forces were deployed in places such as Somalia, Haiti and the Balkans—always performing admirably. Although questions were raised about a growing operational tempo and there were some lingering concerns that manpower levels might have been reduced too far for a period requiring “boots on the ground,” equipment needs were basically met by using the large capital stock accumulated in the 1980s.

After the attacks of 9/11, the nation quickly recovered and the armed forces went to war in Afghanistan. Because of the country’s land-locked location and mountainous terrain, this war was





well-suited for the skills of special operations forces. This conflict was “labor intensive” but not particularly “capital intensive.” By contrast, Operation Iraqi Freedom—and the occupation that followed—was both labor intensive and capital intensive to a much greater degree. The Army found itself poorly structured for maintaining a large force in theater, and unit tours slowly began to extend beyond a year. In peacetime, major ground vehicles were routinely budgeted for 800 miles of operation per year; in the wars in Iraq and Afghanistan many were being operated 100 miles per day—an enormous increase that placed great strains on the equipment and the military units. Each service is facing a similar situation. The personnel tempo was addressed by restructuring the Army with a modular force, and a temporary end strength increase authorized in late 2006 of 65,000 additional soldiers and 27,000 additional marines. But given the size of the area of operations, the tactics of the enemy, the difficulty of the terrain, the desire to retain the AVF construct and the sensitivity of the American public to casualties, it quickly became obvious that significant new procurement was needed to meet the emerging challenges. Systems such as mine-resistant ambush-protected trucks and a large suite of enhanced intelligence, surveillance and reconnaissance capabilities were quickly fielded.

Lessons Learned and Not Learned

What does this brief recollection of the past 40 years suggest in answering the original question, “How Much Is Enough?” Several observations can be made and conclusions can be drawn.

To effectively equip our war fighters, defense spending levels have a certain floor that must be considered. It has been suggested by many, including Chairman of the Joint Chiefs of Staff Adm. Michael Mullen, that a spending level of 4 percent of GDP could serve as a useful metric. From 1975 through 2010, the average was 4.4 percent of GDP (see Chart 3). This is not a number that clearly delineates acceptable from unacceptable spending, nor acceptable from unacceptable risk. For most of the past half-century the United States has spent a much greater portion of its wealth on defense than it does now—even including supplemental funding to finance operations in Afghanistan and Iraq. During the 1990s we spent considerably less, dropping below 3 percent in 1998. As mentioned previously, this was an acceptable condition because we had reduced military personnel and force structure and were taking advantage of a large capital stock that had been substantially modernized during the previous decade. But these recent procurement levels are not sustainable and will not support necessary replenishment levels. Also, given the wide scope of American interests—and potential military missions—procurement levels must be sufficient to permit the development and fielding of improved or new systems. In the absence of more service members, our committed forces must be better empowered.

Although the United States went through much of the last half century with about 2 million people in the active duty military, the current level of about 1.5 million is likely the maximum sustainable

level. There are clear demographic constraints if one wishes to maintain the quality standards that have proven central to the success of the AVF. A fundamental requirement is for high school graduates—an essential but increasingly smaller pool as college attendance rates have increased since the last draftee reported in December 1972. When the AVF was initiated about 40 percent of high school graduates went to college; now the number is closer to 70 percent. When combined with other standards that the military has established—the upper mental category, no history of drug or other behavioral issues, medically and physically acceptable—the population of the services’ prime recruiting group is actually rather small.

Since the armed forces have—and will continue to have—a manpower constraint, going forward we will have to substitute technology for people. We will have to pursue every effort to enhance and empower each individual service member. Even the traditionally labor-intensive services—the Army and Marine Corps—will have to become more “capital intensive” to deal with both current and emerging threats. In order to accomplish this, the United States will have to exploit its greatest comparative advantage—its technologically superior industrial base.

Chart 3: The Key Metrics

	1975	1980	1985	1991	1997	2000	2008	2010
Defense % of GDP	5.4%	4.9%	5.9%	4.4%	3.1%	2.9%	4.1%	4.7%
Procurement % of Defense Budget	16%	20%	29%	22%	14%	17%	24%	20%
R&D % of Defense Budget	9%	8%	10%	12%	13%	12%	12%	12%
Active Duty End Strength	2.129M	2.063M	2.207M	2.077M	1.504M	1.449M	1.474M	1.483M
Procurement per Service Member (\$M)	\$27.4 K	\$38.5 K	\$75.7 K	\$48.7 K	\$36.3K	\$46.4K	\$116.5 K	\$88.7 K
R&D per SM	\$14.4k	\$14.6k	\$25.2k	\$24.7k	\$31.0k	\$33.9k	\$54.6k	\$54.5k

Source: CBO, DOD

Evaluating Manpower and Procurement Levels

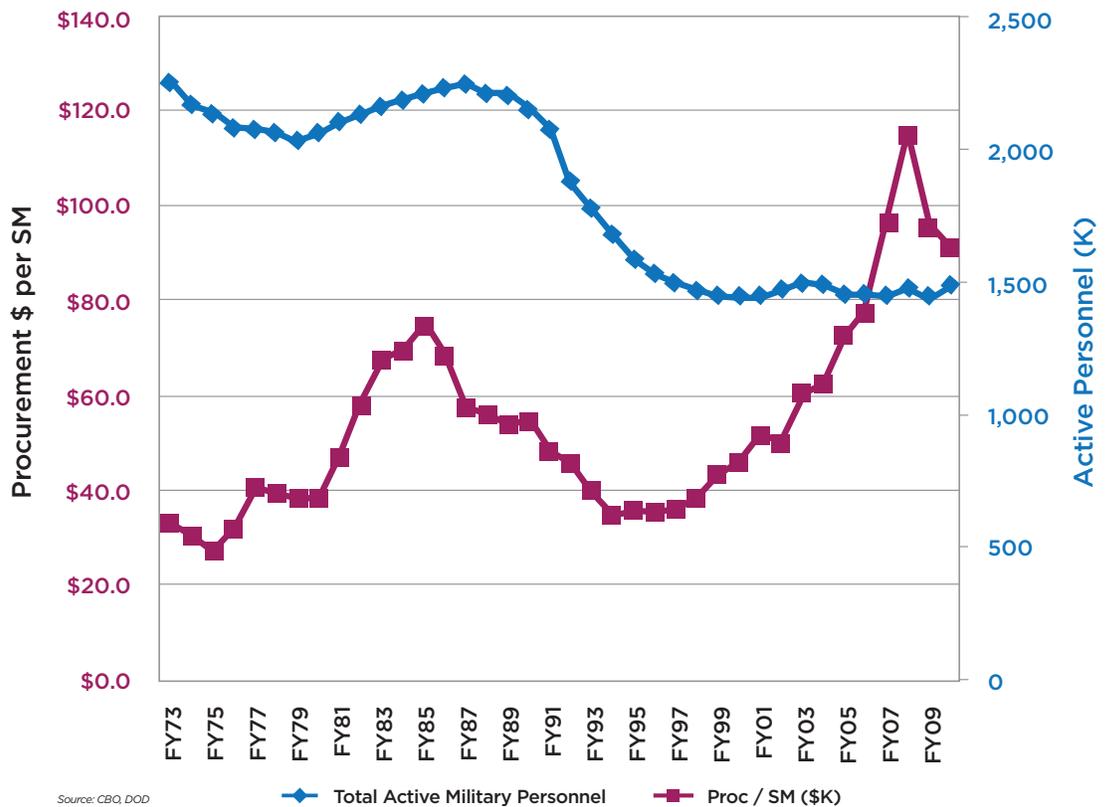
Are there useful metrics that suggest the level of investment that will be required?

Since conscription ended in 1973, active duty manpower hovered around 2.2 million for two decades (see Chart 4). Following the end of the Cold War, active duty manpower dropped to about 1.5 million, a reduction of a third. This level has remained largely constant, driven in no small degree by the very high marginal cost of increasing it.

Throughout the 1970s, procurement level per service member was less than \$40 thousand, a period corresponding to the “hollow Army” years. Although there had been considerable investment in capabilities needed for the Vietnam conflict—most notably in Army aviation and early efforts at aircraft-delivered precision guided munitions—other efforts, such as the Army’s main battle tank, were largely ignored or given lower priority. Considerable RDT&E spending continued during this period while procurement was decreased.

The different metrics we’ve explored here all demonstrate the same reality: the Reagan buildup of the early 1980s was primarily a procurement expansion. Although military compensation enjoyed some significant increases, the end strength of the services changed little. Therefore, procurement spending per capita nearly doubled and many previously developed advanced systems were fielded.

Chart 4: Manpower and Per Capita Procurement Spending



The decline shown after 1986 reflects greatly changed—and rapidly changing—strategic conditions. Budget levels reflected this new reality. As discussed earlier, the fact that we had considerable capital stock on hand to fill the needs of a significantly smaller force made the “procurement holiday” an attractive policy alternative. Although spending in the mid-1990s dipped to a level near that of the late 1970s, it did not descend to the levels of the early 1970s.

After 9/11 and the advent of large military operations in Afghanistan and Iraq, procurement spending per capita started a sharp upward climb, peaking in 2008 at nearly \$120 thousand, a 60 percent increase above the highest Reagan-era level. This level was driven by several factors including a very heavy operational tempo that depleted the defense capital stock and the need to provide enhanced capabilities to service members so they could operate more jointly and with greater situational awareness, and survive the attacks of a determined and agile enemy.

As a result, our current circumstances are rather distinct from those of the early 1970s, the early 1980s or the early 1990s. Unlike the early 1970s, the nation is now committed to ensuring that those who go into battle and bear the greatest burdens will get the equipment and support they need to ensure mission success. Moreover, the armed forces have learned how to recruit and retain a quality, professional force. Unlike the 1980s, where we started the decade in need of a major recapitalization effort and ended it in a period of rapidly declining tensions—certainly not our current circumstance. Unlike the early 1990s, we do not have the luxury of significantly reducing the end strength and force structure of the armed forces. In its latest budget review, the Defense Department did not consider any such reductions, although it does plan reductions to the Army and Marine Corps in the next few years.

Nor have we accumulated a large capital stock over the past decade. Much of what has been purchased since 2005 has been specialized equipment to deal with the particular conditions of the theaters of operations—such as MRAP vehicles, wide-area communications equipment, enhanced soldier ensembles, tactical intelligence systems, improved night-vision devices and various new electronic capabilities. But the need to further empower individual service members with new, emerging technology will endure. Moreover, while the focus has been on counter-insurgency operations, the need to prepare for future high-end conflict with a near-peer competitor has not disappeared and may indeed be growing.

Research and Development

One more key ingredient is needed to provide our deployed forces with the necessary capabilities. Procurement is the last step following a successful research and development effort. Without a structured—or even an unstructured—R&D program, the fundamental exploration of new concepts and capabilities and an examination of technological feasibility simply does not occur. As with procurement, the basic question is “How Much Is Enough?” But all agree that R&D provides the basic investment that





makes future technology possible and provides an invaluable hedge against an uncertain future.

Transitioning a system from development into production—and ultimately fielding—is a complex process with numerous variables. The requirement must be understood and relatively stable, the conceptual approach must demonstrate feasibility, developmental testing must show that the concept can perform to technical expectations and operational testing must show that our armed forces can effectively use the system. Through each step of this arduous process, funding must be adequate to ensure that the concept is fully examined, matured and readied for the next phase. Developing a technologically advanced system is costly, but overall less costly than producing and fielding it.

At the height of the Reagan buildup in 1985, the ratio between procurement funds and R&D funds was nearly 3 to 1. Between 1985 and 1997, this ratio fell to less than 1.2 to 1—that is, \$1.20 of procurement for every dollar of R&D. The average across the period from 1985 to the end of the current Future Years Defense Program in 2015 is 1.6 to 1, with a decrease in the ratio projected for 2010 through 2015 as systems developed the previous decade presumably transition into production. But as with procurement, the circumstances that would allow a comfortable return to the tight ratios of the mid-1990s simply do not exist. There is a strong demand for R&D, particularly in new areas of potential conflict such as undersea warfare (a growing worldwide submarine threat and unmanned undersea weapons), electronic warfare and cyberspace—as well as emerging innovative approaches to reducing casualties such as unmanned systems and countering IEDs and rockets, artillery and mortars. Previous experience suggests that a prudent, sustainable level of R&D exists in the area of 1.8 to 1. If procurement were about \$130 billion as previously suggested, the R&D effort would be roughly \$70 billion, bringing the combined investment effort to about 35 percent of the defense budget. Although \$70 billion is somewhat higher than recent experience, it is well below the highest levels seen in this vital area.

What Does It All Mean?

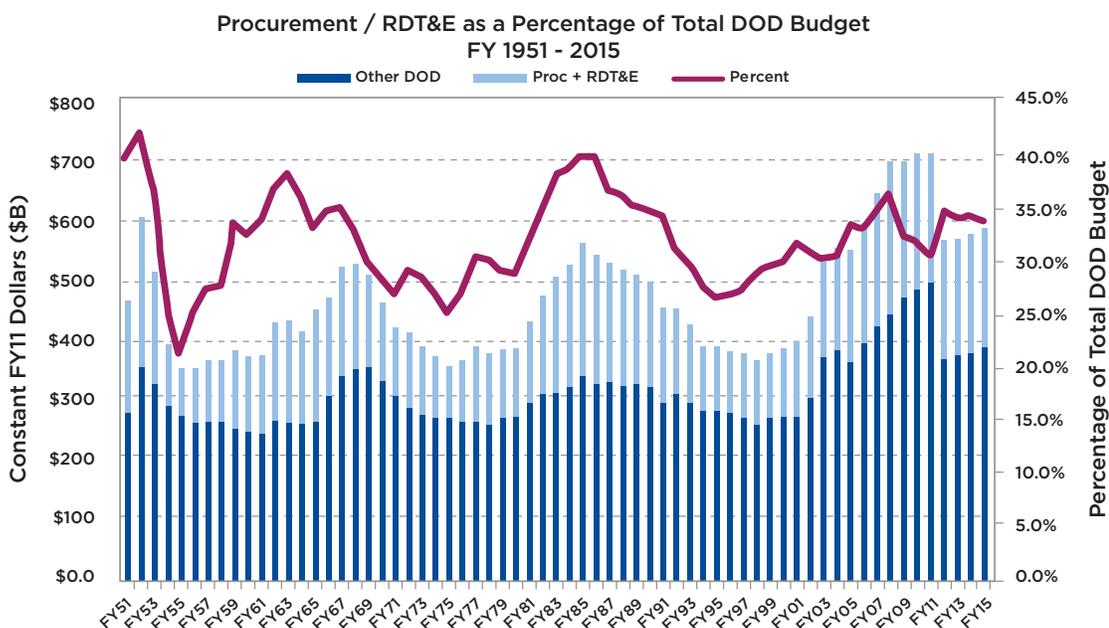
For procurement, this assessment indicates that defense spending reductions to the levels of 1977, 1987 or 1997 are imprudent. The new standard that exists in procurement spending per capita is somewhere in the \$90 to \$100 thousand range, which translates to a procurement account between \$125 and \$140 billion—the approximate level it is today in the base budgets projected by DOD for 2012 to 2015. This also suggests that the procurement accounts will have to remain at about 22 percent of the DOD budget—slightly higher than the average of the past four decades. This level of effort is seemingly recognized by Defense Secretary Gates; his efficiencies initiative is intended to redirect funds into modernization programs that will be important in both the immediate time frame and the coming years.

Procurement spending in this range is also important for the maintenance of a vibrant, innovative defense industrial base. The defense industrial base has evolved to a point where it is robust and

agile, yet lacking in depth. The major consolidation of the defense industry after 1993 saw about 30 major defense firms consolidate into five—and tellingly saw many firms exiting the business altogether. Although many still believe the defense industrial base looks as it did in the 1950s—when it was the nation’s largest industrial sector—the consolidation has resulted in an industry whose top five firms have a combined revenue that is about half of Wal-Mart’s. This is an industry that produces very few serial production runs of thousands—even hundreds—of items and struggles to maintain an active research and design base. If there is no vision of a future strike aircraft, then even if a company desired to field a team to design one they would be operating without useful direction from the customer. This is a certain formula for wasted effort and the production of a system that is technologically capable but operationally questionable.

Although the U.S. defense industry remains a key strategic asset for the United States, it is an asset that must be managed, maintained and sustained. As Undersecretary of Defense for Acquisition, Technology and Logistics Ashton Carter recently said, having such a vibrant base is not a “God-given right.” Ensuring this industrial base remains healthy must be a national priority. As long as the United States plays a major role in the world and retains a strategy that requires rapid response to a wide variety of contingencies, our service members must be equipped to succeed under the most demanding circumstances. They certainly deserve nothing less. A commitment of 4 percent of GDP to defense, with 35 percent of the budget devoted to modernization accounts, is a prudent and affordable level for supporting the force of today and the future.

Chart 5: Historical Investment Level



Source: CBO



Aerospace Industries Association

The Aerospace Industries Association was founded in 1919, only a few years after the birth of flight. The nation's most authoritative and influential voice of the aerospace and defense industry, AIA represents nearly 150 leading aerospace and defense manufacturers, along with a supplier base close to 200 associate members.

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Photos in this report are courtesy of Lockheed Martin Corporation (page 4-5); Vought (pages 9, 13); L-3 (page 10) and Bell Helicopter (page 14). Cover © Chuck Rausin | Dreamstime.com

Endnotes

- 1 Enthoven, Alain C. and K. Wayne Smith, *How Much Is Enough? Shaping the Defense Program, 1961-1969*, New York, N.Y., Harper & Row, 1971.
- 2 See, http://www.bens.org/mis_support/archives/PPBS2000-II.pdf

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AIA Associate Member Companies

300 Below	Dassault Systemes	Meehan Electronics Corporation	Senior Aerospace
3M Company	Data Conversion Laboratory, Inc.	Meyer Tool Inc.	Serco Inc.
A.T. Kearney Public Sector & Defense	Dayton T. Brown Inc.	Microsemi Corporation	Service Steel Aerospace
Acme Industrial Company	Dexter Magnetic Technologies, Inc.	Mid-State Aerospace Inc.	Servotronics, Inc.
ADI American Distributors, Inc.	Electronic/Fasteners, Inc.	Mil Spec Sales Co.	Shapes Aerospace International
Aeronautical Systems, Inc.	Embry-Riddle Aeronautical University	Millitech, Inc.	Sigma Metals, Inc.
Aerospace Alloys, Inc.	Emhart Teknologies, a Black & Decker Company	Modern Industries	SMT Corp
Aerospace Supply Chain Solutions, LLC	ENSCO, Inc.	Monogram Aerospace Fasteners	Sonfarrel, Inc.
Aerospacemall.com	ESP, Inc.	Montana Metal Products, LLC	Southern Manufacturing, Technologies
Air Industries Machining Corporation	Essner Manufacturing, L.P.	Moritz Aerospace, Inc.	Spincraft
AirBorn Operating L.P.	ETA Global, Inc.	Morris Machine Company, Inc.	Spirit Electronics, Inc.
Airfasco Industries, Inc.	Exotic Metals Forming Company LLC	Morton Manufacturing	SPX Precision Components
Albany Engineered Composites	The Ferco Group	National Machine Group	Standex Electronics
Alcoa Fastening Systems	Freedom Alloys	National Utilities Company	Sulzer Metco (US) Inc.
Allen Aircraft Products, Inc.	Frontier Electronic Systems Corporation	Navigant Consulting, Inc.	Sunshine Metals, Inc.
Allied Barton Securities	G.S. Precision, Inc.	New Breed Corporation	Swift Engineering
Altemp Alloys, Inc.	General Products	Norfil Manufacturing, Inc.	Synchronous Aerospace Group
American Brazing	Geater Machining and Manufacturing	North Shore Components, Inc.	Sypris Electronics
AMI Metals, Inc.	H&S Swansons' Tool Company	O'Neil & Associates, Inc.	Systemc
APV Manufacturing & Engineering Co.	Haas TCM/AvChem	Ohio Aerospace Institute	Tactair Fluid Controls
Arkwin Industries, Inc.	HCL Technologies	Omnitrol Networks Inc.	TCS America
Astro-Med, Inc.	HDL Research Lab, Inc.	Orion Industries	TechSolve, Inc.
Astronautics Corporation of America	Hi-Temp Insulation Inc.	Parkway Products, Inc.	Tedopres International, Inc.
ATC Aerospace	Houlihan Lokey	P3 North America Consulting Limited	TEK Precision Co. Ltd.
Athena Manufacturing, LP	Hughes Bros. Aircrafters, Inc.	PAS Technologies Inc.	Telephonics Corporation
Banneker Industries, Inc.	IEC Electronics	PCC Airfoils, LLC	Thermacore, Inc.
Benchmark Electronics, Inc.	Industrial Metals Intl. Ltd.	Pelican Products, Inc.	The World Academy
Blenheim Capitol Services	Infotech Enterprises America Inc.	Perillo Industries, Inc.	TIGHTCO, Inc.
Brogdon Tool & Die, Inc.	InfoTrust Group	PGM of New England, LLC	Tiodize Co., Inc.
BTC Electronic Components	Infosys Technologies	Phillips Screw Company	Tri Polus Inc.
Burton Industries Aerospace Heat Treating, Inc.	Ingenium	Plymouth Engineered Shapes	TSI Group Inc.
California Manufacturing Technology Consulting	Inmedius	Precision Gear	TSI Plastics, Inc.
Carlton Forge Works	InterConnect Wiring	Precision Tube Bending	TTI, Inc.
Castle Metals Aerospace	International Technegroup Inc. (TranscenData Division)	Premier Precision Group	TTM Technologies, Inc.
CDG	Intrepid Learning Solutions	QMC LLC	TW Metals
Celltron Inc.	ITW CIP	RAF Tabtronics, LLC	UFP Technologies
Cherokee Nation Distributors	Janes Capital Partners	RAM Company	Umbra Cuscinetti, Inc.
CIT Aerospace	JRH Electronics, LLC	Renaissance Services	University of Tennessee – Aerospace Defense Clearing House
Cling's Manufacturing	Kennebec Technologies	Renaissance Strategic Advisors II, LLC	Vishay
CMC Electronics	Kubotek USA	Rocker Industries	VISTAGY
Co-Operative Industries Defense, LLC	Kulite Semiconductor Products, Inc.	Rubbercraft	VT Group, Inc.
Coalition Solutions Integrated, Inc.	Level 3 Inspection LLC	Safran USA	Vulcanium Metals Incorporated
Command Technology, Inc.	Lintech Components Co., Inc.	Samuel Aerospace	The Wharton School - Executive Education
Consolidated Precision Products	Loos & Co., Inc.	Schmiede Corporation	Whitcraft LLC
CPI Aero, Inc.	MahindraSatyam	Scot Forge Corporation	Wind River Systems
Crawford & Company	Maine Machine Products Co., Inc.	SDL	Windings, Inc.
Crestwood Technology Group	Materion	Sea Air Space Machining & Molding	X-Ray Industries
Crowell Solutions	McCann Aerospace Machining Corporation	SEAKR Engineering	Yarde Metals
		Seal Science, Inc.	
		Sechan Electronics, Inc.	
		SELEX Galileo Inc.	



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