Beyond the 'Buy America' Debate:

Sustaining America's Industrial and Technological Edge amid the Challenges of Globalization

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Abstract

This paper proposes ways for the U.S. government to secure a long term advantage in access to industrial and technological capabilities important to national security. The author explores the challenges that economic globalization is imposing on the long term viability of U.S access to critical industrial and technological capabilities. Starting with an analysis of the core globalization issues as they relate to the Berry Amendment restricting DOD procurement sources for certain items, the paper puts forth a framework for bureaucratic reforms. Specific reform recommendations aimed at improving bureaucratic organizations, processes, and practices related to DOD procurement policies conclude the paper.

Executive Summary

Avoiding foreign dependencies and protecting technological knowledge with regard to things that are used to defend a nation is rational policy. It is also rational policy to leverage the substantial benefits of the global free market to obtain the best value and capability available when procuring things that are used to defend a nation. The nexus of these viewpoints is what motivates a simmering debate in Washington among Congress, the Department of Defense (DOD), and Industry that could (and should) have a significant impact on how the American bureaucracy charged with supporting the national security industrial and technology enterprise evolves in response to economic globalization.

The study of the ongoing debate over buy America policies and their relevance in a globalized economy served to facilitate insight into fundamental issues that are challenging the long term viability of the U.S. national security industrial and technology base. The discourse centered on the Berry Amendment, an obscure law that places rigid domestic source restriction on DOD procurements of certain materials, is particularly revealing of theses core challenges. The overarching theme of this study is that the challenges wrought by the rapid changes facilitated by globalization demand a national industrial and technology policy making and policy implementation apparatus that is much more adaptable than it is today.

A detailed study of the buy America debate resulted in the deduction of four key globalization issues. First, efforts to balance the benefits of a global free market with the risks of foreign dependency are much more difficult than in previous eras. This is partly due to domestic political anxiety over globalization's socio-economic impacts. These efforts, however, are also becoming increasingly difficult due to the real risks brought on by America's changing international stature and the increasing potential for political differences and instability to disrupt defense trade. Second, the restructuring of the global defense industry and emergence of the high technology sector over the past two decades has led to a rise in the reliance on dual-use technology and its dominant commercial markets, which are increasingly transnational in character. Third, globalization has also placed scrutiny on the

counterproductive nature of an overly prescriptive Congress. Congress often over compensates for a poorly performing federal bureaucracy by imposing strict controls in an environment that changes well inside legislative cycles, ultimately constraining the ability to adapt. Fourth, the American bureaucracy that is supposed to lead the effort to deal with the security challenges of globalization has demonstrated a lack of ability to effectively establish consensus in identifying critical technologies and industrial capabilities. This has degraded America's capacity to adapt to global competition through the use of intelligently targeted protective measures and investment in innovation.

This study finds that moving toward a more adaptable system should center on the following set of principles: more effective management of global supply chain risk, strategic focus on innovation in the dual-use technology sector, and more effective integration and interagency coordination with respect to industrial and technology policy making and policy implementation processes. These principles provide a framework in which reforms can be developed that triangulate toward a more flexible and forward looking approach to sustaining an edge in access to technological and industrial capabilities critical to national security.

Within the aforementioned framework, the following six specific reform recommendations are proposed as the result of this study's findings; each recommendation calls for specific government bureaucratic or process changes that are directed at contributing to one or more of the principles for adaptability:

1. Establish an interagency directorate to integrate and coordinate national industrial and technology policy and policy implementation processes.
2. Establish a forum and system for industrial and technology base knowledge aggregation to help guide policy, serve as a common information resource for the enterprise at large, and to support identification of national industrial and technology priorities.
3. Deliberately decentralize accountability for supply chain assurance to federal procurement and acquisition program managers and provide them the resources and tools to properly manage global supply chain risk.

4. Strengthen Defense Production Act (DPA) programs so that DPA authority can be applied more proactively and for greater strategic effect.
5. Reverse the trend in government funding of national security related Research and Development (R&D).
6. Improve government-industry collaboration by significantly expanding the use of consortiums organized around industrial and technology capability portfolios.

The above reforms are not intended to discount protectionist measures as being obsolete in a globalized economy. Quite the opposite is true. Targeted protection of critical technologies and industrial capabilities will be absolutely essential in the future. But, as the buy America debate reveals, the current bureaucratic apparatus and entrenchment of prescriptive protectionist legislation has dampened America's ability to adjust to the global market and adaptively protect and compete. The existing system has granted disproportionate weight to constituent based priorities and the parochial concerns of individual federal programs and agencies. Additionally, the foundation for innovation in defense and national security industries has been weakening. Decreasing government investment in R&D, at a time when a restructured defense industry has deferred a significant share of the risks of investment in innovation to the sub-prime level, has left a void that needs to be filled. Accordingly, the preceding recommendations are intended to break this pattern and achieve adaptability through key bureaucratic reforms. These reforms are intended to optimize national security outcomes by improving the collective understanding of industrial and technology priorities and risks, by facilitating collaboration within the government-industry enterprise, and by strengthening the commitment to innovation across the enterprise.

Introduction

It's 2013 and one the largest acquisition programs in the history of the U.S. military is in deep trouble. After billions of dollars and twelve years of development the F-35 Lightening II Joint Strike Fighter (JSF) program enjoyed a successful operational evaluation and recently completed delivery of the second low rate initial production (LRIP) lot of aircraft. Negotiations for a huge multi-year production contract with system integrator Lockheed Martin, however, have hit a brick wall. The unit cost for a JSF has greatly departed from initial estimates. Largely due to a combination of reduced numbers in DOD's orders and foreign orders and the skyrocketing cost of advanced materials, the cost per aircraft proposed by Lockheed Martin for the multi-year procurement came in 30% above the latest government estimates used to develop the multi-year procurement budget.

The program's problems began years earlier when the partnerships with ally nations began to weaken. Many partner countries had decided to withdraw from the program entirely or greatly reduce their commitments to buy aircraft. Most noteworthy was the British government's decision to back out of the program due to the inability of the U.S. government to come to resolution on the export of critical software information. This information would have allowed the Brit's to establish an organic maintenance and software support capability for their future fleet of F-35s. Though the U.S. eventually came around to authorizing export of the software information, the U.K. Ministry of Defense became so frustrated with the process and so leery of protectionist forces in Congress and in factions of the U.S defense industry lobby that it decided the risk of future hurdles was too great. Other European partners followed suit by either totally withdrawing support or greatly reducing commitment for future orders.

Of equal impact was the exponential increase in the price of titanium. Titanium, along with other special materials, had long been protected under the provisions of an obscure law know as the Berry Amendment. Because of this law Lockheed Martin was restricted from incorporating any titanium that was not domestically produced into F-35's manufactured for the U.S. military. With some exceptions, 100% of the titanium, which was essential to the JSF's design, was required to be of domestic origin. This restriction had resulted in modest price increases for DOD systems over the past few decades; the increased costs were argued as being necessary to guarantee sustainment of a "warm industrial base" for these critical materials.

In 2007, however, market changes began to emerge that would put enormous pressure on the price of titanium. Global demand for titanium began to surge in 2005 with the recovery of the commercial aircraft market and the stunning expansion of developing economies such as China and India. Additionally,

applications for titanium started to greatly expand outside the defense and aerospace market. High end sports equipment and industrial applications began to dominate demand. The increased global demand and restrictions on DOD's sources started to drive lead times for defense related orders of titanium to greater than 18 months. DOD recognized these changes and the pressure they were putting on procurement programs. Concerns over security began to grow when contractors began to miss delivery schedules just as DOD was starting to recover from the procurement holiday of the 1990s and several years of war. To ensure that repairs and production of key systems needed to support the ongoing wars in Iraq and Afghanistan stayed on scheduled, DOD worked with the Department of Commerce to exercise the Federal Government's powers under the Defense Production Act. Under this law, the Federal Government could compel the domestic titanium industry to give priority to DOD contracts.

Seeing the writing on the wall, several large U.S. commercial manufactures had made the strategic decision to secure international sources for titanium for their commercial product lines. For example, Boeing had established agreements with a large Russian titanium producer. Now that Boeing's orders of titanium from U.S. manufacturers for its commercial aircraft line were being unacceptably delayed, it turned to its Russian partner for the critical material.

Not sitting idly by, in 2007, U.S. titanium manufacturers began to bring latent production capacity on line to meet growing demand. With the undersupplied market keeping prices at record highs, the U.S. titanium industry was seeing impressive profits and was reinvesting some of the windfall into further expansion of existing titanium production processes. Though still profitable in the current market, these processes were quite costly and based on 70 year old technology. The Defense Advance Research Projects Agency (DARPA) had been spearheading an effort to revolutionize titanium extraction process technology. The new process promised to bring titanium prices down by and order of magnitude. But the decreasing Science and Technology budgets in 2008 and 2009, in part to offset rising procurement costs, resulted in program termination short of achieving the goal of industrializing a new cost effective process. Just as important, U.S. titanium companies and other interested companies were hesitant to take on the risk of continuing development without government funding and leadership.

So, while the domestic titanium industry was struggling to meet the demand of its customers at the same time it was raking in huge profits supplying defense contractors, the Russian conglomerate that controlled that country's titanium industry entered into a landmark deal with global automakers. It was long understood that titanium's superior strength to weight and corrosion resistance properties made it an ideal material for the design of fuel efficient and reliable automobiles. In the past, the cost of the metal served as a barrier to expanding its use in automobile manufacturing. Nevertheless, the Russians saw an opportunity.

They had been closely monitoring progress with titanium extraction technology programs in the U.S., Japan, Australia, and Europe. They had built a team of scientist and engineers by recruiting from these other regions and believed they had the ability to take the next step and eventually dominate the market.

The Russians entered into an agreement with global automakers that called for them to invest in a development program to bring the cutting edge titanium extraction technology up to an industrial scale. In return, the Russians would immediately begin to supply titanium at a significant discount to any automaker that participated in the program. The immediate availability of relatively cheap titanium encouraged automakers to begin incorporating the metal into their designs. The Russians believed they could monopolize the global commercial titanium market within a decade by being the first to implement a reduced cost extraction process while already having an advantage in natural resources.

As it turns out, it only took five years. By 2013, General Motors and Toyota were turning out highly efficient hybrid, flex-fuel, plug-in vehicles constructed with light-weight and cheap titanium supplied by the Russians. The automakers, using cheap Russian titanium had established a nascent market for titanium cars by early 2009. By 2010, their investment in the Russian titanium industry resulted in a full scale titanium extraction process that was one sixth the cost of the old process. The Russians could now provide cheap titanium at a substantial profit. The U.S. defense industry, however, was still beholden by law to relatively expensive domestic titanium.

The domestic titanium industry was struggling to modernize to compete with the Russians, but was a long way from capturing a meaningful amount of commercial market share. Although the flood of cheap Russian titanium on the global market was driving down prices, the cost to the U.S. defense industry was artificially high. The U.S. titanium industry was now dependent on defense contracts since it was being squeezed out of commercial aviation and automobile markets by the Russians. To stay viable, the U.S. titanium industry needed to keep prices well above commercial market levels.

Estimates held that titanium costs were adding as much as 15% to the unit cost of the JSF. This increase combined with the loss of economic order quantities due to loss of foreign customers threatened the ability of the program to meet U.S. force structure requirements without drastic increases in procurement budgets. One near term solution was to waive the Berry Amendment restriction on titanium and open up the defense market to foreign titanium including Russian titanium. But, could the U.S. risk developing a dependency on Russian titanium for its frontline strike fighter capability while further reducing the market share of domestic manufacturers? Would introduction of foreign competition a decade earlier have provided the catalyst for the domestic industry to be more willing to take risk and invest more in innovative? What role, beyond protection, should the U.S government have played in shaping this strategically critical industry?

Congress met in the summer of 2013 to address these questions and more during its work to finish the fiscal year 2014 appropriations legislation. Some influential members proposed an amendment that would plus up the defense procurement budget $1.5 billion to cover cost overruns for F-35 buys planned for that year while putting off authorizing DOD to enter into a multi-year contract with Lockheed Martin until costs could be reduced. Though there was some opposition to this approach, the F-35 program was so entrenched in the constituencies of a major segment of Congress that passage of the amendment was virtually assured. Moreover, part of the procurement plus up would come from budget cuts to R&D programs.

The amendment would also require the Under Secretary of Defense for Acquisition, Technology, and Logistics to submit a report one year from the date of enactment to certify that all major defense acquisition programs were meeting the requirements of the Berry Amendment for titanium and other materials on the Strategic Materials Protection List. Taking note of the ongoing struggles of the domestic titanium industry, security minded members of Congress wanted to be sure the U.S. strategic materials industry was being afforded all the protection it was entitled to by law.

Adam Smith already stated that "It is of importance that the kingdom depends as little as possible upon its neighbors for the manufactures necessary for its defense" Avoiding foreign dependencies and protecting technological knowledge with regard to things that are used to defend a nation is rational policy. It is also rational policy to leverage the substantial benefits of the global free market to obtain the best value and capability available when procuring things that are used to defend a nation. The nexus of these viewpoints is what motivates a simmering debate in Washington among Congress, the Department of Defense (DOD), and Industry that could (and should) have a significant impact on how the American bureaucracy charged with supporting the national security industrial and technology enterprise evolves in response to economic globalization.

Protecting critical industries is certainly the right strategy in some circumstances. A grand U.S. industrial and technology strategy, however, should recognize that the future health of the domestic defense and other national security related industries will depend on the ability to adapt to the challenges of an open global market.

The overarching thesis of this paper is that today's government bureaucracy and policies with regard to defense procurements are not structured to effectively adapt to

economic globalization. The analysis that follows focuses on four key globalization issues that are elucidated from an ongoing debate among key stakeholders with regard to buy America policies.[1] Each globalization issue is developed in the context of the recent buy America debate. Three principles for adaptability result from the analysis and they serve as a framework for reform: 1) Proactive management of risk; 2) Innovation support; and 3) Interagency coordination. Based on this framework for adaptability, six specific reform recommendations should be adopted. They include the establishment of mechanisms to foster coordination as well information building and sharing; increase supply chain management capabilities; establish baselines for strategic planning; and ensure adequate funding for research and development (R&D).

Buy America Debate in a Globalized Market

The discourse among DOD, Congress, and Industry centered on the provisions of the Berry Amendmentand its domestic source restrictions on specialty metals and other materials. [1] It reveals the perspectives of the various stakeholders regarding key aspects of U.S. industrial and technology policy, and ultimately brings into question the federal government's current capacity to maintain the preeminence of the U.S. industrial and technology base. Accordingly, an understanding of the key globalization issues is essential in framing a path forward for reform without jeopardizing national security.

The Berry Amendment and other domestic source restrictions are but one part of a complex system that exists, for the most part, to protect and sustain American industrial capability. The Berry Amendment's influence over a particularly vital segment of the industrial base – specialty metals – brings together intense commercial, technological, national security, and constituent based interests. This collision of interests has made the

[1] In this paper the term 'buy America' is used to generically refer to a range of provisions (statutory and regulatory) that impose domestic source restrictions on procurements made by the Federal Government and especially the Department of Defense. This terminology is not to be confused with the Buy America Act, which is one specific piece of legislation that imposes preferences for domestic sources on Federal Procurements.

obscure law a crucible for debate in a time when the U.S. defense-industrial complex is attempting to cope with the uncertain security landscape of the post 9/11 world and the enormous changes resulting from economic globalization.Along with the uncertain economic and security environment, the defense industry is undergoing significant restructuring resulting from corporate consolidation. Finally, DOD's ongoing efforts at military transformation may produce unexpected fallout.

In short, within the context of globalization and other important challenges that are seen today, a useful analysis of the buy America debate can be reduced to a discussion of the following four globalization issues:

- The balancing of the security (and political) risks of foreign sourcing with the rewards of free and open markets.
- The increasing integration of military and commercial technology sectors and dependence on the commercial industrial base at the sub-prime level.
- The reinforcing relationship between the poor performance of the federal bureaucracy and the legislative branch's propensity to micro-manage via statute.
- The lack of consensus and clarity in defining strategically critical materials, technologies, and industries.

Understanding these core issues serves as a starting point in the development of recommendations for targeted reforms. The following sections develop each of these four core globalization issues in the context of the recent buy America debate as well as the existing bureaucratic organizations, processes, and practices.

1. Risks and Benefits of Global Markets

In October of 2000, then Army Chief of Staff, General Eric Shinseki, announced that the Army would adopt the black beret – long used as a distinguishing feature of the elite Army Ranger uniform – as the standard head cover for the entire United States Army. The Defense Logistics Agency (DLA) had determined that the procurement of the required 4.7 million berets could not be met by U. S. manufacturers alone, and granted waivers to the restrictions imposed by the Berry Amendment statute.[2] The waivers enabled DOD to

purchase berets from foreign sources and allowed a domestic producer to enter into a contract despite its use of textile materials from foreign sources. The granting of these waivers by DLA resulted in protests from domestic small businesses, military and veteran's groups, and members of Congress. The House Small Business Committee went on to hold a hearing to discuss the statutory authority to waive the restrictions in the Berry Amendment.[3] The black beret issue seems trivial with respect to major defense acquisition items. This specific issue, however, energized Congress to re-evaluate the effectiveness of domestic source restrictions in light of the perceived growing dependency on foreign suppliers.

The controversy over foreign dependencies became more acute when a Swiss company, at the beginning of the Iraq War, refused to provide critical parts for Joint Direct Attack Munitions (JDAM) because it disagreed with the U. S. decision to invade Iraq. The Swiss company's president blocked shipment of parts to Honeywell, which manufactures guidance system components as a subcontractor to Boeing. JDAM was the core of U.S. precision strike capability and one of the absolutely essential weapons in the coalition arsenal. Boeing was eventually able to find an alternative U.S. source for the parts at twice the cost of the Swiss made parts.[4]

Representative Duncan Hunter, Chairman of the House Armed Services Committee (HASC) statet that Swiss action on the JDAM parts "should raise a red flag with security-minded Americans."[5] Representative Hunter is a well established advocate of buy America policies and has consistently pushed to strengthen buy America laws in recent years.[6]

In another high profile case of foreign products on the U.S. defense market, the Navy announced in January of 2005 that the European designed EH-101 helicopter had been selected as the source for the new presidential helicopter over its U. S competition (Sikorsky Aircraft Corporation). Again, Rep. Hunter and other lawmakers highighted the necessity of buy American laws.

These notable controversies reveal the political and security risks that come with the integration of foreign markets and the U.S. defense industry. Many have argued that the backlashes against procuring new Army berets and a U.S. presidential helicopter of

European design were largely driven by political or constituent base interests under the guise of a concern for national security. Although a case could be made for the strategic value of the textile industry, a production run of a few million berets would contribute little to shoring up domestic capability. Also, despite the origin of the EH-101 design, 90% of the money spent on the program is proposed to be spent in the U.S.[7] In view of this, it seems the real impact on the U.S. industrial base in these two cases is largely symbolic.

In addition, the response from Congress in both situations shows the political difficulties in leveraging the global market for products related to national security. While protectionist laws originally were enacted to preserve critical industrial or technological capabilities, they are now used as a means to advance constituent-based priorities. This, in turn, leads to the entrenchment of these laws and an inability to adapt to changing circumstances. Nonetheless, constituent anxieties over globalization are real and will continue to be a key consideration in managing domestic security and defense capabilities. One of the effects of globalization has been an increase in political sensitivity when foreign products are purchased with U.S. tax dollars. Consequently, procurement managers and contractors may experience significant pressure to shy away from the 'not made here' label when considering sources for specific products.

However, the controversy over a foreign supplier's withhold of JDAM parts during a time of war highlights the real security risks that come with expanding the defense supply base throughout the world. As for the JDAM controversy, in reality, a workaround was quickly implemented. Also, it seems to be an isolated incident (the U.S. continued to receive military imports from both French and Russian companies, despite their respective governments' objection to the invasion of Iraq) in which an individual Swiss company was asserting its private political or moral views. Although such incidents area rare, a changing geopolitical landscape or deterioration in U.S. international standing could result in more frequent official and unofficial sanctions on military related exports to the U.S. In order to continue to leverage the global market the U.S. should have a robust capability to avoid or adapt to disruptions.

One of the effects of the rapid pace of globalization has been the increased integration of foreign content into defense products at all tiers of the supply chain. This has led to a troubling lack of awareness as to the degree and nature of foreign dependency in many defense systems.

A 2006 report from the National Academy of Sciences on critical technology accessibility suggests that adequate information on foreign content in defense products is not currently available to the government or prime contractors since this data is not systematically required by contractual agreements.[8] From the Berry Amendment debate it is apparent that, even when 100% accountability of a products pedigree is the law, the level of uncertainty as to the degree of foreign content can be significant and presents a potential security challenge. As subcontracts are awarded for production of defense system components, the upper tier obligations, such as Berry Amendment clauses, are washed out. Middle to lower tier contractors in many cases are not obliged to track content in their agreements with their parent contractors despite the regulatory and statutory requirements.[9]

The lack of awareness leaves the U.S. unable to assess its level of dependency on foreign providers and prevents the preclusion of future disruption. This security rist can be compounded if the U.S. looses specific domestic industrial capabilities widely available in the global market. If not prepared, the U.S. will likely be caught by surprise, as was the case with the Swiss JDAM parts, more often than not.

Rather than tracking foreign content details for the purpose of demonstrating compliance with rigid domestic source restrictions, it may be a more productive and flexible approach to develop a detailed understanding of foreign supply chains for the purpose of managing the risks of disruptions. The need for better supply chain transparency was corroborated during a 2006 GAO forum on managing the DOD supplier base Participants voiced the concern that there is a “lack of visibility” into defense system supply chains that complicates efforts to maintain a robust global supplier base. They suggested that DOD improve its efforts to collect data on the lower tiers of the defense supply chain.[10]

This general lack of supply chain transparency also makes it difficult to adjust to rapid market shifts such as is an ongoing concern with the semiconductor industry. The 2003 white paper, "National Security Aspects of the Global Migration of the U.S. Semiconductor Industry," by Senator Joseph Lieberman explains that the "center of gravity" of the semiconductor industry, driven by the forces of globalization, is migrating from the U.S. to Asia (specifically, China) [11] The significant security concerns seemed lost on DOD and other federal agencies until Congress pressed the issue.

DOD reacted by creating the Trusted Foundry Program under which IBM was awarded a $600M contract to build a chip foundry in Vermont to meet defense needs. While this may alleviate some risk in the short term, a DOD subsidized foundry for electronic components bears the risks of increased cost and stagnating technological innovation. Rather than a subsidy fix, the U.S. needs " a long term national strategy to reverse the offshore trend [in the semiconductor manufacturing base]," stated Thomas Hartwick, chairman of a DOD electronic devices advisory panel in a testimony to the House Small Businesses Committee in October of 2003.[12]

The challenge, therefore, is to institute changes that effectively manage and balance both the political and security risks of using foreign sources in national security related goods and services. In order to do that, constituent-based anxiety with respect to globalization must be answered with a robust capability to avoid source disruptions. In addition trends in the migration of critical industrial capability must be monitored. This will require clear national level priorities concerning strategic industries and technologies as well changes to improve supply chain transparency and management.

2. Dual-Use Goods and the Global Market

The "dual-use effect" is the result of widespread application of military technology for commercial use (spin-off) or the application of commercial technology for military use (spin-on). In both cases, the result of this effect is that the defense market eventually becomes dependent on a much larger commercial market. Increasingly intricate military systems result from the integration of a whole range of technologies, many of which are

supplied by the commercial sector. In many cases, commercial applications of defense focused technologies soon dominate the market. The Global Positioning System (GPS) is a perfect example of this.

Initially developed and deployed to provide world wide precise navigation capabilities to the armed forces, the commercial applications of GPS have grown exponentially. The large size of the commercial market provides significant cost and quality advantages. The commercial sector of the GPS market is expected to exceed $30 billion by 2008,[13] while the average unit cost of receivers is decreasing at a rate of 30% per year.[14] This commercialization phenomenon, however, can greatly increase the complexity and uncertainty of supply chains and often results in dependencies on commercial markets over which the government has little influence. While many dual-use technology companies welcome government business, they focus on the larger commercial market. In this situation, rigid domestic source restrictions on key dual-use technologies are often at odds with efforts of federal procurement managers to achieve cost reductions without compromising quality. The Air Force faced this very issue in 2004 with respect to their commercial derivative aircraft programs.

In 2004, the Air Force Secretary approved a permanent, broad based, Berry Amendment waiver for 23 commercial derivative aircraft systems that drew sharp scrutiny from Congress. In response to the waiver, Rep. Hunter, HASC chairman, tasked the Government Accountability Office (GAO) to investigate whether or not the Air Force followed established policy when evaluating the requirements for the waiver from Berry Amendment restrictions.

The problem the Air Force faced was that some of its manufacturers – most notably Boeing – could not easily comply (meaning it would be cost prohibitive) with the Berry Amendment specialty metal requirements for commercially derived military aircraft. Titanium, for example, was a huge problem. The light weight, high strength material is widely used in aerospace applications and is available from both American and foreign suppliers. DOD had long leveraged commercial derivations for military aircraft applications to achieve cost benefits; supply chains that fed into commercial derivative manufacturing

lines, however, did not distinguish among U.S. produced metals and foreign sourced metals down to each individual component at each tier in the supply chain.

GAO's study, completed in September 2005, found that the Air Force did not conduct sufficient market research to determine if adequate substitutes were available from domestic sources.[15] The GAO also found a number of contracts that lacked the clause that implements the Amendment's specialty metal restrictions. Clearly, the Air Force's desire to obtain cost and quality benefits by leveraging commercial product lines was bumping up against the rigid source restrictions contained in the Berry Amendment. Short of incurring huge additional costs, the Air Force had no ability to compel Boeing to adapt its manufacturing operations in order to comply with the 100% domestic content requirements for certain materials.

The Aerospace Industries Association (AIA), a consortium of aerospace and defense contractors, points out that DOD's relatively small share of the global specialty metals market renders protectionist policies irrelevant, and thus a more balanced approach to protecting the industrial base is necessary.[16] In its early days, government support and guaranteed military contracts were certainly essential to nurturing the industrial base for titanium since the defense sector dominated the market. Commercial aviation and other applications for titanium, however, now dominate the market. The defense market share for titanium was just 14% in 2005, and is expected to shrink to 11% by 2015.[17] Like GPS technology, market dominance has even begun to shift from aerospace (military and commercial) to industrial and consumer applications such as heat exchangers and sports products.[18] This promises to marginalize the government market even further. Additionally, AIA suggests that despite lapses in Berry Amendment compliance the domestic specialty metals industry is currently quite healthy and globally competitive in the commercial market.

In contrast, the Specialty Steel Industry of North America (SSINA) emphasizes that the need for protection is to counter the unfair global trading environment, despite the current commercial success of a particular industry.[19] In a letter to the White House from its chairman, Jack W. Schilling, SSINA attached a detailed report titled "Specialty Metals and National Defense." The report touts the specialty metals provisions in the Berry

Amendment and DOD's recent focus on stricter enforcement of these provisions as an affirmation of the strategic importance of the statute in helping assure the industry's long term survival.[20] A key thesis of the SSINA report is that domestic industry survival in critical dual-use sectors require strong incentives for companies to invest in the U.S.; incentives are needed that are comparable to the enticements to invest overseas. "[The] only meaningful way to influence this situation," the report explains, "is for the U.S. government to make sure the playing field is at least level with regard to factors influencing investment. And that is not being done."

Moreover, SSINA warns that atrophy of the manufacturing base would cause the loss of America's technological lead, asserting that "our factories are our laboratories." The implication is that a 'warm' manufacturing base is essential to support research and development work and to provide a base for innovation. This base would necessarily follow the manufacturing base as it migrated outside U.S. borders due the better business opportunities in foreign countries.[21] Thus, from SSINA perspective, strict protection of a strategic industry is necessary to ensure continued innovation. It also serves as a counter to the unfair competitive advantage that globalization has afforded several foreign economies.

Yet, it is not clear that protectionism has resulted in a more secure situation for the specialty metals industry. Titanium provides a good example. Despite Berry Amendment protection, the number of domestic producers of titanium sponge – the product of titanium ore refinement – went from three to one between 1990 and 2003 with a 70% reduction in capacity.[22] The domestic industry was reacting to a general slowdown in the global market. As the market improved in 2005, the price of titanium increased by 317% driven by increasing demand from China, India, and the commercial aerospace sectors. The recent spike in demand has led to increased cost and delivery delays on titanium products, including defense systems.[23] Berry Amendment protection ends up further restricting supply sources for defense production lines and aggravates an already tight market. National security interests are, thereby, negatively affected by increased upward pressure on unit costs and more frequent schedule delays.

U.S. titanium producers react to tight markets by bringing latent production capacity back on line after it was reduced in the last market downturn.[24] Consequently, while protection may serve to keep industrial capabilities simmering during unfavorable market conditions, it also seems to motivate a business model that depends on modulating productive capacity to take advantage of high prices. This model achieves substantial profits in undersupplied markets and then falls back on guaranteed government business when demand slows. Defense programs are left to ride the boom and bust cycle driven by commercial demand. This adds considerable uncertainty to program costs and increases overall program risk.

The growing importance of dual-use technologies, such as specialty-metals, to national security and defense poses another important globalization challenge for the U.S. industrial and technology enterprise. Government influence over the economics of particular technology markets, despite their strategic importance, is often small in comparison to the influence of the corresponding commercial markets. In this environment, dependence on protectionist policies alone may lead to negative cost and schedule impacts for federal programs. Rigid domestic source restrictions can aggravate supply and demand imbalances in tight markets. They can also deter defense programs from leveraging commercial products to meet military requirements because the source restrictions are difficult to enforce and incur added cost and schedule to achieve compliance. In some cases, key companies may become somewhat isolated from competition and, therefore, lack the motivation to invest in innovation. From a national security perspective, the problem reduces to one of selecting the policies and processes that can adapt to the market by allowing for the modulation of government intervention. A reformed process must facilitate early recognition of, and action on, unfavorable market conditions for critical technologies or industrial services. At the same time, however, any reform should provide federal programs the flexibility to extract maximum benefit from the global commercial technology while helping sovereign industry to remain commercially competitive.

3. Poor Performance and Micro-Management

In 2006, mounting political pressure from Congress and the uncertain state of DOD compliance with the Berry Amendment motivated DOD's acquisition leadership to take

action. The Defense Contract Management Agency (DCMA) and the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD-ATL) issued a series of directive memos clarifying DOD's policy regarding enforcement of domestic source restrictions. Acquisition program managers and contracting officers were now explicitly required to address compliance with the Berry Amendment prior to contract award.

Before DOD's clarification, many programs believed they were in compliance with the spirit of the amendment and operated under the assumption that the statute did not apply to many commercial items. The sudden requirement to comply wit specified standards raised problems, and a number of acquisition programs faced significant schedule delays and additional costs.[25] This situation resulted in a backlash from elements in DOD and the defense industry, not only against the new enforcement guidelines, but against the validity and practicality of strict protectionist laws in general.

In fact, DOD's failure to effectively manage Berry Amendment compliance and its subsequent efforts to correct that failure elicited strong responses from both sides of the argument. While protectionist elements in Congress saw it as another reason to strengthen buy America legislation, industry advocates from both sides of the issue point out the existing law is overly prescriptive and, therefore, not adaptable to a global dynamic economy.

One such argument against the current restrictions and enforcement policy focuses on the practicality of meeting the 100% domestic specialty metal requirement at all tiers of the supply chain.[26] As retired General John Douglass, President and CEO of AIA, put it in round table discussion on the Berry Amendment, "…our best estimate is that [AIA companies] buy about 99.9% of our specialty metals that go into DOD from domestic suppliers…Our problem is that the legal wording implies that 100%, not 99.9%, of the specialty metals for defense should be domestically produced. It's getting that last 0.1%, which finds its way into our systems in the form of nuts and bolts and screws and very small things – which are widely available in the commercial marketplace – that is the issue."[27]

Even when Congress intends to improve the flexibility of legislation, they risk creating legal quagmires that can negatively impact the performance of government

programs. Specialty metal industry advocates see these types of problems arising from certain proposed modifications to the Berry Amendment, such as exceptions for commercial items and the use of a market basket approach.[28] With these changes, they argue that the complexity of global supply chains would make it extremely difficult to practically and legally enforce the domestic specialty metal content restrictions. Larry Lasoff, who serves as counsel for the specialty steel industry, summed up the concern during the AIA round table discussion as follows:

> "With respect to the bigger issues of the market basket and commercial items exception, I believe the current language being proposed on its face is very sound. But if you put on a lawyer's hat, you see a bureaucracy created at every level of the contract chain. Who is going to determine whether or not their particular item is commercial, whether it meets the 5% test? Who's going to determine whether or not there's a 40% test with respect to market basket? Is only the prime going to do that? Is each subcontractor who buys metals?"[29]

So describes the dilemma that the government-industry complex faces in attempting to implement a balanced policy based on prescriptive statutes that strive to preserve vital sovereign industrial capabilities but that also struggle to provide the flexibility to leverage the efficiencies of the (global) commercial market place. As Mr. Lasoff points out, striking this balance for titanium or other specialty metals is not trivial within the framework of the Berry Amendment. This suggests a need for a more flexible approach to managing critical industries and technologies in a global economy where change occurs well inside the decisions cycles of the legislative process.

In order to provide flexibility, the Berry Amendment has exceptions that apply to trade with *qualified countries*.[30] However, the rules for U.S. companies are effectively much stricter than for companies from those qualifying countries. Under the current law, the Air Force can buy tankers made with 100% foreign sourced titanium from Airbus, a European company, with no questions asked. While Boeing, on the other hand, would be compelled to use only U.S. titanium or go through a potentially complicated and expensive process of building a case to justify a waiver. A number of Berry Amendment critics believe this has the

unintended consequence of migrating business, industrial capacity, and defense industry jobs to our allies. Even proponents of the Berry Amendment would like to see modifications that put U.S. companies in a more equitable position relative to qualified countries.

The most recent changes to specialty metal source restrictions became law with the passage of the 2007 NDAA. The modifications provided some near term relief for acquisition programs with stalled contracts. More importantly, they entailed structural changes to the law that increased Congressional influence into the management of strategic materials. The act engrafts specialty metal restrictions under a new separate section of the U.S. Code: *Requirement to buy strategic materials critical to national security from American sources.* This change, together with the establishment of the Strategic Materials Protection Board within DOD, provides Congress with a formidable mechanism to manage future industrial policy via statute and exert political pressure on high ranking DOD political appointees. In addition, the NDAA requires that regulations are rewritten to establish definitions for new guiding terms found in the modified law. Achieving broad consensus among Congress, DOD, and industry on these definitions will likely be difficult. The potential for future controversy over the specialty metal restrictions looms large.

To many defense industry advocates the current Berry Amendment flap is just another indicator that prescriptive or complex legislation is not suited for the current global environment. They argue that Congress maintain protectionist policies even though they want DOD to have access to the best commercial technology. The tendency is to add exceptions to the rules that end up increasing complexity and often have unintended consequences. This dynamic is not optimal and can negatively impact program performance and, as a result, national security.

The challenge, accordingly, is to develop a system that clearly delineates accountability within federal agencies for industrial and technology base matters but also strengthens Congress's ability to exercise oversight. This would reduce legislator's propensity to support overly prescriptive statutes as a hedge against the poor performance of executive branch bureaucracies. A reformed approach would see greater emphasis on Congress's role in establishing broad strategic goals for the industrial and technology base but would depend

on robust oversight rather than prescriptive legislation to ensure that the appropriate federal agencies are held responsible for achieving those goals.

4. Identifying Strategically Critical Materials, Technologies, and Industries

The 2007 NDAA codifies specialty metal restrictions under a separate subsection dealing with the protection of strategic materials.[31] The U.S. government, however, lacks an adequate organization and a strong process for developing consensus and clearly identifying critical materials, technologies, and industrial capabilities.

The process by which the U.S. creates, communicates, and implements critical technology and industrial capability policy is diffused among a number of government agencies. This diffusion of responsibility results in a significant degree of uncertainty within the federal acquisition community and national security related industries with regard to strategic priorities. This uncertainty in turn leads to an emphasis on parochial concerns at the program level of the industrial enterprise to the detriment of focus on real strategic deficiencies. "The development of a governmental effort to facilitate technological advance has been particularly difficult because of the absence of consensus on the need for an articulated policy…," concludes a 2005 Congressional Research Service report.[32] Consequently, a policy vacuum exists that is frequently filled by Congressional action based on constituent priorities rather than national security concerns.

The shear number of processes and bureaucratic entities in the U.S. Government that strive to understand, document, and protect critical technologies and their industrial base highlights the diffused nature of the process. Studies, reports, and lists generated by this scattered system are often informative and useful when taken individually, but when considered in aggregate one could easily conclude that just about everything is critical and must be protected. Once again, this makes it difficult for acquisition managers, industry, and Congress to develop a consensus about what is strategically important.

The use of the Military Critical Technology List (MCTL) provides evidence of the existing problems. The MCTL is maintained by the Office of International Technology Security's Military Critical Technologies Program (MCTP), which falls under the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD-ATL). The MCTL is

intended to provide overarching guidance for counter intelligence activities, research plans, and technology protection programs as well as export control decisions. But, as GAO concluded in a July 2006 report, the MCTL is rarely used to inform export decisions or other DOD technology and industrial base policy decisions because it is too broad and mostly out of date. Other DOD agencies have developed their own lists and databases to deal with parochial technology and security issues ranging from anti-tamper efforts to identifying international cooperative opportunities for research.[33] The weakness of the MCTP and the history of a lack of confidence in the MCTL[34] highlight the ad hoc and disjointed nature by which the U.S. Government formulates industrial and technology policy. There is clearly a lack of synergy in developing a common understanding of what technologies, materials, and industrial capabilities are critical to national security and are also at risk of diminishing accessibility.

A 1999 study on security implications of globalization recognized the broad, but largely diffuse and uncoordinated effort to understand the state of globally available military technologies. The study calls for an interagency effort to establish and maintain a real-time data base of militarily relevant technologies and capabilities available on the domestic and international market. This database would be used to aid in informing decisions on export control, domestic industry protection, and technology classification.[35] More recently, the GAO identified the lack of integration of federal efforts to identify and protect critical technology as a high risk area for the nation.[36] A January 2007 update to its "High Risk Series" report states:

> The U.S. government has a myriad of laws, regulations, policies, and processes intended to identify and protect critical technologies so they can be transferred to foreign parties in a manner consistent with U.S. interests. The government's technology protection programs include those that regulate U.S. defense-related exports and investigate proposed foreign acquisitions of U.S. national security-related companies…Responsibility for administering or overseeing the different programs is divided among multiple federal agencies and several congressional committees. However, in the decades since these programs were put in place, significant forces have heightened the U.S. government's challenge of weighing security concerns with the desire to reap

economic benefits. Most notably, in the aftermath of the September 2001 terrorist attacks, the threats facing the nation have been redefined. In addition, the economy has become increasingly globalized as countries open their markets and the pace of technological innovation has quickened worldwide. Government programs established decades ago to protect critical technologies are ill-equipped to weigh competing U.S. interests as these forces continue to evolve in the 21st century. Accordingly, we are designating the effective identification and protection of critical technologies as a government wide high-risk area, which warrants a strategic re-examination of existing programs to identify needed changes and ensure the advancement of U.S. interests.

Like other complex national security problems, sustaining a robust technology and industrial base will depend on the effectiveness of the interagency process and its ability to identify priorities with the goal of optimizing national security outcomes. The U.S. Government must, therefore, migrate from the current diffused and ad-hoc approach to an integrated and agile approach in formulating and implementing its of technology and industrial policy.

Adapting to the Challenges of Globalization

The preceding analysis of buy America policies identified four core globalization issues that are challenging America's industrial and technological leadership. This section puts forth recommendations for bureaucratic reforms by extracting the common threads and considering the essential stakeholder concerns embedded in these issues. Based on the common themes garnered from the analysis of each issue, specific recommendations for reform are made within the framework of the following three principles for industrial and technological adaptability in a global free market economy:

- Improve proactive management of the risks that come with global sourcing.
- Provide increased resources and develop organizations to more effectively foster innovation, especially in the dual-use technology sector.
- Improve integration of industrial and technology policy at the interagency level as a component of national security policy and planning.

In short, the first two principles are about becoming more adaptable, in the near term and the long term, to the competition and risk that come with globalization. Becoming more adaptive entails striking a balance between embracing the advantages of the free market and government actions to protect national security and defense interests. The balance point is a constantly moving target that is "pushed and pulled" by competing interests, including technology proliferation concerns, socio-economic benefits, program costs and schedule, diplomatic impact, and constituent concerns. Hence, to successfully meet these challenges, the U.S. government must address the third principle and provide focus to its technology and industrial policies through a balanced consideration of the interdisciplinary components of national power, i.e. economic, military, diplomatic, informational power.

Within this framework of principles, six reform recommendations are proposed:

1. Establish an interagency directorate to integrate and coordinate national industrial and technology policy and policy implementation processes.
2. Establish a forum and system for industrial and technology base knowledge aggregation to help guide policy, serve as a common information resource for the enterprise at large, and to support identification of national industrial and technology priorities.
3. Deliberately decentralize accountability for supply chain assurance to federal procurement and acquisition program managers and provide them the resources and tools to properly manage global supply chain risk.
4. Strengthen Defense Production Act (DPA) programs so that DPA authority can be applied more proactively and for greater strategic effect.
5. Reverse the trend in government funding of national security related Research and Development (R&D).
6. Improve government-industry collaboration by expanding the use of consortiums organized around industrial and technology capability portfolios.

1. Establish an Interagency Directorate for Industry, Science and Technology

When addressing issues of national security, sound policy starts with proper integration of the elements of national power. Defense industry and technology are national security issues. Like other national security concerns, defense industrial and technology policy can not be approached as being merely an aspect of military power and must be formulated by taking into account the interactions among all elements of national power.

Congressional Researcher Wendy H. Schacht concludes in a 2005 report that the diffusion of responsibility on technology and industrial issues may sometimes "result in actions which, if not at cross purposes, may not have accounted for the impact of policies or practices in one area on other parts of the process."[37]

The current lack of fusion and clarity amounts to a weak foundation with which to balance the constituent dominated priorities coming from Congress. DOD and other agencies are resigned to applying ad hoc solutions to pressing industrial base problems while its procurement agencies and defense suppliers wade through a swamp of "static lists [of technologies and materials] that are retrospective in nature"[38] in order comply with a disjointed industrial and technology policy such as enigmatic export control laws and inflexible buy America restrictions. Lack of clarity in national objectives also discourages industry from devoting more resources and engaging in more long-term planning with regard to research and development (R&D) investment.[39]

Historically, the U.S. government has attempted to institute a national level approach to forming technology and industrial policy. Yet, it has thus far failed to establish an effective process or bestow the requisite authority required to integrate dispersed, multi-disciplinary knowledge into a coherent policy making and coordinating apparatus that specifically strives to optimize national security outcomes.

Past efforts to formulate policy and advice in an interagency, cabinet-level forum are the National Security Resources Board (NSRB) and the National Science and Technology Council (NSTC). The NSRB, now defunct, was created as a cabinet level body through the National Security Act of 1947, but proved to be largely ineffective due to a diffusion of authority among its board members. Its mandate was to conduct strategic planning to ensure the U.S. was adequately prepared for industrial and economic mobilization. Though there were attempts at reform, its functions were eventually absorbed by DOD. [40]

The NSTC was created during the Clinton administration by executive order as a cabinet level organization that would be responsible for coordinating science and technology policy in order to focus the national research and development enterprise. Though the original vision for the organization is commendable, today's complex and competitive globalized world requires the role of the NSTC to be expanded. The council brings together a broad range of interagency expertise and interests to focus on cutting edge technologies and provides R&D strategies for these technologies. There is scant evidence, however, that the council's work substantially influences the activities of industry and government beyond providing a catalyst for discrete R&D investments.

Additional integration at the national level is needed to put more rationality and flexibility into how the U.S. manages access to vital industrial capabilities. In short, a national level authoritative body is needed to guide processes that protect technological knowledge, manage foreign dependencies, and initiate industrial base development or support in specific areas. Most importantly, the core objective of any integration effort must be a balance between national security and the benefits of a global competitive market.

Congress and the Administration should create an interagency and interdisciplinary directorate, notionally re-titled the Director National Industry, Science, and Technology (DNIST). Based on the existing NSTC, the DNIST's core mission would be to provide forward looking strategic guidance and assessments on critical materials, technologies, and industries, and their respective global markets. The organization would no longer simply be a presidential advisory council, but would function as a national authoritative body and have the statutory responsibilities to facilitate interagency coordination. With this responsibility, the new directorate would need formally established lines of accountability from the relevant agencies distributed throughout the federal departments, such as USD-ATL at Defense and BIS at Commerce.

The directorate must be insulated from political pressure to the greatest extent possible. It should be led by a director appointed by the President and confirmed by the Senate for a term length well outside electoral cycles. The body should be interdisciplinary in make up (including scientists, engineers, economists, foreign service professionals, business and financial professionals, etc.) and maintain a high degree of independence in its decision making much the same way the Federal Reserve Board does with respect to monetary policy. Notionally, the DNIST would be endowed with the interagency authority and responsibility similar to that envisioned for the Director National Intelligence (DNI).

The policy products generated by this body should not be overly prescriptive. Rather, they would compliment statutory and regulatory actions. In fact, the ideal situation would be for DNIST's products to provide the foundation to create a more flexible and more focused process for applying federal levers toward the strengthening of the technology and industrial base. Although Congress may be loath to relinquish influence over specific

materials, technologies, or industries, it could make up for this by compelling better interagency coordination through the DNIST. Congress would be able to leverage the integrated knowledge base and policy guidance that would grow from the improved coordination in the exercise its power of oversight and the purse. Congress would also be able to deflect toward the DNIST some of the political backlash from constituents that inevitably follows tough decisions on industrial base matters.

A strengthened interagency apparatus will provide more clarity on strategic priorities, better risk management with respect to global supply chains, and protection of technological knowledge. It will reduce uncertainty within government and industry and, therefore, motivate long term investment in innovation. Most importantly, a strong interagency process could improve the confidence level of Congress and reduce their tendency to be overly prescriptive in industrial and technology base related legislation.

2. Forum for Knowledge Aggregation

The greatest challenge and most important task for the proposed interagency industrial and technology directorate would be to establish and maintain functional relationships and information exchanges with a broad community of interest. To achieve this objective, the DNIST must implement and oversee a mechanism to tap the knowledge dispersed throughout government, industry, and academia. A potential model for this type of knowledge fusion is the DNI initiative in creating *Intellipedia* based on the popular online and open source encyclopedia, *Wikipedia.* Accessing and integrating this dispersed knowledge would help to better inform judgments and would reduce the risk of making poor decisions regarding industrial and technology policy.

Knowledge aggregation would directly support development of integrated policy and information products. These products could include identification of critical technologies and materials, assessment of competitiveness in key areas, prioritization of targets for R&D investment, future skill requirements for industry, and strategic assessments of commercial markets, such as descriptions of trends in geographic concentrations of technology suppliers. Just as important, the knowledge base would be a resource for the wider community .

If properly designed, a knowledge aggregation system will provide a common understanding of 'ground truth' that would serve as a basis for facilitating better collaboration among Congress and federal agencies. It would serve as a key enabler for identifying common risks and common focus areas for innovation. Finally, a well functioning knowledge aggregation capability will improve collective decision making, reduce bureaucratic stovepipes, and deter parochial tendencies.

3. Global Supply Chain Risk Management

Defense and commercial sectors have become increasingly integrated at the lower tiers of the supply chain. IN addition, the industries that support these sub-prime suppliers are ever more likely to be under foreign influence or control. Therefore, the U.S. should develop better tools and methods to understand the international structure of defense and national security supply chains. By reducing supply chain uncertainty and increasing the understanding of underlying markets and their players, the U.S. can better manage overall security risk in the global economy. A more cohesive national industrial and technology policy will undoubtedly help in this pursuit, and Congress should work with DOD and other agencies to establish a standard method for assessing supply chain risk for national security systems. While defining federal standards, the government must decentralize supply chain management and endow procurement program executives and managers more authority and adequate resources to manage supply chain risk. At the same time, the government must hold them accountable for supply disruptions or excessive risk taking.

Supply chain risk management must be considered at the very start of programs and become a core tenant of systems management. At the program level, there must be more emphasis on developing acquisition strategies that are designed to promote supplier diversification. Decisions taken in the early stages of an acquisition program could be compared to a comprehensive knowledge base containing information on supply sources and assessments of the global supply chain that supports a particular material or technology. Alternative sources could then be pursued if it is determined that too much risk would be assumed by depending on a single source or single geographic concentration of industrial capability.

Supply Assurance would maintain detailed information of supply sources through the lowest tiers of the chain. Contractors require, to the greatest extent practical, the flexibility to leverage the open market to obtain materials and technologies. But they and federal procurement agencies must be held accountable to manage the risks entailed in doing this. Detailed supply chain awareness, however, would not require the capability to identify the exact percentages of foreign content for each and every component of a system. Rather, it would involve a certain level of disclosure from contractors and suppliers down through the supply chain that would identify manufacturing sources down to the lowest level of components and materials. Each national security related system should have a geographic supply chain map that provides a snap shot of that system's global dependency.

A picture of geographic global dependency must be complimented with knowledge of risk factors in order quantify overall risk. Global supply chain risk factors could include the following:

- High market supplier geographic concentrations combined with political or geopolitical instability.
- Activity of competitor nations in their efforts to secure access to and dominate specific markets, suppliers, technical expertise, and advanced materials.
- Market suppliers from politically unfriendly nations
- Market suppliers that act based on political agendas not necessarily influenced by host nation government
- Market suppliers in nations with weak financial institutions.
- In cases where sensitive technology is an issue, market suppliers that are vulnerable to compromise or are likely to facilitate illicit transfer of information.

4. Strengthen the Defense Production Act (DPA)

There is a general disconnect between the various government assessments designed to identify critical industrial and technological needs and applications. This is particularly true for the Defense Production Act (DPA), one of the government's most potent industrial base tools. DPA provides broad authority to incentivise or compel domestic industry to meet priority defense needs. Today, however, DPA programs are more reactive than proactive and too often, there is already a critical shortage that has resulted in a real world operational or tactical deficiency.

Title III under the DPA provides the President with the power to use financial incentives to expand industrial capability. The Title III program operates by identifying and coordinating projects that focus on specific technological and industrial needs relevant to national security. DPA Title III program officials, while they may be aware of forward looking industrial base and critical technology studies from other government agencies, essentially respond to whatever program is willing to provide funding. In fact, the program receives a large percentage of its funding for projects via Congressional add-ons. Concentration on critical industrial base issues, therefore, may get somewhat diluted by constituent based concerns, leading to a less than optimal national security results. Consequently, improving the strategic and proactive use of DPA authority should be top priority.

Reauthorization of the DPA is due at the end of fiscal year 2008. As part of the reauthorization, Congress and DOD should work to establish an Industrial Base Priorities account that would provide a direct funding source for DPA Title III programs. This would stabilize funding for long term investment in strategically important industrial and technology sectors.

Forward looking application of DPA authority and its dedicated resources must go hand in hand with improved knowledge resulting from interagency strategic planning on industrial and technology matters. To accomplish this, budget authority for the Industrial Priorities Account should be vested in the DNIST (or comparable interagency organization).

This would establish the necessary connectivity between the interagency process and allocation of resources toward priorities established by that process.

These innovations would alleviate legislative intrusion into the details of industrial and technology base management, while giving Congress a powerful appropriations vehicle to directly influence the process at the strategic level. Additionally, using the DPA as a mechanism to couple the DNIST to specific budget authority would provide that body additional bureaucratic influence that it would require to be effective over the long term.

5. Security Related Research and Development (R&D)

Protecting the U.S. defense industrial base from competition has been the strategic logic behind buy America policies for over 60 years. The reality is, however, that the defense industrial base is becoming a less competitive sector of the economy and this could have severe impacts on innovation. To counter this trend, it is recommended that Congress, DOD, and industry intensify their focus on competitiveness, especially in the dual-use technology sector of the defense industrial base. With the upper tier of the industry dominated by entrenched systems integrators, the U.S. must tap the reservoir of innovative energies at the sub-prime level where military and commercial technology most frequently overlap and where there is greater potential for emerging companies to participate.

Basic and applied research are essential to building new knowledge and maintaining the foundations for innovation. The government's role in this area is crucial. Nevertheless, federal research investments are decreasing relative to overall U.S. economy while other countries are significantly increasing funding. The federal research funding to GDP ratio has decreased to a projected 0.38% in the 2008 budget proposal, below the historical average of 0.4%.[41] Overall defense R&D, while being essentially flat over the past three years, would decrease in 2008. Of more concern is that an ever smaller share of the defense R&D dollars is going to basic and applied research programs. It is basic and applied research, as opposed to development, that is recognized as being most effective at generating new knowledge that serves as the basis for innovation.[42] The U.S must reverse this trend in R&D spending and

increase R&D budgets substantially in order to keep pace with competing foreign economies.

The consolidation of the defense industry has resulted in the migration of the center of gravity for innovation to small businesses and universities. The government's role in stimulating innovation, therefore, is all the more important Large businesses tend to be less vertically integrated and more specialized, resulting in the reduction or elimination of their basic and applied research programs.[43] Thus, the government must make a specific commitment to apply R&D resources toward expanding the dual-use technology base that is found at the sub-prime level. Achieving and maintaining competitiveness at this level should be a core tenant of America's industrial and technology strategy. The dual-use segment of the industrial base is impacted the most by globalization and it is difficult to reap sustainable benefits from an over reliance on protectionist policies in this sector.

A good vehicle to expand R&D resources for the dual-use industrial base is DOD's portfolio of technology transition programs. These programs tend to favor small businesses and research centers that serve the sub-prime market where commercial and military opportunities most frequently overlap.

The primary goal of DOD technology transition programs, necessarily, is to quickly get technological capability to mainstream defense acquisition programs and ultimately to the warfighter. Secondarily, these programs also attempt to facilitate collaboration with the private sector in order to identify opportunities to expand commercial applications. These programs, however, are challenged by the wide variety of technological requirements established a wide range of organizations within DOD.[44] Consequently, programs such as TechLink and the Dual-use Science and Technology (DUST) Program, which focus on expanding commercial technology in the interest of military needs, compete for a piece of what is already a small R&D budget [45] Only one half of one percent of DOD's annual R&D budget goes to programs like DUST.[46] A substantial shift in allocation of R&D resources to dual-use technology transition efforts is sorely needed.

Expansion into higher volume commercial markets could have the effect of greatly broadening the industrial base for key dual-use technologies. A 2006 report from the Industrial College of the Armed Forces (ICAF) on strategic materials states, "[the] government's principal roles in advanced materials markets will revolve around developing strategic materials that lack a viable commercial market. However, creating a supportive environment for commercial transition of these advanced materials can significantly improve their strategic value to the nation."[47] Moreover, expanded commercial application could facilitate access to the manufacturing ingenuity of high volume industries, thus accelerating the pace of innovation.[48]

The U.S. government clearly advocates innovation, but has been inconsistent in its attempts at facilitating it. The entrenchment of protectionist policies is on part of the problem, but the government's waning support for R&D and a weak commitment to innovation programs adds to the challenge, particularly with respect to dual-use technology. Achieving an adaptable industrial and technology base demands that this trend be reversed.

6. Improve Government-Industry Cooperation

In addition to increasing the resources for dual-use technologies, the government's technology transition efforts should include the expansion in the use of collaborative industry forums. These forums would scrutinize and prioritize technology projects for funding across specific industrial sectors or technology portfolios. They could facilitate resource consolidation across government and industry, reduce redundancy and improve program stability. This would mitigate technology transition risks and greatly enhance a strategy of innovation toward commercialization.

A model for these collaborative industry forums can be found in the specialty metals industry that has been so central to the recent buy America debate. The Metals Affordability Initiative (MAI) is a government and industry consortium addresses industrial and technology base issues. On the industry side, the consortium includes a cross-section of the aerospace supply chain that range from primary metals producers to leading system integrators. In coordination with the Air Force Research Laboratory's DUST program, the

consortium identifies technology projects that are targeted at improving cost and performance of advanced metals. These potential projects are reviewed, prioritized, and selected for funding through close collaboration among industry and government teams. Government funding is complimented by private sector funding from the consortium's industrial members.

This type of collaboration enhances innovation efforts in two important ways. First, it provides a forum for exchange of technical information and provides the government sustained access to industry experts. The structure of the forum also puts sub-prime suppliers in a more equitable position to exchange ideas with prime contractors. Second, it reduces the diffusion of limited R&D funding by allocating resources to prioritized projects that have gone through a vetting process that considers military applications, technical risk and commercial business potential. This improves the likelihood of successful transition of technologies to both military and commercial application.[49]

Expanding the use of formal government-industry collaborative programs will provide industry an alternative to Congress to voice ideas and concerns about international competition and protectionist policies. At the same time, these forums would provide another source of knowledge and expertise available to support Congress oversight of federal industrial and technology efforts. In the same vein, technology specific consortiums could also provide a natural policy implementation vehicle and source of knowledge forthe proposed interagency industrial and technology directorate.

Conclusion: Beyond the 'Buy America' Debate

The study of the ongoing debate over buy America policies and their relevance in a globalized economy has facilitated insight into the core issues that are challenging the long term viability of the U.S. national security industrial and technology base. The rapid changes brought on by the process of globalization demand a national industrial and technology policy that is much more adaptable than it is today.

The changing environment has made balancing the benefits of a global free market with the risks of foreign dependency much more difficult than in previous eras. Adding to the complexity of the overall challenge is the restructuring of the global defense industry over the past 15 years that has given rise to a reliance on dual-use technology and its commercial markets. Globalization has also placed scrutiny on the legislative role of Congress and constituent politics. Finally, the American bureaucracy that is supposed to lead the effort in dealing with the security challenges of globalization has demonstrated a lack of ability to effectively identify critical technologies and industrial capabilities. This has impacted America's ability to adapt to global competition

.

Moving toward a more adaptable system centers on three principles: management of global supply chain risk, strategic focus on innovation in the dual-use technology sector, and effective integration and interagency coordination with respect to industrial and technology policy.

Central to the overall reform must be the establishment of an interagency and interdisciplinary organization that has the statutory responsibility and authority to integrate industrial and technology policy and coordinate interagency policy implementation efforts. This includes a system that facilitates the aggregation of dispersed knowledge within the wider industrial and technology community.

Improved integration at the policy level must be complimented by deliberate decentralization of accountability for global supply chain risk management within the federal acquisition community. The complexities of global supply chains and the convergence of military and commercial technology are incompatible with centralized or ad hoc approaches to risk management. While held to be accountable, program executives and managers must be endowed with the requisite authority and resources to accomplish the task.

Additionally, competitiveness in a global economy requires a focus on innovation. Commitment to innovation must start with a sharp reversal in the trend that sees decreasing federal funding for R&D, particularly for basic and applied research. Increasing R&D funding must be accompanied by increasing the proportion of innovation resources directed

at programs that are designed to facilitate the competitiveness of the dual-use technology industrial base. Furthermore, expansion in the use of government-industry consortiums organized around technology portfolios is needed to improve collaboration. Improved government-industry collaboration with regard to planning and funding will not only help to properly target innovation resources at dual-use technology but also help to stabilize the availability of those resources.

Finally, strengthening programs that implement federal authority under the DPA will be essential to improving adaptability. DPA programs must be transformed from collection of ad hoc projects to a core vehicle for implementating U.S. industrial and technology policy. Congress should establish an Industrial Priorities Account as a direct and stable source of funding for DPA programs. In addition, DPA must be used more proactively and strategically. DPA projects should be clearly aligned with national level priorities. Toward this end, the DNIST should be provided budget authority over the Industrial Priorities Account. Budget authority would also provide DNIST with added bureaucratic clout necessary for it to be and effective organization. Finally, a strengthened DPA system will be a powerful programmatic vehicle that is uniquely suited to respond to both national level priorities as well as program specific supply chain or technology transition issues.

The above reforms are not intended to discount protectionist measures as being obsolete in a globalized economy. Quite the opposite is true. Targeted protection of critical technologies and industrial capabilities will be absolutely essential in the future. But, as the buy America debate reveals, the current bureaucratic apparatus and entrenchment of prescriptive protectionist legislation has dampened America's ability to adjust to the global market and adaptively protect and compete. The existing system has granted disproportionate weight to constituent based priorities and the parochial concerns of individual federal programs and agencies. In addition, decreasing government investment in R&D, at a time when a restructured defense industry has deferred a significant share of the risks of investment in innovation to the sub-prime level, has left a void that needs to be filled. Accordingly, the preceding recommendations are intended to break this pattern and achieve adaptability through key bureaucratic reforms. These reforms are intended optimize national security outcomes by improving the collective understanding of industrial and

technology priorities and risks, by facilitating collaboration within the government-industry enterprise, and by strengthening the commitment to innovation across the enterprise.

Appendix A: Background on Domestic Source Restrictions

Buy America policies date back to 1933 with the passage of the Buy America Act (BAA); the act imposes domestic preference requirements on all federal procurements. In basic terms, the law requires that "substantially all" of the costs of foreign components not exceed 50% of the cost of all components. What is known today as the Berry Amendment was first enacted in 1941 as part of the National Defense Appropriations Act just prior to U.S entry into World War II. In contrast to the BAA, this amendment only applies to DOD (then the War and Navy departments) procurements of specific items and materials, but requires those items to be of 100% domestic origin. That year's appropriations act included a number of specific restrictions on DOD purchases. Certain provisions of these restrictions that became the origins of the Berry Amendment were meant to ensure that U.S. troops wore military uniforms and were fed with food products produced exclusively within the United States. From this point forward the Berry Amendment would become a fixture in annual defense appropriations and authorization legislation, evolving along the way, and eventually being codified in 1993.

In 1952 South Dakota Congressman E.Y. Berry (the congressman's name was ultimately identified with amendment) introduced a change to DOD's procurement restrictions that extended the coverage of the original 1941 provision to include additional clothing, cotton and wool. This modification was included in the 1953 DOD Appropriations Act. Through the years, the amendment's coverage continued to be expanded. Silk was added in 1955, synthetic fabric in 1967, protective clothing in 1978, and tents in 1987. In 1973, the restriction on specialty metals was added. Then in 1992, the restrictions that had been accumulating over the years were written into United States Code as a note to 10 USC 241. The Amendment was later codified under its own section, 10 USC 2533, in 2001.

As of fiscal year 2006, the Berry Amendment prohibits using funds appropriated or otherwise made available to the DOD for the procurement of an item in the list below, if that item is not grown, reprocessed, reused, or produced in the United States. The items include:

- Food;
- Clothing;

- Tents, tarpaulins, or covers;
- Cotton and other natural fiber products, woven silk or woven silk blends, spun silk yarn for cartridge cloth, synthetic fabric or coated synthetic fabric, canvas products, or wool, or;
- Specialty metals, including stainless steel flatware;
- Hand or measuring tools.

The Berry Amendment does allow for several exceptions. In the case of specialty metals, DOD is allowed to procure from foreign sources when there is an agreement with a foreign government requiring the U.S. to make purchases to offset sale of American goods to that foreign government or in furtherance of agreements in which both governments have agreed to remove barriers to purchases of goods produced in the other country. However, the Berry Amendment has no general exception for the procurement of commercial items at any tier of the supply chain.

Additional buy America restrictions are also encoded into U.S. law under 10 USC 2534, "Miscellaneous limitations on the procurement of goods other than United States goods." This law allows procurement of certain items by the DOD, such as buses, anchor chain, ball bearings, and chemical weapons antidote, only if they come from the national technology and industrial base.[50]

Beyond codified domestic source restrictions there are a number of limitations that are continually renewed in annual appropriations and authorizations legislation. For example, carbon, alloy, and armor steel plates that were not melted or rolled in the United States are prohibited from purchase with appropriated funds under the most recent annual appropriation, the Fiscal Year 2007 Defense Appropriations Act. But this particular restriction was originally passed under the 1992 Defense Appropriations Act. Similarly, Defense Appropriations Acts have imposed domestic source restrictions on purchases ranging from vessel propellers to diesel engines to supercomputers.

Adding to the rules of the game are additional regulations that go beyond specific statutory restrictions. When DOD determines there is a deficiency in the industrial base that needs to be addressed it can impose source restrictions via its regulatory authority. Defense Federal Acquisition Regulation (DFARS) Part 225 consolidates rules governing foreign acquisition, including buy America restrictions derived from public law. DFARS Subpart

225.71 – Other Restrictions on Foreign Acquisitions – adds specific restrictions, beyond those required by statute, for the purchase of certain items in order to shore up the domestic industrial base in a particular sector. These regulatory restrictions have covered the purchase of items such as forgings (e.g., ship propulsion shafts and periscope tubes) and polyacrylonitrile (PAN) carbon fiber used in composites.

Hence, buy America restrictions on DOD purchases are imposed by a variety of laws and regulation, most of which are implemented through the DOD regulatory instrument for procurements, DFARS Part 225. These rules can be categorized as follows:

- Codified law that includes 10 USC 2533 (Berry Amendment), 10 USC 2534 (Miscellaneous limitations on the procurement of goods other than United States goods), and 41 USC 10 (The Buy America Act).
- Part of annually recurring legislation (e.g., DOD appropriations or authorization acts).
- Regulation beyond what is explicitly required by statute.

This body of restrictions has a significant impact on how the U.S. defense industry interacts with the global market. The specialty metals provision of the Berry Amendment proves particularly useful in studying this impact for the following reasons:

- Specialty metals can be viewed as both a strategic commodity and a high technology product, so industrial capability in this sector ranges from basic mining of natural resources to highly technical ore refinement and metal fabrication processes.
- Specialty metals can be characterized as dual-use with the commercial market generally being dominant over the defense market.
- Specialty metals and advanced materials are generally injected into the lower and middle tiers of the supply chain and provide the basis for the advanced performance of many high technology systems.
- Titanium and other specialty metals are ubiquitous in defense systems, so the supply and demand dynamics in the specialty metal markets have a large impact on the cost and schedule of many defense acquisition programs.
- The 100% domestic source requirement is effective at magnifying the complexities that businesses and government face in maintaining awareness

of their supply chains and in complying with strict regulation in the very competitive and dynamic environment that characterizes the globalization phenomena.

For these reasons the growing buy America debate and the Berry Amendment controversy in particular provide an ideal filter through which to analyze the broader challenges posed by economic globalization on the long term vitality and primacy of the U.S. defense (and national security) industrial and technology base.

Appendix B: Factors Shaping today's National Security Industrial And Technology Base

The U.S. defense industry is operating in incredibly demanding times. The current defense industrial and technology enterprise is being influenced by many considerable pressures. The first of these is the incredible expansion of the global free market over the past fifteen years. It is, largely, the world the United States helped create by leading the push for free trade, providing freedom of the commons (sea, air, space, and cyberspace), and facilitating the proliferation of information technology and access to the virtually unlimited bandwidth on which it thrives.

The shear scale of the impact of globalization on the world economy – world gross domestic product increased from $17.4 trillion to $40.9 trillion between 1989 and 2005[51] – suggests that any enterprise seeking some level of economic optimization must leverage the productive capacity, innovation, and efficiency of the global market. This expansion has been greatly facilitated by the rapid development and application of information technology to commercial enterprises and the widespread adoption of liberal trade agreements among national economies in both the developed and developing world.[52]

With globalization there has also been a leveling of technology playing field. The explosion of the internet and free flow of information has made technological knowledge much more accessible.[53] Consequently, in the future, the U.S. may have to focus strategy on maintaining a technological edge in defense and national security areas and on being more adaptable with innovations in methodologies and applications of advanced technology rather than depending on a large technology gap as a tenant of national security.

In addition to the pressures of economic globalization, there is the pressing need for the Department of Defense to recapitalize the force after the declining budgets of the 1990's put the department on a procurement holiday.[54] This break in system procurements has left the military dependent on aging platforms and equipment, much of which require expensive service life extensions and ample increases in operations and maintenance budgets in order to keep them at an acceptable level of readiness. [55]

Furthermore, the recapitalization effort is also more focused on a network-centric approach to developing and acquiring systems rather than the traditional platform centric

approach. This has resulted in increased dependence on the commercial information technology sector. Additionally, there are increasing requirements for access to capabilities across the spectrum of conflict. Forces must be equipped for stability operations in an asymmetric threat environment as well as conventional force on force combat. This leads to requirements for multi-mission systems and puts more pressure on the need for access to innovative companies that are increasingly found in the commercial world and in foreign countries. This in turn leads to a need for ever more sophisticated and specialized systems integration capability at the upper tiers of the defense industry.

These factors combined with the shrinking DOD budget of the 1990's provided the impetus for a consolidation of prime defense contractors so the resulting companies would be more viable. The result of reduced budgets and a consolidated industry is an intense competition among numerous defense acquisition programs for finite government procurement resources. There is, however, somewhat less competition in industry at the prime integrator level to put downward pressure on costs. This situation compels acquisition programs and upper tier contractors to search for options to keep costs down. This pressure pushes DOD to leverage the products and services of the commercial sector and the efficiencies and innovative capacity that that sector has achieved through globalization and competition.

Just as consequential, U.S. conventional dominance has forced adversaries to become highly adaptable and embrace innovation in asymmetric methods as counter to technological power. This has resulted in a high degree of uncertainty as to where industry should focus its efforts to improve military capabilities and build industrial capacity. The high profile controversy over equipping ground forces with high performance body armor and adequately protected vehicles for the improvised explosive device (IED) and sniper infested environment of Iraq is a sobering example of this uncertainty. Early in the conflict when the requirement became apparent, the defense acquisition system had great difficulty identifying reliable suppliers to meet the high capacity production requirements for armor.[56]

The dynamic between cost pressures, technology requirements, and globalization has presented a growing challenge for the defense acquisition system. The globalization phenomenon has recently been inviting intense focus from Congress, DOD, and industry. Globalization's accelerating pace has also invited increasing public awareness. This increased focus is partly due to genuine security concerns regarding foreign dependency for sources of

industrial capability in a post 9/11 world. This rising concern, however, is also due to the often wrenching socio-economic impact that increased foreign competition has on many local economies. Adding to the overall concern is the recent disappointing cost and schedule performance of a number of high profile major defense acquisition programs. This recent disappointing track record has sparked another wave of acquisition reform and is placing additional scrutiny on why, what, where, and how the U.S. buys weapons systems.

This confluence of pressures has caused the globalizing commercial sector and its underlying markets to emerge as an indispensable component of the defense industrial and technology base. In this setting, the intense debate over the domestic source restrictions imposed on DOD procurements by buy America policies provides a rich forum in which to analyze key challenges that confront U.S. industrial and technology policy and policy implementation processes.

End Notes

[1] Domestic source restrictions on specialty metals were codified in subsection (c) of 10 U.S.C. 2533a, know as the "Berry Amendment," prior to enactment of the FY 2007 National Defense Authorization Act. That act removed specialty metal provisions from subsection 2533a and placed the restrictions under a new subsection, 10 U.S.C. 2533b. Despite this change, when referring to the "Berry Amendment," this monograph includes both 10 U.S.C. 2533a and 2533b under that label.
[2] The determination by DLA that domestic firms could not meet the Army's quantity and schedule requirements was likely driven by a trade off and market analysis that determined that the cost of full compliance with the Berry Amendment was simply not in the best interest of the U. S. government.
[3] Congressional Research Service Report, "The Berry Amendment: Requiring Defense Procurements to Come from Domestic Sources," June 24, 2004,4.
[4] Bill Gertz, "Swiss Delay of Military Parts Sparks 'Buy America' Push," *The Washington Times*, July 24, 2003 [accessed October 16, 2006: http://www.washintontimes.com/national/20030724-113347-4214r.htm]
[5] Bill Gertz, "Swiss Delay of Military Parts Sparks 'Buy America' Push," *The Washington Times*, July 24, 2003 [accessed October 16, 2006: http://www.washintontimes.com/national/20030724-113347-4214r.htm]
[6] Proposed legislation in 2003 that would increase Buy America threshold for DOD purchases from 50% American made to 65%.
[7] William Hawkings, "Saving the U.S. Defense Industrial Base," American Economic Alert website, November 10, 2004 [accessed December 3, 2006 at: http://www.americaneconomicalert.org/view_art.asp?Prod_ID=1200]
[8] Committee on Critical Technology Accessibility, National Research Council, "Critical Technology Accessibility," National Academy of Sciences, Washington D.C., 2006, 40.
[9] John W. Chierichella and David S. Gallagher, "Feature Comment: Specialty Metals and the Berry Amendment – Frankenstein's Monster and Bad Domestic Policy," *The Government Contractor :Information and Analysis on Legal Aspects of Procurement*, April 21, 2004, Vol. 46, No. 16, Section 168, 8.
[10] Government Accountability Office, "Highlights of a GAO Forum: Managing the Supplier Base in the 21st Century," GAO-06-533SP Supplier Base Forum, March 31 2006, 16.
[11] Joseph I. Lieberman, "White Paper: National Security Aspects of the Global Migration of the U.S. Semiconductor Industry," June 2003, 1-5.
[12] Richard McCormack, "$600 Million Over 10 Years for IBM's 'Trusted Foundry' Chip Industry Shift Overseas Elicits National Security Agency, Defense Department Response," *Manufacturing and Technology News*, Volume 11, No. 3, February 3, 2004.
[13] From key findings of the "World Global Positioning Systems Market Forecast (2006-2008)," Global Information Corporation, January 2007 [accessed February 15 2007 at: http://www.the-infoshop.com/study/rnc35986-positioning-systems.html].
[14] Jason Y. Kim, "Promoting Commercial Interest in GPS," Department of Commerce Briefing, July 2002 [accessed November 27 2006 at: http://www.nesdis.noaa.gov/space/library/speeches/2002-07-15-zambia.ppt].
[15] General Accountability Office, "Defense Procurement: Air Force Did Not Fully Evaluate Options in Waiving Berry Amendment for Selected Aircraft," GAO-05-957, September 23, 2005, 1-2, 5-6.
[16] Berry Amendment Reform Coalition, "Senate Berry Amendment Streamlining Proposal: Myth Versus Reality," July 18, 2006.
[17] Frank Haflich, "Stronger titanium market seen deep into next decade," *American Metal Market*, Oct 4, 2006 [accessed November 20, 2006 at: http://findarticles.com/p/articles/mi_m3MKT/is_39-3_114/ai_n16777129].
[18] "Global perspective on titanium innovation," *Light Metals Update*, [accessed February 20, 2007 at :http://www.csiro.au/news/newsletters/0511_metals/story2.htm].
[19] SSNIA is a trade association representing manufacturers of stainless steels, nickel-based alloys and super alloys and other specialty metals such as titanium, titanium alloys, and zirconium and niobium alloys.

[20] Specialty Steel Industry of North America, "Specialty Metals and the National Defense," December 2005, 3.
[21] Specialty Steel Industry of North America, "Specialty Metals and the National Defense," December 2005, 1.
[22] Robert J. Noel, Advisor to the Metals Affordability Initiative Consortium, Testimony before U.S House of Representatives Resource Committee, Sub-committee on Energy and Mineral Resources, July 17 2003.
[23] Pat Toensmeier, "Metal Fatigue; Skyrocketing Titanium Prices Raise National Security Concerns," *Aviation Week & Space Technology*, April 11, 2006. [accessed December 5, 2006 at: http://www.admaproducts.com/news_apr_11_2006.asp].
[24] Pat Toensmeier, "Metal Fatigue; Skyrocketing Titanium Prices Raise National Security Concerns," *Aviation Week & Space Technology*, April 11, 2006 [accessed December 5, 2006 at: http://www.admaproducts.com/news_apr_11_2006.asp].
[25] Discussions with various defense acquisition program officials and contractors during my time as systems engineer and program manager on major defense acquisition program clearly demonstrated to me that there was a general lack of understanding as to the affectivity of the Berry Amendment to commercial items. Program officials and contractors often deferred to the 'easier to deal with' assumption that commercially acquired components with minimal specialty metal content were not covered by the amendment.
[26] Berry Amendment Reform Coalition, "Senate Berry Amendment Streamlining Proposal: Myth Versus Reality," July 18, 2006.
[27] Aerospace Industries Association, "Buy America and the Berry Amendment; A Roundtable Discussion," Transcript of event, September 13, 2006, 2.
[28] The market basket approach to defining domestic source restrictions on defense procurements would require companies to buy only a certain percentage of material from U.S. sources that is proportional to the overall percentage of its business that is defense related. For example, if 15% of the titanium that Boeing uses goes to products it sells to DOD, than they would be required to ensure that 15% of its overall (including defense and commercial) titanium purchases are from domestic sources.
[29] Aerospace Industries Association, "Buy America and the Berry Amendment; A Roundtable Discussion," Transcript of event, September 13, 2006, 9.
[30] Qualifying countries include: Australia, Belgium, Canada, Denmark, Egypt, Federal Republic of Germany, France, Greece, Israel, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, and United Kingdom of Great Britain and Northern Ireland.
[31] House Armed Services Committee Press Release, "House and Senate Conferees Approve Conference Report for the National Defense Authorization Act for Fiscal Year 2007," September 29, 2006.
[32] Wendy H. Schact, "Industrial Competitiveness and Technological Advancement: Debate Over Government Policy," Congressional Research Service, April 1, 2005, 3.
[33] General Accountability Office, "DOD's Critical Technologies Lists Rarely Inform Export Control and Other Policy Decisions," GAO-06-793, July 28, 2006, 2-12.
[34] Since the publication of the GAO report on DOD's Critical Technology List, the Director, Defense Research and Engineering implemented an International Technology Security action plan, one of the results of which was the update of a number of sections in the MCTL. The list can be accessed at http://www.dtic.mil/mctl/.
[35] Defense Science Board, *Final Report of The Defense Science Board Task Force on Globalization and Security*, Office of the Under Secretary of Defense for Acquisition and Technology, December 1999, 36.
[36] Government Accountability Office, "High Risk Series: An Update," GAO-07-310, January 2007, 20-21.
[37] Wendy H. Schacht, "Industrial Competitiveness and Technological Advancement: Debate Over Government Policy," Congressional Research Service Issue Brief For Congress, April 1, 2005, 3.
[38] The idea that policy enforcement systems based on static lists of retrospective technologies are inherently ineffective has been articulated in a number of forums by former Under Secretary of Defense for Industrial Policy, Suzanne D. Patrick. Secretary Patrick recently reiterated this idea in the context of the current export control system. See transcript of "Defense Coalitions and the Global Character of the New Defense Industry," The Hudson Institute, December 6, 2006 [accessed 2 February 2007 at: http://www.hudson.org/files/publications/DefenseCoalitionsConferenceTranscript.pdf].
[39] Wendy H. Schact, "Industrial Competitiveness and Technological Advancement: Debate Over Government Policy," Congressional Research Service, April 1, 2005, 3.

[40] Herman Miles Somers, "Post War Organization for National Security," Transcript of speech delivered at the Industrial College of the Armed Forces, Publication No. L53-8, Washington D.C., September 2, 1952, 6-10 [accessed March 5, 2007 at: http://www.ndu.edu/library/ic2/L53-008.pdf].
[41] American Association for the Advancement of Science, "Federal Research Would Continue to fall in 2008 Budget," *Guide to R&D Funding Data Program*, [accessed 28 February 2007 at: http://www.aaas.org/spp/rd/guihist.htm].
[42] "Spring 2005 Industry Study Final Report: Strategic Materials," Industrial College of the Armed Forces, National Defense University, 2005, 10.
[43] "Spring 2005 Industry Study Final Report: Strategic Materials," Industrial College of the Armed Forces, National Defense University, 2005, 16.
[44] Government Accountability Office, "Management Processes can be Strengthened for New Technology Transition Programs," GAO-05-480, June 17, 2005, 4-5.
[45] The following is a description of TechLink and DUST program from GAO-05-480 report on management of new technology transition programs: TechLink mission is threefold: (1) integrate advanced commercial-sector technologies into DOD systems, particularly from nontraditional defense contractors; (2) spin-off DOD-developed technologies to the commercial sector to make these technologies more affordable for military acquisition; and (3) establish collaborative research and development projects with the private sector for cost-sharing of new dual-use technology development. DUST program facilitates partnering with industry to jointly fund the development of dual-use technologies needed to maintain technological superiority on the battlefield.
[46] Government Accountability Office, "Management Process Can Be Strengthened for New Technology Transition Programs," GAO-05-480, June 17, 2005, 5.
[47] Industrial College of the Armed Forces, "Industry Study Final Report: Strategic Materials," National Defense University, Washington D.C., 2006, 9.
[48] Brian E. Hurless, F. H. Froes, "Lowering the Cost of Titanium," *AMPTIAC Quarterly*¸ Volume 6, No. 2, Summer 2002. 8.
[49] Mary E. Kinsella, Daniel Evans, "Technology Transition through Collaborative R&D, Metals Affordability Initiative: A Government-Industry Technical Program," Defense AT&L Magazine, March-April 2007, 12-15.
[50] For the purpose of 10 U.S.C 2534, the term "national technology and industrial base" refers to the persons and organizations that are engaged in research, development, production, or maintenance activities conducted within the United States and Canada.
[51] National Research Council: Committee on Critical Technology Accessibility, "Critical Technology Accessibility," National Academy of Sciences, Washington D.C., 2006, 13.
[52] For an detailed perspective of the phenomenon of globalization see Daniel Yergin and Joseph Stanislaw The *Commanding Heights: The Battle for the World Economy*, Touchtone, New York, N.Y.: 2002, 379-398.
[53] See *Final Report of the Defense Science Board Task Force on Globalization and Security*, Office of the Under Secretary of Defense for Acquisition and Technology, Washington, D.C., December 1999.
[54] Michael E. O'Hanlon, *Defense Strategy for a Post-Saddam Era*, Brookings Institution Press, Washington D.C., 2005, 72.
[55] For example, the Navy and Marine Corps fleet of EA-6B electronic attack aircraft, Navy P-3 Maritime Patrol Aircraft, and Air Force B-52 Bomber are just a few of the in service platforms that have had major retrofit programs in order to extend service lives in order to compensate for procurement gaps. Another example of aging equipment is seen in the Army's front line ground combat vehicles - the Abrams Tank and Bradley fighting vehicles - that are the products or 1970s technology and have served through several major combat operations as of 2007.
[56] Michael Moss, "Many Missteps Tied to Delay in Armor for Troops in Iraq," New York Times, March 7 2005.