Annual Industrial Capabilities

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1. Executive Summary

The Department of Defense (DoD) submits this report in accordance with section 2504 of title 10, U.S.C.

For over a decade, the Nation has increased annual defense spending in support of our women and men engaged in two active conflicts while, at the same time, investing in the capabilities to prevent and deter future conflicts around the globe. Over that period, we have supported a clearly articulated mission – plan, train, fight, win the ongoing conflicts – while simultaneously planning to train, fight, and win contingencies around the globe that threaten our national interests.

As we executed our mission over the last decade, the industrial base has been with DoD every step of the way – responding to our immediate needs while investing in our future requirements. The industrial base that supports DoD is, and remains, a vital component of our national security capability, second only to the women and men in uniform.

DoD relies upon our Nation's industrial capabilities and capacity for everything from ships to shoestrings, and industry continues to answer the call to respond to both the current and emerging threats our Nation faces. In return, the firms that serve our Warfighters must do so at a fair price to the taxpayers, and should reasonably expect fairness in treatment, rationality in our program decisions, and certainty in our spend plans which financially correspond to the market risks industry bears. DoD leverages a largely market-based approach that continues to produce innovative ideas, products, and systems that remain the envy of the world.

Our market-based approach has served DoD well. It is important to recognize that over the last 20 years, the industrial base upon which we rely has steadily become more global and diverse. Now, more than ever, we must accept that DoD does not control the supply chain that supports production. An overly-prescriptive approach to industrial policy, rather than a market-based approach, is a model that tends to destroy innovation, produce false competitive choices, and prevent the best and brightest America has to offer from entering the national security sector. Put simply, a directive approach is not in keeping with the rapid pace of technological development – largely commercially dependent – upon which the Warfighters of the future will depend.

Since the end of World War II (WWII), DoD has experienced four major swings in investment spending: the first after WWII, the second after the Korean conflict, the third after the Vietnam conflict, and the fourth initiated due to a domestic fiscal crisis, but accelerated by the fall of the Berlin Wall. Each of these four cycles had unique and significant implications for the Military Departments and the industrial base. In each of these major swings, the impact on our industrial capacity was not adequately understood or addressed. In each cycle, for very different reasons, industry was not able to respond to new and emerging threats in a time and cost-effective manner. A

more proactive focus on understanding the necessary skills and capabilities would have allowed for a more robust, resilient, and reversible industrial capacity, even in a declining budget cycle. Moving forward, a more nuanced and sophisticated approach to our industrial capacity will be essential to effectively managing our way through the current fiscal challenges.

Since the end of WWII, U.S. industrial innovation and response to crises have supported sustainment of our ability to surge in crises. This requires a continued robust and effective dialogue with our industrial partners, along with more efficient management of our programs as highlighted in the Better Buying Power (BBP) initiatives. The stresses resulting from an uncertain budget environment will only accelerate and accentuate the need for dialogue.

As DoD enters a period of decreased acquisition spending, we anticipate increased stress on our industrial base. The United States is in danger of losing some key industrial capabilities that will be vital for our future national security. Insufficient near-term demand for certain products will keep some companies below their minimum economic sustaining rates, making it financially challenging to keep workers with unique, technical expertise active enough to maintain their proficiency in these advanced skills.

DoD recognizes its responsibility to ensure it maintains a robust industrial capacity well into the future – and, indeed, to enhance industrial capacity – by investing in those defense unique items that will support future acquisition programs. In addition, sequestration and longer-term budget cuts, as well as prolonged uncertainty, could limit capital market confidence in the defense industry. Faced with this continued uncertainty, companies will be less willing to make internal investments in their defense portfolios or more likely abandon them altogether.

Continued uncertainty will hit smaller, innovative, and niche product companies particularly hard due to a lack of capital resources to withstand the turmoil and uncertainty. The effect on these firms is especially important to emphasize, since a substantial portion, often 60-70 percent, of defense dollars provided to prime contractors is subcontracted. Many of these subcontractors, and their own suppliers, are small and innovative firms.

Given the overall budget environment, DoD cannot afford to solve all industrial base challenges before us with additional procurement spending. Now, more than ever, buying products beyond what is required is not an option, no matter how much those products may protect key industrial base capabilities by generally exercising the entire industrial base. We simply cannot pursue a strategy that ultimately results in solving “million dollar” problems with “billion dollar” solutions. Therefore, DoD is explicitly considering options along the broader range between program cancellation and completed full-scale production. These options include upgrading or extending the service life of existing programs, hovering or slowing ongoing programs, shelving or rolling over technology for future systems, executing planned low-rate procurements,

and/or choosing silver bullet procurements of successful prototypes. We have had success with many of these options in the past. However, the two options that hold the greatest promise for keeping the industrial base intact during long intervals between new major weapon program starts are:

(1) Selective low-rate procurements (sometimes called “block” production); and

(2) A hedging approach which produces a highly-capable system with a high-technology operational advantage against current or near-term threat and forms a basis to build out larger production runs, if necessary, while preserving critical human, manufacturing, and technical capabilities.

In earlier periods of substantial downward defense spending, notable key leaders (e.g., Dr. William Perry in the late 1970s, later appointed as Secretary of Defense) made conscious decisions to invest in specific technologies and capabilities, guarding that funding for nascent programs and technologies necessary to pursue American dominance on future battlefields. Such thoughtful investments, while at the time difficult, proved to be the inception of technologies that led to the development of such stalwarts as the F-16, the Abrams tank, and the Patriot air and missile defense system, as well as the stealth technology for the F-117. Buying “extra” finished products, even at low rates, to protect the industrial base can be effective when careful analysis directs that investment and when true national industrial capacity needs are well understood.

A key advantage to this type of hedging strategy to the industrial base is to provide funding to keep the cutting edge of the industrial base focused on advanced technologies. It also better postures the Government to deal with unanticipated threats and adversaries who, with unrestricted budgets and whose technology may advance at a rapid pace, requires us to be more agile and adaptive in our response.

DoD recognizes that only a small fraction of our enormous industrial base capabilities are truly at risk (fragile) and, therefore, in danger of disappearing without dedicated efforts to sustain them. Even in these cases, when properly identified and vetted, DoD may choose to invest in the next generation of technology or, in some cases, simply be forced to accept the disappearance of a certain skill or capabilities if assured suitable alternatives are available.

Niches of industrial capabilities that are not critical (e.g., niches that could be readily replaced in the future) and niches that are not fragile (e.g., niches that will remain viable due to continued demand from commercial and defense spending without targeted industrial base sustainment efforts) will not warrant special attention and spending based on industrial base grounds. In these instances, we expect the market to dictate success or failure. All industrial base sustainment efforts must target only those niches that meet a common and stringent set of criteria and are either too costly or simply not available.

The fragility and criticality assessments described as part of the Sector-by-Sector, Tier-by-Tier (S2T2) process in Section 3 are designed to systematically evaluate the need for program adjustments or investments to sustain specific niches in the defense industrial base. This common framework, developed by AT&L with the support of the Military Departments, will allow DoD leadership to compare industrial capabilities across all the sectors and tiers of the industrial base and combine scores for industrial capabilities that contribute to multiple programs, allowing portfolio analysis as part of DoD's normal budget process.

Of particular concern to DoD are the implications of the continued budget environment for small innovative companies. As we collectively live through this downturn, small companies are going to have the greatest difficulty absorbing cuts. As part of the S2T2 effort we continue to focus on smaller, lower-tier firms to identify those which may warrant action if appropriate.

As DoD deals with the turmoil of the last several years and develops courses of action to ensure the strength and viability of our industrial base partners, we must continue to look beyond this year to the future. We must ensure that we have a clear vision of how to plan effectively for the great strategic transition that is before us, and provide the country with the defense it needs within the confines of the amount of money the Government has to spend, all while ensuring we continue to be good stewards of the taxpayers' dollars. Now it is time to turn the corner strategically and to focus our attention on the challenges and opportunities that will define our security future. In all of this, industry will be turning a corner with us. The technological vibrancy and financial success of our industry partners is critical to the national interest. The long-term investor in the defense industry, and the long-term interests of the Government, must be aligned. DoD is committed to partnering with industry both throughout this current turmoil and, more importantly, in turning the strategic corner to collectively focus our efforts in the future challenges our nation faces.

2. Strategic Guidance

The Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy (DASD(MIBP)) was established by section 896 of the Ike Skelton National Defense Authorization Act (NDAA) for Fiscal Year 2011. MIBP supports the Office of the Secretary of Defense and Service Acquisition Executives by providing detailed analyses and in-depth understanding of the increasingly global, commercial, and financially-complex industrial supply chain essential to our national defense and recommending or taking appropriate actions to maintain the health, integrity, and technical superiority of that supply chain. In addition to MIBP's core mission to broadly assess and address the health and resiliency of the defense industrial base (title 10, U.S.C., sections 2501, 2503, 2505, and 2506), it oversees important program and policy functions including:

- The title 50, U.S.C., Defense Production Act (DPA) Title I Defense Priorities and Allocations System;
- The title 50, U.S.C., DPA Title III program;
- The title 10, U.S.C., section 2521 Manufacturing Technology (ManTech) program;
- Section 721 of the DPA, Committee on Foreign Investment in the United States (CFIUS);
- Section 722 of the DPA Defense Production Act Committee (DPAC); and
- The title 10, U.S.C., section 2372, Independent Research and Development.

This extensive and diverse portfolio enables MIBP's holistic focus on defense manufacturing, production, and industrial base issues.

2.1 Presidential Commitment to Advanced Manufacturing Initiatives

This Administration has repeatedly highlighted the growing importance of advanced manufacturing to the economic and national security of the United States. One of the key examples of this focus is the recommendations provided in the President's Council of Advisors on Science and Technology 2011 report, "Ensuring American Leadership in Advanced Manufacturing," that laid out a strategy and specific recommendations for revitalizing the Nation's leadership in advanced manufacturing.[1] Another key effort signaling the emphasis being placed on advanced manufacturing is the 2011 establishment of the President's Advanced Manufacturing Partnership (AMP) initiative across Government, industry, and academia that has been tasked to chart a

[1] Report to the President on Ensuring American Leadership in Advanced Manufacturing, Executive Office of the President, President's Council of Advisors on Science and Technology, June 2011.

course for investing and furthering the development of emerging technologies to create high quality manufacturing jobs and enhance U.S. global competitiveness.[2]

In his 2012 State of the Union Address, President Obama further emphasized manufacturing's importance to the Nation, stating that "our first priority is making America a magnet for new jobs and manufacturing." He pointed out that last year, the Government created our first manufacturing innovation institute in Youngstown, Ohio, and noted that he intends to launch three more of these manufacturing hubs – two additional institutes will be led by DoD; the Department of Energy (DoE) will lead a third. These regional hubs are geared to accelerate development and adoption of cutting-edge manufacturing technologies for making new, globally-competitive products.

Another initiative that helps to set the framework for jumpstarting vital advanced manufacturing initiatives in the United States is the 2012 release of the National Science and Technology Council's (NSTC) *National Strategic Plan for Advanced Manufacturing.*[3] This plan sets forth five objectives for improving Federal policy in order to accelerate development of advanced manufacturing:

- Accelerating investment, especially by small- and medium-sized manufacturers;
- Making the education and training system more responsive to the demand for skills;
- Optimizing Federal advanced manufacturing R&D investments by taking a portfolio perspective;
- Increasing total public and private investments in advanced manufacturing R&D; and
- Fostering national and regional partnerships among all stakeholders in advanced manufacturing.

In addition, Department of Commerce has formed the Advanced Manufacturing National Program Office (AMNPO), supported by DoD and other Interagency partners. This interagency office is charged with convening and enabling industry-led, private-public partnerships focused on manufacturing innovation and engaging U.S. universities. It also is working to design and implement an integrated government advanced manufacturing initiative to facilitate collaboration and information sharing across federal agencies.

Throughout 2012, both the Administration's and the Department's leadership have given the highest priority to advancing manufacturing within DoD and throughout the nation. One example of this is MIBP's ManTech program, which is leading an interagency effort to launch a $69-million public-private partnership in additive manufacturing. Participants include the Department of Defense, DoE, National Aeronautics and Space Administration, National Science Foundation, and the Department of Commerce's National Institute of Standards and Technology. The private partner team is led by the National Center for Defense Manufacturing and

[2] http://www.whitehouse.gov/the-press-office/2011/06/24/president-obama-launches-advanced-manufacturing-partnership.

[3] A National Strategic Plan for Advanced Manufacturing, Executive Office of the President, National Science and Technology Council, February 2012.

Machining, a not-for-profit 501(c)3 company. The interagency investment of $30M has been matched by a $39M cost share from non-federal sources. More commonly known as "3D Printing," additive manufacturing is an enabling manufacturing technology for our military platforms. The National Additive Manufacturing Innovation Institute (NAMII) officially opened on September 27, 2012, and will serve as a training and collaboration center to bridge the gap between basic research and technology adoption. NAMII will also serve as an example for the proposed National Network for Manufacturing Innovation and has a goal to be self-sufficient within three years.

2.2 Expanded Efforts to Incorporate Industrial Base Impacts in the Department's Budget Deliberations

The Department has continued efforts that were initiated in the FY2013 budget cycle to explicitly consider the effects of program adjustments on the industrial base. Last year, the USD(AT&L) created a process to work with the Military Departments to comprehensively identify critical and fragile industrial base niches involved in the supply chains for major defense acquisition programs. DASD(MIBP) is spearheading these Fragility and Criticality (FaC) assessments in order to effectively analyze the portfolio of critical and fragile niches across the defense enterprise, and these results will inform DoD budget discussions. The information that is derived from these analyses may be used, for example, to make adjustments to ensure a smooth workflow, especially by considering the impact of spending across different programs that have a common sub-tier supplier considered at risk. This effort is described in more detail in Section 3.0, Sector-by-Sector, Tier-by-Tier evaluations of the defense industrial base.

The Department, in collaboration with the Military Departments, continues to expand upon these efforts in order to ensure that industrial base concerns are incorporated into the budget process. Beginning in FY2014, the Department has created an Industrial Base Sustainment Program (ISBP) to provide an enabling process that enhances the DoD's ability to preserve or improve the industrial base's capability to sustain readiness by mitigating risks and issues which diminish those capabilities. IBSP core projects will be identified through FaC assessments and will target remedies to multiple-program, multiple-Military Department concerns.

Industry must be allowed to continue to evolve as innovative, original technologies are discovered and the identification of potential new threats emerge. Adjustments to the proposed budget should take into consideration these developments, although intervention should be considered very selectively and must be based on solid data. However, it will ensure that the Department stays responsible to both the Warfighter and the taxpayer by supporting affordable investment and innovation in critical industrial niches that are experiencing low demand in the short-term, but that the Department may likely need in future years.

2.3 Continuation of the Better Buying Power Initiative

It has been over two years since the Deputy Secretary of Defense and USD(AT&L) issued guidance to the acquisition community to ensure affordability and increase productivity in defense spending to deliver better value to the taxpayer and the Warfighter. The guidance was followed by Better Buying Power (BBP) initiatives for increasing efficiencies in order to “do more without more.” In these last two years, the Department has made significant strides to institutionalize many of these initiatives. Affordability analysis is now part of the standard Defense Acquisition Board (DAB) planning process to facilitate investment decisions. Should-Cost estimates are being used as standard practice within the Military Departments. In addition, competitive incentive contracts, services acquisitions, and small business opportunities are receiving greater attention and focus.

On April 24, 2013, USD(AT&L) issued a memorandum providing implementing guidance to acquisition professionals for BBP 2.0. BBP 2.0 reinforces much of the content from BBP 1.0, but it also includes new initiatives and modifies some of the previous guidance. These moves toward better business practices will help the Department's industrial partners. BBP 2.0 reflects a number of inputs from industry, including better definitions of acceptable outcomes in contracting. In addition to more accurate applications of technically acceptable contracts, the acquisition community is working to better define “value” from its perspective as the customer. Sometimes this will mean spending more for more capability, a win for both industry and the Department, because it rewards innovation and gives DoD a higher-performing, more effective product.

The DoD is striving to strengthen the industrial base in tandem with making it a leaner, more productive industry through industry incentives. DoD wants industry to be strong and profitable but it wants to tie profit to performance. The Department is reworking its incentive structure to reward good performance. DoD is developing a superior supplier incentive program that identifies our best performers and rewards them.

The Department remains committed to the BBP initiative. It seeks to achieve greater efficiency in the acquisition process in conjunction with lowering the burden of non-value-added requirements on the defense industry. The Department also recognizes that industry is driven by profits and thus is the primary incentive that we can offer to businesses to respond to our requirements. The BBP initiative offers companies the possibility to increase their profits as they lower their costs. BBP is one of the mechanisms through which the Department seeks to reinvigorate its partnership with industry to develop, produce, and sustain the systems that offer American Warfighters their technological edge.

2.4 Increased Cooperation on Materials Industrial Base Assessments

Section 901 of the National Defense Authorization Act for Fiscal Year 2013 addresses a specific facet of the industrial base – the availability of materials critical to national security. DASD(MIBP) shares with the office of the Defense Logistics Agency Strategic Materials (DLA SM) the responsibility for assessing the material needs of the defense industrial base, assessing the robustness of the associated material supply chains, and, as appropriate, developing, implementing and monitoring policies to ensure the availability of required materials. The legislation also reconfigures the Strategic Materials Protection Board (SMPB) such that it will now be chaired by the DASD(MIBP) while the Administrator of DLA SM serves as vice-chair. In the past, the SMPB was chaired by the USD(AT&L).

DASD(MIBP) recognizes the goal of Congress and the synergies to be gained from a strategy that emphasizes a more centralized approach by the Department to issues concerning the supply of materials critical to the defense industrial base. Therefore, DASD(MIBP) is drafting a memorandum of agreement to be signed by the DASD(MIBP) and Administrator of DLA SM that will outline areas of cooperation for the offices to ensure the availability of raw materials for the defense industrial base as well as on the SMPB.

3. Sector-by-Sector, Tier-by-Tier (S2T2) Evaluations of the Defense Industrial Base

The Department is working through its Joint Industrial Base Working Group (JIBWG) to perform Sector-by-Sector, Tier-by-Tier (S2T2) assessments of the defense industrial base. The JIBWG membership includes representatives from Military Department-level acquisition and industrial base assessment organizations as well as the Department of Commerce (DOC). DOC exercises its authority to conduct surveys to assist in the collection of information regarding the health of the defense industrial base. As a starting point for analyzing criticality to national security, the Department divided the defense industrial base into seven major sectors: ground vehicles; missiles; command, control, communications and computers (C4); space; aircraft; ships, and radar and electronic warfare.

Each product DoD acquires often has thousands of items provided by hundreds of suppliers with various degrees of separation from the prime contractor. Businesses treat their supply chains as proprietary trade secrets and closely guard these secrets from their competitors, their customers and their suppliers. This situation results in more and more opacity in supply chain knowledge as the relationships become more and more indirect. A substantial level of effort is required to assemble a set of information from which to extract a credible list of critical elements down through several tiers within a product or sector. Even though significant effort is required for this extraction, the Department rarely, if ever, includes requirements or funding in its contracts for suppliers to provide lower-tier suppliers. Instead, the Department relies upon persuasion, surveys, and the subject matter expertise of a cadre of industrial base assessment professionals.

A process has been developed and piloted for S2T2 analysis to identify critical elements within the sectors and assess the risks and consequences of disruption. The core of this process is a Fragility and Criticality (FaC) assessment. The first step is to sift through information on thousands of items, using subject matter expertise, down to a manageable few for detailed assessment. For detailed assessment, fragility and criticality have been broken down into 14 factors. Subject matter experts meet and score each of the 14 factors for the manageable few. The result of this scoring is a short list of critical items most at risk. This scoring is followed up by site visits and interviews to validate the scoring. A plan has been developed, and work begun, to implement FaC assessments across multiple sectors and across the Military Departments.

In order to map the supply chain and examine the structure of the industrial base, the Department is working with the DOC to conduct a series of surveys of the industrial base that includes questions about customers, suppliers, competitors and financial health. MIBP is also working closely with the Military Departments and Defense Agencies in developing and conducting collaborative industry surveys to reduce the

administrative burden on industry and maximize efficiencies. A database is under construction to organize and display the collected information and is in the final stage of testing. Given the vast number of suppliers in the industrial base, changing and opaque business relationships, and changing DoD products, mapping the supply chain for critical items will always be a work in progress.

4. Industrial Sector Assessments

The following sections examine the industrial base sectors based on assessments and analyses conducted by the DASD(MIBP). Each section encompasses an overview of the health of the sector, financial performance of industries supporting the sector, at-risk areas or critical issues important to the defense industrial base, and potential impacts of major (ACAT 1) program terminations in FY2012, as required by section 2505(b) of title 10, United States Code.

4.1 Aircraft Sector Industrial Summary

The industrial base impacts of the 2001 F-35 downselect decision are nearing the point of no return for tactical aircraft suppliers not associated with the F-35 program. With 2014 currently scheduled as the last year for production funding of the F/A-18E/F, long lead item producers are already feeling the impact. Additionally, the F-35 has been the only high performance aircraft in development in the U.S. for the last decade or so, bringing concern that key tactical aircraft design and development capabilities are already atrophying. In answer to these concerns, the Department has initiated an air dominance initiative with the Military Departments and the Defense Advanced Research Projects Agency (DARPA) that will (1) explore concepts for the next generation of air dominance and (2) lead to a prototype program based on the results of the concept definition effort. Although the Department is still in the early stages of transitioning to a largely F-35-based tactical aircraft fleet, it is not too early to begin consideration of the next generation of capability that will someday complement and eventually replace the F-35. U.S. industry design teams for high performance air vehicles are an important national resource and therefore, this initiative will provide meaningful opportunities for leading-edge design, build, and test activities. Innovative platform concepts for airframe, propulsion, sensors, weapons integration, avionics, and active and passive survivability features will all be explored. Select concepts will continue into prototyping to demonstrate the highest risk and most innovative elements.

The Air Force is also co-investing with industry in advancing aircraft engine technology. The Adaptive Engine Technology Development (AETD) program focuses on maturing technologies developed through the ADaptive Versatile ENgine Technology (ADVENT) program that will provide improved fuel burn to provide combat aircraft in the beyond-2020 timeframe with significantly enhanced range, performance, and thermal management capabilities. The AETD program will help to maintain a competitive engine technology environment for future Air Force combat aircraft. Technologies demonstrated through ADVENT that will be validated by AETD include an innovative adaptive three-stream fan, third stream-cooled cooling air, and ceramic matrix composite materials, resulting in improved power extraction, thermal management, and inlet recovery, while reducing installed drag.

An effort similar to the air dominance initiative is also underway at DARPA focused on the next generation of vertical flight. Over the past decade, the Department has relied heavily upon the vertical lift sector. This sector provides critical support to ongoing conflicts in extremely high operational tempos. While this has provided near-term good news for companies' financial returns, the long-term effects of no new starts since the 1980s have resulted in research and development (R&D) engineering skill shortages in nearly all disciplines, and an inability to make needed capital investments. To help overcome this problem, DARPA has launched the vertical take-off and landing (VTOL) X-Plane program to challenge industry and innovative engineers to concurrently push the envelope in four areas: speed, hover efficiency, cruise efficiency, and useful load capacity. They are looking for true cross-pollinations of designs and technologies from the fixed-wing and rotary-wing worlds.

The Unmanned Aerial Systems (UASs) segment continues to evolve. As technology matures, operational lessons-learned are analyzed, and long-term strategies are developed beyond current conflicts. As evidenced by their extensive use in operations in Afghanistan and Iraq, UASs have proven themselves an effective tool for the Warfighter. The capabilities they bring – from providing constant imagery to serving as strike platforms – are now virtually indispensable to combatant commanders. However, even with surging demand to meet combatant commanders' desire for more UAS support, the DoD's total research, procurement, and sustainment costs are relatively small compared to the spending on manned platforms. Future years spending plans allow for flexibility and continued growth as required. The civil UAS market also shows great promise and the potential applications are virtually endless, if regulatory standards, certification, and operational procedures can be resolved for full integration into the National Airspace System. Greater computing power, combined with developments in miniaturization, sensors, and artificial intelligence, have and will continue to dramatically boost UAS capabilities. These technological advances will aid in UASs' ability to operate with each other, and interact with humans. This evolution in UASs has the potential to provide alternative solutions to meeting operational requirements in the future. However, there is concern that if the U.S. does not resolve export issues with respect to UAS, this segment will suffer a fate similar to that of the U.S. satellite industry, where a dominant position in the market was ceded to competitors because of unique U.S. export controls.

According to the Aerospace Industries Association's 2012 Year-End Review and Forecast, while civil aircraft sales were strong in 2012 – increasing by 3.4 percent – the military aircraft sector continues to contract – falling 2.4 percent last year – and will no doubt further decline in 2013. The end of the F-22 production line and upcoming completion of the Air Force buy of the C-17 are factors in the contraction of the military aircraft sector. Each of the Military Departments continues to modify and upgrade their current fleets, including service life extension programs. While these activities may not provide the same engineering and design demands as do development programs, they help to sustain industrial capabilities in the military aircraft sector.

In 2012, the Air Force proposed cancelling the C-130 Avionics Modernization Program (AMP); however, the FY13 National Defense Authorization Act prevents the Air Force from cancelling AMP until 90 days after the Institute for Defense Analyses submits a cost benefit analysis to Congress. C-130 AMP is currently slowed pending study release in October 2013, and further Congressional direction.

Also in 2012, the Navy terminated the Medium-Range Maritime Unmanned Aircraft System (MRMUAS). Due to changing priorities and the demonstrated capability of the MQ-8B Fire Scout, the Navy decided that it would terminate the MRMUAS after issuing a broad area announcement in September 2011. No contract had been awarded and, therefore, a very minimal amount of work had been done on the program, resulting in a negligible impact to the existing UAS industrial base.

4.2 Electronics Sector Summary

Over the past twenty-five years, there has been an unprecedented globalization of the electronics industry, in particular, firms that engage in consumer communications and information technology. While globalization has many economic benefits, it also provides increased access and opportunity for malicious actors to manipulate information and communications technology products and services to gain unauthorized access to otherwise closed-off technologies and services. Threats to the supply chain can affect both software and hardware products. Software is growing exponentially in size and complexity, which creates assurance challenges. Software design, development, testing, distribution, and maintenance can be done more inexpensively offshore in easy reach of malicious actors. This situation creates a major challenge for the DoD and the U.S. Government.

Security of the supply chain can be compromised by untrustworthy or counterfeit microelectronic components. The semiconductor industry has increasingly moved toward offshore or foreign-owned semiconductor component production. This trend creates an increasing threat to the U.S. as the potential increases for unauthorized design inclusions to appear on integrated circuits used in military applications.

Microcircuits and related leading edge technologies are strongly influenced by global commercial interests that are not the same as defense and aerospace interests. Devices used in defense and aerospace applications are subject to environmental effects not found in the consumer market such as long-life and storage periods, environmental factors such as shock, vibration, nuclear radiation hardening, electromagnetic environmental effects, and wide temperature ranges. Atmospheric radiation is also a concern to the aerospace industry. Aircraft and especially spacecraft are vulnerable to cosmic ray and solar particle radiation total dose and single event upsets with future electronic systems being more vulnerable due their higher sensitivity. Consumer products are not designed for these kinds of conditions.

Compounding the challenge for U.S. defense and aerospace companies is that with the migration of electronics manufacturing offshore, issues of counterfeiting, trust (intellectual property theft and anti-tampering), product reliability, and assured sources of supply become increasingly more difficult to manage. While consumer markets, manufacturing costs, and industrial policies have affected the global semiconductor industry, the need for "trust" in systems and components is complicating matters for the defense and aerospace community.

Potential adversaries could tamper with electronic devices used in defense and aerospace systems in ways that are undetectable and steal intellectual property from designs and thereby defeat key defense systems. A counterfeit electronic component is one where material, performance, or characteristics are knowingly misrepresented by the vendor, supplier, distributor, or manufacturer. The objective of malicious tampering is to engage in espionage or sabotage; whereas the motivation for counterfeiting is economic. The effect of either is the same; intentionally compromised devices may be impossible to detect and can jeopardize both mission and life.

The Department is working with the Congress and industry to address the above concerns. Mission critical functions and critical components are being managed based on system criticality. Policy and standards are being developed and source intelligence used to select reliable suppliers of critical components. Risk to trust in covered systems is being managed throughout the entire system lifecycle. The application of risk management practices begins during the design of covered systems and prior to the acquisition of critical components or their integration within covered systems, whether acquired through a commodity purchase, system acquisition, or sustainment process.

4.2.1 Radar and Electronic Warfare Sector Industrial Summary

The 2012 Annual Industrial Capabilities Report to Congress identified the overall health of the radar and electronic warfare (EW) sector to be "sustainable, but shallow." This assessment is grounded in the number of legacy electronic systems deployed by the Military Departments for which there are steadily diminishing manufacturing sources. It is also due to the evolution of solid-state technologies that will eventually supplant the analog technology mainstays of the last several decades.

Of particular concern is the ability for the U.S. industrial base to produce new radar and EW systems using advanced solid state technology as the old technology and tacit knowledge required to maintain the analog technology "ages out" of the defense industrial base. The 2012 report indicated good progress in refining the manufacturing of key components for solid-state radar subsystems, e.g., Gallium-Nitride (Ga-N) power amplifiers. The increasing expertise and manufacturing skills that defense companies need to produce reliable and producible solid-state power amplifiers and active electronically scanned antenna (AESA) architecture have increased the "bench strength" of U.S. industry to produce the future radar and EW systems required by the Military Departments.

In 2012, USD(AT&L) developed an in-depth assessment of this niche in the radar and EW market because of its importance to future defense acquisitions. The assessment was conducted by DASD(MIBP) and the Defense Contract Management Agency's Industrial Analysis Center (DCMA IAC). Acquisition program offices and prime contractors were interviewed and visited to determine the capacity of the U.S. defense industrial base to produce AESA radars in the numbers required over the next decade. The findings are summarized below:

- The defense industrial base sector skilled in the design, development, manufacture, and sustainment of AESA radar systems is currently supported by three viable domestic suppliers.

- Sufficient industrial capacity and capabilities (skills, processes, technology, facilities, and equipment) currently exist within this sector to support production schedules of the five planned AESA programs, along with other radar program production.

- Capacity and capabilities are not issues. Engineering skills essential to AESA development are well staffed with no projected shortages.

- The materials required to support AESA production are for engineering prototype material only, or for a small quantity of parts to support the TD phase of development. This is not unusual in the electronic component industry, where suppliers are reluctant to capitalize their enterprise without a certainty of economic order quantities. Affordability is the primary risk AESA radar programs will encounter, mainly due to:
    - increased foreign competition,
    - budget cuts,
    - lack of consistent procurement,
    - rapid technology changes, and
    - obsolescence.

  Industry has indicated the desire for government to focus investments on technology breakthroughs in these areas to lower the costs of AESA technology and make the systems more affordable.

- Government export control and disclosure regimens hamper access to foreign markets.

The findings of the report offer a good basis for discussion. The following insights provide elaboration and analysis of the main findings and highlight possible avenues for further examination:

- **Number and Quality of Vendors.** The Department now has three vendors that can provide the manufacturing capabilities for all phases of AESA radar development and production. This is a major change from as little as ten years ago, where only one system development/integration house had the necessary

intellectual capital and experience to develop and produce large AESA radars. From a competition standpoint, this is a major advantage. Large and complex systems, such as the Navy's Advanced Maritime Defense Radar (AMDR), will have the opportunity to develop a versatile acquisition strategy that potentially draws from the strengths of all three companies.

- **Capability and Capacity.** The report indicates this is low risk; however, the caveat is that a Major Defense Acquisition Program (MDAP) must provide funding to expand these attributes as necessary. This is less of an area of concern for airborne AESA radars, which have the advantage of existing production lines and in-place expertise. More problematic is the expansion of capability and capacity for the larger systems, such as Air and Missile Defense Radar (AMDR), which may be tied to shipbuilding forward-fit and back-fit schedule considerations.

- **Transition from Tech Demo to Production.** Some of the programs are in the technical demonstration or prototype phase of development. Many of the critical technologies (e.g., GaN power amplifiers, low-cost digital receivers/exciters, and digital beam forming) are currently at questionable levels of maturity with respect to production. It is difficult to say with certainty that all of the necessary technologies currently have sufficient, simultaneous maturity to initiate an acquisition program with stable cost, schedule, and performance baselines. Each of the three vendors is confident its architecture and component technology maturity are sufficient for initiating an acquisition program; however, the recent trend in defense acquisition is to aggressively insert technologies of questionable readiness that later require program funds to complete the maturation.

- **Need for Technology Breakthrough.** This recommendation spans the entire technology spectrum and is aimed at cost reduction rather than achievement of necessary levels of performance. The breakthroughs cited focus on efficient production at very low production scales. The inference is that the component technology and system architectures in development at the three major vendors are fixed and that incremental improvements in reliability and/or performance will come at increasing cost. The report hints that some of the technology and affordability issues may be addressed through robust procurement quantities; e.g., leveraging products across programs at the component level may open the door to more efficient production processes.

- **The Talent Pool.** The analysis asserts that all three vendors have established plans to increase their talent pool to provide intellectual talent in niche functional areas such as Radio Frequency (RF) engineering.

- **Access to Foreign Markets/Export Control.** The DCMA IAC team received the full complement of industry opinion on this subject. Foreign sources are showing increasingly sophisticated approaches to producing radar sub-systems and technologies that, in some cases, come near to the performance of a U.S.

counterpart. It highlights, yet again, the question of whether the U.S.'s export and disclosure laws are needlessly penalizing U.S. industry in the global marketplace.

The following recommendations from the assessment can help secure the industrial base capability to produce the required systems in the future:

- Evaluate in greater detail critical suppliers for the production phases. Areas of limited competition in the supply base are very likely to drive up costs.

- Continue focus on cost/affordability. Increasing pressures on acquisition budgets will place ever-increasing demands for even lower cost. To create low cost radars, it is imperative to leverage products at the component level.

- Continue DoD investment in technology breakthroughs to help assure manufacturers can achieve the needed cost reductions without having to sacrifice system capability.

- Review and reassess U.S. technology release policies and processes.

4.2.2 Command, Control, Communications, and Computers (C4) Sector Summary

A wide variety of vendors is qualified to design and build an array of defense products within the C4 industrial sector. A robust global commercial electronics industrial base supports these vendors. Second-tier suppliers of assembled components tend to serve both commercial and defense customers. Third-tier suppliers of individual components, such as integrated circuits, frequently supply identical products for both commercial and defense use. At the fourth-tier, such as design tools and reused intellectual property, there is frequently minimal awareness of the final end use in defense products. In essence, the C4 industrial base upon which the Department typically relies is largely global below the prime contractor tier.

The global and commercial nature of this sector of the industrial base, coupled with the impracticality of thoroughly testing all elements of electronic hardware and software, makes supply chain management and anti-counterfeiting efforts particularly important to this defense sector. The Department is undertaking a number of risk-based initiatives to assure security of the C4 supply chain to include implementing a Supply Chain Risk Management (SCRM) methodology. Another on-going concern for the Department is the trustworthiness of software in information systems, communications systems, and embedded systems. The Department is undertaking an important initiative in this area in accordance with Sec. 925 of the National Defense Authorization Act for Fiscal Year 2013 that addresses "Improvements of Security, Quality, and Competition in Computer Software Procured by the Department of Defense."

More specifically, research conducted by the DPAC Telecommunications Study Group established that the historical dominance of U.S. telecom providers and their technology vendors is waning in several strategic areas. If domestic weakness persists within critical subsectors and gives way to foreign ascendance, not only will the United States' economic competitiveness suffer, but access to the products and technologies that enable the future of secure communication networks for both the USG and private industry could be put at risk. For more information about this study group, see Section 6.1.1.

4.3 Contract Services Sector Industrial Summary

All DoD contract actions are classified by Federal Supply Class/Service Codes (FSCs), which map to 23 service categories. In order to identify strategic sourcing opportunities, the Office of Strategic Sourcing in the Defense Procurement and Acquisition Policy (DPAP) Directorate consolidated the 23 service categories into eight portfolio groups. These include the following, listed in order of largest to smallest total expenditure: Knowledge Based Services (KBS), Research and Development (R&D), Facilities Related (FR), Construction Related (CR), Equipment Related (ER), Electronics and Communications Services (ECS), Medical (Med) and Transportation (Trans).

An examination of data for company cross-participation in multiple service sector groups reveals a breakout into two major categories. One category has high levels of cross-participation in other service portfolio groups by the ten largest DoD contractors while the other category does not. The portfolio groups with high cross-participation include R&D, ER, KBS, and ECS, while those without include Trans, FR, CR, and Med. Defense-specific requirements are the apparent pattern of the category with high cross-participation by top-ten defense contractors.

In addition to cross-participation rates, the members of the two categories share another characteristic. As measured by the share of dollars awarded with sole-source contracts, every member of the defense sector is less competitive than every member of the commercial sector. Given an apparent pattern of defense-specific requirements, it is not a surprising observation.

The share of contract dollars going to mid-size companies is a topic of significant discussion. An analysis of mid-size company share by portfolio group does not share the pattern of defense-specific requirements or exhibit good correlation with competition for contracts. This leads to a conclusion that other factors are in play. Two specific factors that appear to be important but resist quantitative analysis are geographic specificity and business network. For example, a construction project is geographically specific whereas transportation utilizes a large network. A company is defined as being mid-sized if it has less than $1B in annual revenues but is not classified as a small business by government standards.

An important area of growing interest for industrial base analysis is examination and characterization of the supply chain for different sectors. While the supply chain for many types of goods has several layers of active business relationships, the supply chain for many types of services is one-deep, consisting only of the employees of the prime contractor. This is sometimes expanded to a second layer of subcontracted specialists. Still, many companies, even large ones, often serve their customers with "small" teams of employees working full-time on discrete projects that are often only loosely connected with other projects. Frequently, the customer makes the connections, if any, between projects. In these cases, a substantial majority of the intellectual capital of the business resides with the company's employees who, in at-will employment environments, are free to leave their current employers, start their own businesses with "small" teams of employees and compete for similar projects with relatively low barriers to entry.

Other service sectors are characterized by offerings of on-demand services with diverse expertise or geography, which in turn is characterized by the provider's prior development of a sophisticated supplier network without the support of the customer. The offering is also generally available to, and shared by, a large number of customers. Network set-up and sustainment is amortized over a large customer base and each buyer pays only the incremental cost of their services. An example of this concept occurs in transportation services such as package delivery or air travel. In these cases, a substantial majority of the value of the business is the existence and sustainment of an internal or external supply chain, and perhaps a physical infrastructure, able to provide small increments of complex services. A small group of employees could not form a viable business to compete for similar projects such as nationwide on-demand delivery or transportation services. The barriers to entry are relatively high. Because two-thirds of DoD research and development (R&D) costs consist of manufacturing development, advanced component development, and advanced technology development for major weapons systems, it's arguable whether R&D should be considered a service or as a separate intermediate R&D category that's neither a supply nor a service. Regardless of preference, the R&D category has all the characteristics described above of defense industry service sector members.

4.4 Ground Vehicles Sector Industrial Summary

With the surge to support the recent wars in Iraq and Afghanistan, the past decade has experienced growth in demand for military ground vehicles that has not been experienced since World War II. Now, with the military withdrawal from Iraq completed and the withdrawal from Afghanistan anticipated by the end of 2014, the future will bring an equally unprecedented reduction in work for companies that are dependent upon the U.S. military for business. The following table depicts the changes in ground vehicle funding requests from FY2010 to FY2013.

FY ($M)	2010	2011	2012	2013
Medium Tactical Vehicles	1,800	1,600	865	400
Light Tactical Vehicles	2,200	1,500	323	500
Heavy Tactical Vehicles	1,600	4,400	1,088	1000
Combat Vehicles	8,800	2,600	5,218	1,700
Total Ground Vehicles	14,400	10,100	7,494	3,600

Source: OSD Comptroller

Supplemental appropriations represent approximately 42 percent of the above figures. With their near elimination plus programmed reductions, the amount of funding available has been reduced by more than 75 percent. The three largest budgeted vehicle programs are the Family of Heavy Tactical Vehicles (FHTV), the Family of Medium Tactical Vehicles (FMTV), and the Stryker Family of Armored Vehicles. Funding for FHTV went from $650.4M in 2012 to $58.1 in 2013, a 91 percent reduction. Funding for FMTV went from $438M in 2012 to $377.4M in 2013, a 14 percent reduction. Funding for the Stryker Family went from $771.9M in 2012 to $332.3M in 2013, a 57 percent reduction. In comparison, the largest vehicle programs the prior three fiscal years were Mine Resistant Ambush Protected (MRAP) All-Terrain Vehicles (M-ATV) at $4.4B/year, High Mobility Multipurpose Wheeled Vehicles (HMMWV) at $2.1B/year, and the FHTV at $1.4B/year.

The Department has not acquired new combat tracked vehicles for many years, instead choosing to remanufacture and update legacy platforms. The Army upgrades and maintains its existing fleet of tracked vehicles using a combination of organic capabilities and the private sector. As a result, the average age of refurbished Abrams Tanks and Bradley Fighting Vehicles is only a couple of years. With the drawdown of the military, there are few requirements to continue remanufacturing these platforms, with the possible exception of Foreign Military Sales. Unlike combat tracked vehicles, the Stryker combat wheeled vehicle is still in production, but its quantities have also dropped off – from 292 in 2011, to 100 in 2012, to 58 in 2013.

Despite a lack of operational requirements, the Army is considering the need to bear the cost of continuing Abrams, Bradley, and Stryker production lines at a minimum sustainment rate (MSR) to maintain manufacturing capabilities and to avoid shutdown and startup costs resulting from a three-year production gap. Abrams ECP1 (FY17-FY18) and BFV ECPII (FY17) will help to revitalize the Combat Vehicle Industrial Base. The next major new combat vehicle to come on line is the Ground Combat Vehicle, but

it is not scheduled for a production decision until 2019. Since there is little new work planned over the next five years, manufacturing capabilities will undergo a substantial drawdown and consolidation across the industrial base. There will likely be a loss of at least some military unique engineering and manufacturing capabilities.

In 2012, the Department initiated a detailed fragility and criticality (FAC) analysis of the industrial base to better understand the effects of reduced vehicle requirements on industry capability. This effort was piloted using the Abrams tank supply chain, but was eventually expanded by the Army to encompass the entire combat vehicle fleet. The analysis looked at components and systems for the Abrams tank to determine the risks for parts and suppliers at the low demand rates expected in future years. At the same time, the prime contractor and major tank component suppliers conducted their own internal FAC assessment of their supply chains. The results of these parallel studies permit supply chain risks to be considered from both government and industry perspectives. The implications of offsetting little to no Army tank, Bradley and other vehicle remanufacturing work with potential Foreign Military Sales (FMS) scenarios are being compared to provide the roadmap for future year funding strategy profiles. The Abrams FAC assessment provided lessons learned and a blueprint for how other programs might conduct similar types of analyses.

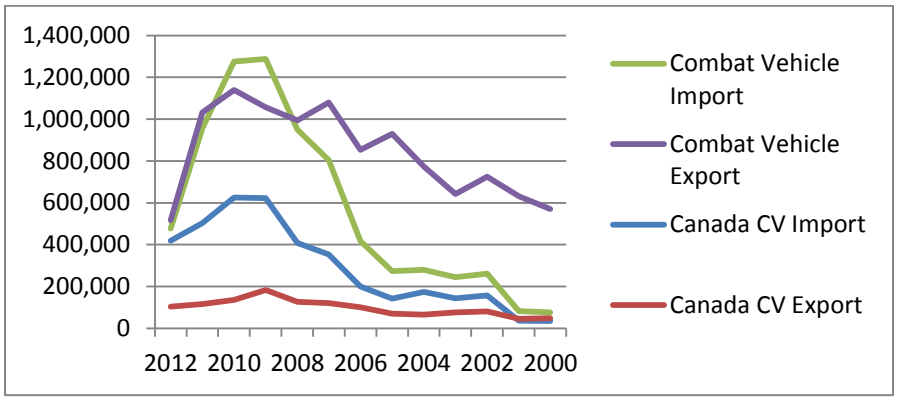
Tactical Wheeled Vehicle systems integrators are also facing much lower production requirements. Major programs such as the Armored Security Vehicles (ASV), HMMWV, and MRAP have entered the post-production phase. Combined, this program represents many thousands of new vehicles each year. Although demand for military vehicles has declined, there has been an increase from 306,189 in 2011 to 345,876 in 2012 class 8 trucks ordered by the private sector.

The only new wheeled tactical vehicle on the horizon is the Army and Marine Corps Joint Light Tactical Vehicle (JLTV) program. However, these programs are not expected to exceed a production rate of more than 1,000 vehicles per year until FY2018. As a result, military tactical wheeled manufacturers will also undergo drawdown and consolidation. Nevertheless, the JLTV does offer an opportunity for at least one vehicle manufacturer to maintain its capabilities. JLTV is currently in the Engineering and Manufacturing Development phase of its Defense Acquisition Life Cycle. One possible issue is that the Army and Marine Corps may request different configurations for their missions, thus increasing the cost of the vehicles overall.

The loss of military vehicle economies of scale could have repercussions for the industrial base. Fortunately, growth in the commercial truck business is offsetting some military business losses. This is especially true for dual use companies who service military and commercial markets, such as engine, transmission, and axle suppliers. These companies are less susceptible to swings in military budgets. While a decline in military vehicle work is expected, companies that service both commercial and military markets will fare much better than those that only service the military. In addition, companies that specialize in retrofitting and refurbishing of existing military vehicles will

fare better than those that do not. However, they must compete or partner with the DoD depots for this work.

The geographic regions most affected by the drawdown in military vehicle manufacturing are the upper Midwest and Great Lakes. A majority of manufacturers in the military ground vehicle supply chain is located within these geographic areas. It reflects a strong relationship between military and commercial automotive supply chains in the U.S. and Canada. Over the past few years, there has been increased globalization of combat vehicle imports and exports but, due to the budget drawdown, this activity has diminished. The following chart is compiled from U.S. International Trade Statistics data for Military Armored Vehicles, Tanks, and Tank Components for the past 13 years of the import and export of military vehicle goods, services, and supplies.



Source: U.S. International Trade Statistics

Although the previous chart implies there is currently little global influence in the combat vehicle market, potential advancements in global technologies such as electronic and autonomous systems and material sciences will eventually lead to affordable opportunities for technology refresh, automation and enhanced protection of military vehicles. Developments in improved power management, communication, command, control, situational awareness and safety for soldiers and marines will work their way into future vehicle requirements. The question is: When will these enhanced capabilities be mature enough for adoption? Current acquisition planning implies it will not occur for many years. However, advancements in weight reduction, mobility improvement, increased fuel efficiency, and reduced manufacturing costs in the commercial vehicle sector will eventually migrate to military vehicles, which will inevitably lead to new business opportunities for industry.

4.5 Materials Sector Industrial Summary

Access to the basic materials needed for producing intermediate products, components, and finished products is integral to the nation's manufacturing base, and thus to the nation's overall economic and national security. This requires robust and diverse material supply chains. Typically, to accomplish this, material supply chains rely

on considerable international trade, including basic raw material inputs through intermediate and fabricated materials products. However, actions taken worldwide can distort supply chains. These may include export controls which distort trade patterns and price structures, as well as differing approaches to the regimes governing mining activities which serve to make mining more attractive in some countries over others. Generally, the requirements of the defense industrial base represent a small percentage of overall U.S. demand for materials. U.S. consumption and supply chains are focused on serving the needs of the commercial sector. Therefore, maintaining a vibrant commercial manufacturing base is essential to the health of the defense industrial base.

Rare earth elements constitute a group of materials with numerous commercial as well as defense applications. These materials gained considerable attention in 2011 as prices increased drastically and concerns rose over their availability especially due to one nation, China, being the source of over 95 percent of the global supply. However, global market forces are leading to positive changes in rare earth supply chains and a sufficient supply of most of these materials likely will be available to the defense industrial base. In fact, there has been a significant reversal in the situation in 2012 from the prevailing market conditions in 2011. Overall demand for rare earth materials has decreased considerably from the previous year. A leading global expert forecast in August 2012 that 2012 global demand is expected to be 20 percent less than forecast in early 2011. Similarly, this expert believes that demand in 2016 will be 20 percent less than forecast in 2011. One factor contributing to reduced demand is the substitution of other materials for rare earth materials. There has also been reduced rare earth usage in individual applications and a drawdown in inventories accumulated the previous year. In conjunction with these factors, there has been an increase in supply of material from outside of China. As a result, prices for most rare earth oxides and metals have declined approximately 60 percent from their peaks in the summer of 2011.

A strengthening and diversification of the supply chain for rare earth materials, including in the U.S., is anticipated in the coming year. The private sector's reaction to market forces has been to increase exploration for rare earth materials and development of downstream processing capabilities. According to one industry expert, there are over 400 rare earth projects under review globally, approximately four dozen of which may be considered in advanced stages of development in over a dozen countries worldwide. Two new projects in particular should have a significant impact on markets in 2013. Rare earth oxide production that has commenced in the U.S. and Malaysia based on mined material from the U.S. and Australia, respectively, will add approximately 40,000 tons of oxide production capacity to global supply in 2013, close to one-third of forecasted demand. Furthermore, the facility in the U.S. will have the capability to increase its capacity by an additional 20,000 tons in 2013.

The market for rare earth elements, though, is not homogeneous, as each element has its own distinct market fundamentals. Thus, there are individual rare earth materials and processing capabilities for which concerns remain regarding their availability, and for which the Department has taken action to address supply concerns. These include certain heavy rare earth elements and the ability to produce related high

purity oxides, metals, alloys, and rare earth permanent magnets. In general, the domestic supply chain for all of these exists, but is thin. One important market segment for which there has been no domestic production is sintered neodymium-iron-boron magnets. However, a domestic facility to produce these magnets is under construction and operation should commence in by the end of 2013. In addition, a U.S. producer of rare earth materials, through a joint venture with Japanese companies, has developed the technology for producing these magnets and is building a facility in Japan. Currently, China and Japan are the principal sources for these magnets, and presently, China is the ultimate source for most of the rare earth material required to manufacture the magnets in Japan. However, the U.S. will grow as a source. Thus, while diversification of the supply chain will continue, international trade will remain an integral aspect of rare earth markets.

The Department is reaching out to industry to identify areas of concern in the supply chain and address shortcomings. The Department is conducting research in cooperation with a domestic producer to develop an economic and environmentally superior process for producing rare earth metals. The Department also has provided funding for research projects focused on domestic supplies of heavy rare earth elements and addressing gaps in the associated supply chains. In addition, in 2012, the Department provided two reports to Congress regarding rare earth supply chains. The first report, as required by Section 853 of the FY 2012 National Defense Authorization Act (NDAA), assessed the feasibility and advisability of establishing inventories of rare earth materials. The second report, pursuant to House Conference Report 112-329 of the FY 2012 NDAA, is an assessment of the feasibility and desirability of recycling, recovering, and reprocessing rare earth elements from the Department's waste streams, including from fluorescent lighting.

Another material that has garnered significant recent attention is titanium and concerns about its availability. In the past, the defense industrial base represented a significant share of demand for titanium, but its share has steadily decreased and now represents less than ten percent of the overall domestic market. The commercial aerospace industry is now a major industry for titanium since the introduction of aircraft that are larger and more titanium intensive than in the past. The titanium market has also experienced an increase in broader industrial uses. The announcement by Boeing of plans to double the build rate for the Boeing 787 by the end of 2013, as well as increases in the production of other such commercial aircraft in conjunction with expected increases in JSF production, should result in solid demand for titanium in the coming year. This confluence of programs simultaneously exerting pressure on the supply chain caused DASD(MIBP) to review the titanium sector as part of its initial sector-by-sector, tier-by-tier analysis. It was determined that this demand, though, had been expected to materialize sooner by the domestic industry, and that the industry is prepared to meet the increase in demand as a result of capacity expansions it undertook in anticipation.

The DPAC Metals Fabrication Study Group determined that domestic heavy forging capabilities are currently at risk because of market segmentation due to the low-

volume, specialty-demand of the Department. It is working to address these issues, particularly in the areas of castings adaptability and machining. Additional information about these efforts can be found in Section 6.1.1. In addition, the Department is investing in a Title III project to upgrade and refurbish equipment at the single domestic source for heavy forgings for DoD applications including propulsion shafts for surface and sub-surface naval vessels, periscope tubes, ring forgings for bull gears, and reactor vessels. This project will address production constraints and single points of failure that are critical to maintain the supply of heavy forgings to the DoD. For more details, see Appendix C.1.

Recognizing the increasing global demand for materials, the diminishing role of demand from the defense industrial base, and the susceptibility of supply chains to distortion, the Department is engaged in a number of activities aimed at continually assessing the ability of material supply chains to provide reliable and cost-effective products to meet the requirements of the nation's Warfighters. For example, the Department co-chairs (with the Department of Energy) a working group of the recently chartered National Science and Technology Council's (NSTC) Committee on Critical and Strategic Minerals Supply Chains. The working group, Material Criticality Assessment and Early Warning, will assess the material needs associated with the technologies that will be essential to future economic growth, as well as those that will be required by the defense industrial base. This effort provides synergies to efforts undertaken by the Department, such as those in DLA Strategic Materials, which are focused more narrowly on the defense industrial base.

4.6 Munitions and Missiles Sector Industrial Summary

The munitions and missile industrial sector consists of DoD's smart bombs, and tactical, missile defense, and strategic missiles. For this report, it does not include ammunition, mortars, or tank rounds. The munitions and missiles industrial sector is primarily a defense unique sector. The munitions and missiles development and production market has contracted, resulting in aggressive competition for limited new program opportunities. Most current missile development activity consists of modifications to existing systems. Over time, the Department has provided the necessary resources to allow the industrial sector to ramp up production for munitions and missile systems to support Warfighter needs when the country is engaged in conflict, and reduces these resources when the conflict ends. This cycle of rapid ramp-ups followed by precipitous declines of demand and production adds significant supplier capacity management challenges to munitions and missile suppliers and their critical sub-tier providers.

Within the munitions and missile sector, two prime contractors account for roughly 85 percent of the Department's munitions and missile procurement funding. These prime contractors provide a full complement of missile types across the munitions and missiles sector and, for the most part, are able to meet defense unique technical performance requirements, but not without concerns. Roughly half of the

Department's munitions and missile production programs are operating at facility utilization rates equal to or less than 50 percent. DoD's prime contractors and their associated sub-tier supplier base must align company production capacities with expected DoD budget realities, while ensuring the industrial capabilities needed for our next generation weapon systems are sustained.

As already constrained DoD budgets become more strained by continued budget uncertainty and higher priority programs like operational readiness and aircraft and ships procurements, investments in munitions and missile research and development and subsequent procurements may be further reduced. The munitions and missiles industrial sector faces a number of industrial capability challenges. These challenges fall into two broad categories: (1) sustaining our design and engineering teams and (2) sustaining the sub-tier supplier base.

Sustaining Missile Sector Design and Engineering Industrial Capabilities

Most of the research and development funding in the munitions and missile sector is associated with legacy program upgrades or modifications, which limit competitive opportunities. The shortage of new missile program developments inhibits the Department's ability to fully exercise the industrial capabilities necessary– from design concept, system development, and production – to meet current and future national security needs. The Joint Air-to-Ground Missile (JAGM) is the only "new" missile development program in competition and it has been restructured as a technology development program. An indication of the concern for missile design engineering capabilities can be seen through the development of the newest DoD strategic missile in the U.S. inventory, the Trident D5 missile. This missile began its development in 1978, which built upon the development of the Minuteman III that had its inception in the 1960s. Both of these strategic systems, the Trident D5 and the Minuteman III, will eventually reach the end of their operational service lives as currently configured, and will require either modification or replacement. Both the Navy and the Air Force are developing requirements for next generation missiles: Navy Offensive Anti-Surface Warfare (OASuW) and Air Force next gen Air-Launched Cruise Missile (ALCM). However, the Department remains concerned that the design engineering capabilities needed for these systems may not be readily available should the sector atrophy in the absence of demand. The following table provides a sampling of when some of our missile programs began development and lists the current program variant.

DoD Missile Program Updates			
Missile Program	**Development Started**	**Production or Delivery Started**	**Current Variant**
AIM-9 Sidewinder	1946	1953	AIM-9X
AMRAAM	1979	1988	AIM-120D
Hellfire	1974	1982	AGM-114N
TOW	1963	1968	TOW-2B
Patriot	1969	1981	PAC-3 MSE
Standard Missile	1963	1967	SM-6
Trident D5	1978	1987	D5
Minuteman III	1964	1968	MM III
Tomahawk	1970's	1983	Block IV
JASSM	1995	2001	JASSM-ER

Source: DASD(MIBP)

The contraction of the munitions and missile development and procurement market has created a situation where expertise in defense-unique technologies is thinning in both the contractor and the Federal government workforce. Declining munitions and missiles research and development funding, coupled with limited competitive opportunities projected in the near-term for new munitions and missile systems, will make it difficult for the missile sector industry to attract and retain a workforce with the industrial capabilities to design, develop and produce future missile systems that will meet national security requirements. Continuing our S2T2 activities will improve the Department's ability to identify at-risk design capabilities. Two examples of at-risk sub-tier sectors include:

- *Missile Propulsion Systems*: Sustaining the design engineering skills for missile propulsion systems is at risk. The Department relies on the viability of a small number of SRM and turbine fan engine propulsion providers to sustain propulsion technology and design engineering skills. Many of the Department's missile upgrade and modernization programs utilize the existing propulsion system. Decreased Navy Tactical Tomahawk cruise missile production quantities (and the potential for future production quantity reductions), Air Force delays to the JASSM-ER LRIP program, few new start missile or upgrade programs that develop new propulsion systems, and the lack of future research and development technology investments threaten the viability of the missile propulsion technology and engineering capabilities. Developments in foreign nations have led to higher speed, longer-range weapons and advanced air defense capabilities abroad. These increased capabilities will compel the U.S. to pursue improved standoff, survivable and responsive missiles. Without sustainment of the existing missile propulsion industrial base, future development of missile programs could be delayed by five to ten years or more while the U.S. is reconstituting its propulsion design and engineering capabilities. Preserving the existing national missile propulsion capability, with an emphasis on the design engineering team, is of utmost importance.

- *Tri-mode Seekers*: Tri-mode seekers are defense unique systems that offer a technologically advanced capability. Over the years, the Department fought to maintain two competitive sources for these systems to ensure we maintained competitive design teams for current and future applications. These systems require a highly trained and unique design engineering and production workforce. While seekers have a broader cross-defense sector market, they are predominantly provided by the munitions and missile prime contractor because it considers this capability a core competency.

Sustaining Missile Sector Sub-tier Suppliers

The health of sub-tier suppliers in defense unique fields is a serious and valid concern. Examples of defense unique fields in this sector are radomes, infrared domes, sensor arrays, thermal batteries, actuators, advanced electronic components and assemblies, warheads, and propulsion systems. Important sub-tier components in the munitions and missile industrial segment that continually face excess capacity challenges include thermal batteries, solid rocket motors (SRMs), fuzes, jet engines, inertial measurement units (IMUs), global positioning system (GPS) receivers, seekers, and warheads. The suppliers that provide these components are important because these components are used on multiple programs and some require 12 months or more to manufacture. Some of these sub-tier supplier products have broader cross industrial sector and commercial applications that provide a more reliable and stable market base to sustain our industrial design and production capabilities like the IMUs, GPS receivers, and seeker product sectors, while others are more unique to the munitions and missile industrial sector.

The munitions and missile industrial sector is routinely impacted by significant shifts in DoD demand as a result of various factors – including initiation of new conflicts, conflict drawdowns, and the fact that weapons represent the most fungible of the products that the DoD procures in terms of procurement quantities. Decisions on quantities for ships, combat systems, and radars tend to be binary in that one is procured or isn't, but with weapons that isn't the case. This flexibility in weapons procurement quantities has tended to result in weapons being used as bill payers and the resultant impact of a declining business base. The Department is concerned with the ability of our munitions and missile prime contractors to manage and sustain critical sub-tier suppliers during these shifts in demand. Some of these critical sub-tier suppliers are single or sole source providers and some are foreign. As the Department draws down its operations in Iraq and Afghanistan, it is monitoring the impact of reduced demand on the sub-tier supplier base through continuing S2T2 assessments of the defense industrial base, in close cooperation with the Military Departments. The Department expects to identify a growing number of industrial capability risk areas as sub-tier suppliers realign and adjust their industrial capacities to new DoD budget realities. Using data obtained through the S2T2 analytic process, the Department identified several examples of defense unique at-risk areas – the solid rocket motor, thermal batteries, fuzes, and steel forged bomb bodies. Some of these areas of concern are described below.

- *Solid Rocket Motors (SRMs)*: SRMs are predominantly defense unique items upon which the Department depends. The certainty of demand is at risk because munitions and missiles are often used as bill-payers in fiscally constrained environments. The challenge is the high cost of reconstitution should the SRM industry encounter a significant production gap, particularly in the large, over 40-inch diameter segment of the market. NASA's retirement of the Space Shuttle and the transition of the Constellation program to the Space Launch System have resulted in significant under-utilization of existing capacity.

- *Thermal Batteries*: All DoD missiles and Precision Guided Munitions (PGMs) use thermal batteries. Thermal batteries are predominantly defense unique items. The domestic thermal battery industry has historically been dominated by one company, with little participation by other firms. The two other domestic companies that produce thermal batteries constitute less than 20 percent of the DoD thermal battery market. The dependency on one dominant thermal battery supplier makes this industry at risk.

- *Fuzes*: Fuzes are defense unique items. They are used on all munitions and missile programs. While funding for munitions has remained healthy over the last ten years, continued improvements in guided systems significantly reduce the quantity of fuzes required for our current and future systems. This has contributed to excess capacity in the fuzes sector. Excess capacity limits manufacturers from being cost competitive and sustaining a viable design engineering cadre. The U.S. currently has three full-capability fuze design manufacturing suppliers. The fuze prime contractors are aggressively managing several defense unique sub-tier component areas, such as electronic energy devices (e.g., bellows actuators), liquid reserve batteries, and certain obsolete electronic components, to ensure their ability to design and produce fuzes in the future.

- *Steel Forged Bomb Bodies:* Steel forged bomb bodies are a unique defense item. The Department relies on a sole source for the MK80 series bomb bodies used in the 500/1000/2000 lb. bombs. Projected procurements are down drastically. The producer is a large parent company; however, the business unit is at high risk of financial distress due to the projected downturn in procurements. Other technologies have been explored to include Cast Ductile Iron (CDI); however, this technology has not been qualified as a replacement for all applications.

Additionally, the Department has previously identified several sub-tier supplier issues of critical materials that require mitigation. These materials have been identified and provided to decision makers, including the OSD-level Critical Energetic Material Initiative (CEMI), for risk mitigation strategy development and execution. Examples of domestic and foreign source supplier issues are highlighted below:

- *Ammonium Perchlorate (AP)*: One sole U.S. supplier for AP remains for the SRM industry (both small and large diameter systems). The size and grain of the AP used in defense applications is unique to the SRM market. Demand for production of AP is well below historic levels and approaching the minimum sustaining rate (MSR). Volumes have fallen so low that there is a risk that the vendor may not be able or willing to sustain its workforce skill levels and the supply chain, while remaining competitive. The Department is working across the Government to preserve this capability as well as invest in future capabilities.

- *Butanetriol (BT)*: The Department is currently dependent on a foreign source for BT. Butanetriol, identified on the U.S. Munitions List (USML), is a chemical precursor needed for production of butanetriol trinitrate (BTTN), a nitrate ester/plasticizer (part of the binder), used in the production of SRMs for the Army's Hellfire, TOW-2, Griffin and Javelin missile systems. The previous BT source discontinued production of the chemical in 2004. At that time, the Department's BTTN provider acquired the remaining inventory and began looking for another supplier. In 2007, the Army conducted a global search for sources of BT. Only one source was identified that could produce at the quantities and quality required. However, Section 1211 of the National Defense Authorization Act for Fiscal Year of 2006 prohibits the acquisition of items listed on the USML from companies such as this producer unless a waiver is approved. The Secretary of the Army signed a waiver in 2008 and 2011 to prevent a production gap until the Department can develop a domestic source. The U.S. Army expects to have a new source qualified by the end of FY2013.

- *Rayon Precursor Material*: Rayon precursor material is commonly used to produce high thermal resistance in SRM nozzles and other space composite applications. The sole U.S. supplier of rayon precursor material shut down its facility in 1997. However, the Defense Department and NASA were able to purchase the remaining stockpile of rayon precursor material for use while they, along with the SRM prime contractors, are continuously working to qualify another source to fill this supplier void.

- *Triaminotrinitrobenzene (TATB)*: TATB is one of the least sensitive explosive materials known. This material is predominantly used in PBXN-7 and PBXW-14 for fuze applications. TATB has not been produced since 2006. The Department awarded the TATB Phase I Mod and Phase II Facilitization contracts in July and August of 2011. The TATB plant design completed earlier this year is based on the Benziger process and leverages existing infrastructure. Process prove-out, completion of consecutive specification compliant production runs, and formulated production scale batches of PBXN-7/PBXW-14 are expected to be completed in FY2013.

- *Antimony Sulfide*: Antimony Sulfide is a component of energetic compositions used in percussion primers and several fuze/detonator ignition trains that support over 200 DoD munitions. It is also an industrial commodity material used

commercially to manufacture flame retardant plastics and textiles. Antimony Sulfide is refined from stibnite ore that is mined underground. Large deposits of stibnite ore are located in the earth's crust. There are no known mines producing acceptable grade ore under U.S. or NATO partner control. China is the largest producer of antimony sulfide and controls its availability on the world market. The Army Research and Development Engineering Center (ARDEC) has ongoing efforts to identify and qualify alternative percussion primer compositions that do not contain antimony sulfide and other similar materials that are foreign dependent or environmentally undesirable.

The Department will continue to monitor at-risk areas within the munitions and missile sector using various analysis tools, to include S2T2 assessments, and will identify additional mitigation strategies, as warranted.

4.7 Shipbuilding Sector Industrial Summary

The shipbuilding industrial base is highly concentrated. In the U.S. shipbuilding and repair industry, the largest 50 companies account for about 90 percent of the combined annual revenue of about $21B. The defense industrial base for shipbuilding is comprised of two major primes, General Dynamics and Huntington Ingalls (formerly a unit of Northrop Grumman) and their subsidiaries, and a thin layer of second tier industrial base suppliers. The result is a shipbuilding and repair supply base that is often one-deep in specialized capabilities.

The industrial base necessary to build and maintain platforms for Defense relies on a complex, heavy industry where ships are procured at very low annual production rates that require significant capital investment and infrastructure, coupled with a wide range of technical capabilities designed for operations at sea, undersea, and air, often requiring unique design and engineering skills. Yet research and development investment is low, and building ship prototypes is infeasible. Accordingly, procurement and modification contracts are key mechanisms for maintaining shipbuilding design engineering skills in the U.S.

In 2012, the shipbuilding sector remained generally stable. However, it is unclear at the writing of this summary what the impact of an extended budget sequestration may have on the mix of future force structure and on the contracts awarded to companies for future year deliveries. Given the reliance of the shipbuilding sector on defense procurement contracts to maintain skills and infrastructure, changes in quantity and/or fleet composition will need to be assessed for impacts on the primes and sub-tier suppliers moving forward.

At the prime level in defense shipbuilding, shipyards and major tier-one suppliers remain in stable financial health with little growth in revenue. As a result of poor fourth-quarter revenues, General Dynamics (GD) Marine Systems reported relatively flat revenues (decrease of 0.6 percent) and an increase of 8.5 percent in operating earnings

for CY2012. GD-Electric Boat is the prime contractor for the Virginia-class program that includes 30 submarines. The group has delivered ten of 18 boats under contract, in conjunction with an industry partner that shares in the construction of these vessels. The remaining eight boats under contract extend deliveries through 2018. GD-Bath Iron Works delivered the final DDG-51 ship under a prior multi-year procurement contract in 2012, and was awarded construction contracts for two destroyers under the Navy's restart of the DDG-51 program, scheduled for delivery in 2016 and 2017, and was awarded four ships under the FY2013-2017 multi-year procurement contract. The group is also currently building the three ships planned under the DDG- 1000 destroyer program, the Navy's next generation, guided- missile naval destroyer. GD-NASSCO was awarded a construction contract for a third Mobile Landing Platform (MLP) auxiliary support ship in 2012, has delivered MLP 1, and will complete MLP 2 in early 2014. Delivery of the final 14-ship T-AKE program was completed in 2012, which may result in excess production capacity at the shipyard, creating a potential risk that needs to be monitored. GD-NASSCO continued its partnership with a design firm in South Korea to design commercial containership and tankers. In late 2012, GD-NASSCO was awarded a new contract to build two commercial LNG-powered containerships and in 2013 was awarded a contract to build four commercial petroleum tankers.

Huntington Ingalls Industries, Inc. (HII) reported modest growth of sales and services revenues (an increase of two percent). HII plans to consolidate shipbuilding from the Avondale shipyard into the Pascagoula facility in 2014. HII is the sole supplier of aircraft carriers and amphibious assault ships to the Navy, the sole builder of the National Security Cutters for the U.S. Coast Guard, and the sole source maintenance provider for the aircraft carrier refueling complex overhauls (RDOH). They also team with GD-Electric Boat in constructing Virginia Class submarines. The first ship of the U.S. Navy large deck amphibious ships, LHA-6 America-class, is under construction with builder's trials beginning in November 2013. HII was awarded the construction contract for LHA-7 Tripoli in 2012. HII currently is constructing several classes of amphibious transport dock ships (LPD), with three scheduled for delivery in FY2013, and two more for delivery in 2016 and 2017. As with GD, the restart of the DDG-51 program has resulted in new awards for HII, with construction of two destroyers scheduled for delivery in 2016 and 2017, and the award of five ships of the FY2013-2017 multi-year procurement contract.

The mid-tier[4] shipbuilding suppliers were stable in 2012. Mid-tier shipbuilders are the primary source of littoral combat ships (LCS), combat logistics ships, and other support ships. Variants of LCS awarded in 10-ship block buy awards have provided stable workloads for shipyards including, for example, Austal USA and the Lockheed Martin-led industry team at Fincantieri's Marinette Marine Corporation. This has resulted in significant capital investment for modernization and workforce training.

[4] While there is no generally accepted definition of a mid-tier shipbuilder, mid-tier yards typically employ more than 200 people but rarely more than 600-800. They tend to construct small- to medium-sized vessels and a high level of subcontracting is common. In addition, the yards tends to have lower levels of investment than the large yards and the overhead structure is generally lean with managers often having multiple roles.

As in earlier years, consolidation and vertical integration continues in the shipbuilding sector. For example, GD-Marine Systems acquired two ship-related businesses in 2012, one to support Navy ship repair, and another a provider of applied submarine research and development services. With the potential for slower procurement levels, continued consolidation in the sub-tiers is anticipated. These manufacturers are typically smaller companies that are more vulnerable to program and schedule changes than the firms they supply. Additionally, they are often more reliant on DoD business to remain profitable and to sustain their product lines. Delays and/or cancellations of major programs often financially cripple these companies or drive them out of business. While aftermarket support represents a significant portion of the valve and actuator business, they typically support only component parts vice the fully assembled component or system. The resulting effect is that valves and actuator manufacturers are consolidating to sustain their operations, remain competitive, and meet U.S. Navy requirements. For example, in the 1990s, four domestic companies manufactured naval main reduction gears: General Electric, Northrop Grumman, Philadelphia Gear, and Cincinnati Gearing Systems. Today, only two domestic and one foreign supplier remain – Northrop Grumman, Philadelphia Gear, and Germany's Renk AG.

Sole- and single-source suppliers continue to be a source of risk for the shipbuilding industry. For example, while medium-speed diesel manufacturing in the U.S. is stable, there is limited U.S. design capability. As a result, our nation's industrial base is limited to manufacturing the Navy's engines only under a license agreement from a European company, European Diesel Manufacturers. That is to say that all U.S. marine medium-speed diesels are manufactured to a European design.

4.8 Space Sector Industrial Summary

Space systems are used continuously, every day, around the world. Space capabilities have become an indispensable component of global commerce, communications and information infrastructure. Global Position Systems (GPS) provides a global utility that supports both commercial and military applications alike. Space systems remain fully integrated with and a crucial element of military power projection. The space industry worldwide continues to grow. European nations are advancing their capabilities, a number of Asian nations are investing heavily in space, and at least 55 nations now have some degree of space involvement, whether through research, academia or the production and deployment of actual space systems. As of May 2012, there are an estimated 994 active satellites in orbit, with 58 percent of those satellites being commercial, civil or military communications satellites.

Although the U.S. is the overall world leader and investor in the space arena, its global dominance is slowly eroding. The Futron *Space Competitiveness Index (SCI)* shows the U.S. SCI ranking has gradually decreased about one percent each year, with a four percent total drop from 2008 to 2012. The U.S. space industrial sector remains

stable, with the potential for modest growth in the coming years, despite the global recession and expanding foreign competition. Eleven of the top 15 companies ranked in the *Space News* list of the Top 50 global space companies (by sales) were U.S. companies. The U.S. government outspent all other nations combined in 2011, establishing 67 percent of the global total for government space budgets. However, this is a significant reduction of seven percent, from 74 percent, in 2010.

According to the Satellite Industries Association (SIA) *State of the Satellite Industry Report*, dated September 2012, in 2011, the global space economy grew for a sixth year in a row, at a robust rate of 12.2 percent, principally due to growth in commercial space services and the commercial infrastructure and ground equipment sectors of the broader space economy. Due to the overall expansion of the global space economy, the market entry of new space-faring nations, and the proliferation in the use of either space-based or space-enabled services, the space sector has continued to grow, year-over-year, despite degraded global economic conditions. The five-year growth rate for the sector is a healthy 41 percent. Worldwide space revenues in 2011, the last year for which complete data has been compiled, were approximately $290B. According to the Space Foundation's *The 2012 Space Report*, the U.S. government space budgets remained basically level at $47B in 2011, while global government space budgets grew at an aggregate rate of 6 percent. Russia, India and Brazil each increased government space spending by more than 20 percent in 2011; Europe's investment grew at a modest seven percent; and the U.S. and Japan spending were basically level, compared to the prior year.

In 2011, the U.S. captured 66 percent of global space revenues, at $53.7B, with Europe retaining another 27 percent, or $22B, of the space market. All four segments of the space industrial base – satellite services, launch, satellite manufacturing and ground equipment – posted growth in 2011.

Global launch industry revenues increased by 10 percent in 2011. In 2011, there were 84 launches, 14 percent more than the previous year. Russia led with 31, China had 19, and the U.S. had 18 (three more than last year), marking the first time that Chinese launches exceeded those of the U.S. Commercial launch orders, globally, were down sharply in 2011, decreasing from 49 to 30 launches. The U.S. share of these orders dropped dramatically, to 10 percent, from 41 percent in 2010. The majority of worldwide launch revenues continue to come from government launch orders. Despite lower orders for commercial launches, U.S. launch revenues, as a whole, actually rose to $1.9B, a 12 percent increase over 2011, accounting for almost 40 percent of global revenues. This increase marks a departure from 2009-2010, where global launch revenues decreased by four percent. Seventy percent of 2011 U.S. launch revenues were derived from U.S. government contracts.

Overall, global satellite industry growth in 2011 was five percent and has averaged approximately 11 percent per year over the past five years (2006-2011). According to the Futron SCI report, the U.S. remained the world leader in spacecraft manufacturing in 2011, building 44 spacecraft and garnering approximately one-third of

the global market in terms of the number of space vehicles. During the same period, Russia produced 25 spacecraft. China vaulted over Europe to become the third largest producer with 20 space vehicles, an increase of almost 200 percent since 2009. In 2011, Europe decreased by over 35 percent to just 15 spacecraft, likely a result of fiscal austerity and growing global competition. India, Japan, Israel, and the remainder of the world accounted for production of approximately 25 spacecraft.

U.S. satellite manufacturing revenues worldwide increased by 10 percent, to $6.2B, in 2011. This increase marks a departure from 2009-2010, when global satellite manufacturing revenues decreased by 20 percent. The U.S. share of the global satellite manufacturing revenue remained constant at 52 percent. The U.S. is the leader in the manufacture of larger, commercial communications satellites, capturing 50 percent (77 out of 154) of the announced orders for commercial geosynchronous satellites between 2006 and 2011. This fact, in addition to technologically complex and profitable government satellite orders, leads to the disproportionately larger U.S. share of global satellite manufacturing revenues.

Growth in the space industry writ large is principally being driven by consumer demand for direct-to-home (DTH) television and GPS devices and chipsets. High Definition Television (HDTV) and increasing numbers of channels continue to drive growth in satellite service revenues, which were up six percent in 2011. The advent of HDTV will drive not only growth in transponder agreement revenues, but also consumer or subscriber demand. Since approximately 70 percent of HDTV channels currently serve the Americas, analysts continue to see significant growth potential for increased deployment of HDTV in both Europe and the Asia-Pacific. This forecast – and the continuing growth in HDTV channels worldwide, which, year-over-year, is over 30 percent – demonstrates the potential for continuing growth in the commercial satellite communications industry going forward. Satellite radio and Broadband internet services also continued growth in 2011, serving primarily North American markets. Sales of satellite-related ground equipment included network and gateway hardware, as well as consumer equipment, including satellite TV and broadband dishes, mobile satellite terminals and stand-alone GPS devices and chipsets. The proliferation of GPS devices and the use of GPS services in personal navigation devices, in-vehicle navigation systems, shipment tracking devices, and precision measurement instruments have driven development of a broad range of applications and customized hardware for a very large number of devices. A side benefit of the continued growth in the commercial telecommunications market is that it provides the U.S. government ready access to a healthy commercial communications satellite industry to meet its current and future needs.

The global recession is still having a modest negative impact on employment in the space industrial sector. According to the SIA, and using the most recent Bureau of Labor Statistics data available, the U.S. satellite industry continues to lose jobs (2,169 jobs in 2011), just as it had the previous year (a revised 7,302 jobs in 2010). In 2011, three out of four segments, including satellite services, manufacturing, and the launch industry, lost jobs, while the ground equipment sector grew slightly (1.6 percent). SIA's

current estimates for third quarter 2011 employment are well below the ten-year average of approximately 260,000 personnel, cited in the annual 2012 *Space Report* from the Space Foundation. The 2012 *Space Report* also documented a decline in the U.S. space workforce for the fifth year in a row, dropping three percent in 2010. SIA data reflected a one percent reduction in 2011, through the third quarter of 2011. This was the second-lowest employment level recorded for the industry, during the previous ten years. Conversely, Europe and Japan both saw increases in their space workforces in 2011. The U.S. military space workforce rose to 16,739 in 2011, a six percent increase from 2009. The Air Force space workforce grew eight percent, while the Navy space workforce declined five percent.

Modest consolidation continues to occur in the space industry, largely as a result of planning for future declining government space investment budgets. Companies must make decisions regarding divestiture of lower-performing units while acquiring or restructuring other business units to increase margins and prepare for potentially lower sales. Notable mergers and acquisitions in 2012 included the acquisition of commercial satellite manufacturer Loral Space Systems by Canada's McDonald Dettwiler Associates, Ltd.; the merger of DigitalGlobe and GeoEye commercial imaging providers; GenCorp's (Aerojet) acquisition of rocket manufacturer Pratt & Whitney Rocketdyne (part of United Technologies Corp); and United Technologies' acquisition of space hardware manufacturer Goodrich Corporation.

Financial Analysis of the Space Sector

Financially, within U.S. public markets, the Space Foundation Index (a weighted index that tracks the performance of space industry companies) recorded a third straight year of gains, completing 2011 with a 6.81 percent increase in value. The index outperformed both the S&P 500 index, which posted no gain for the year, and the NASDAQ Composite, which finished down by almost two percent in 2011. The index tracks the market performance of 28 publicly held companies that derive significant revenues from the sale of space-related infrastructure, including hardware, software, and integration services for space related applications, such as the manufacture of satellites and launch vehicles or ground based equipment such as terminals and chipsets.

DASD(MIBP) performed a financial analysis of 37 U.S. companies that represent a broad cross section of the space industrial base to include: satellites, launch services, ground systems, satellite components and subsystems, networks, engineering services, payloads, propulsion, and electronics. DASD(MIBP) looked at financial ratios for margin, profitability, short-term liquidity, and long-term solvency.

While there were a few exceptions, the space sector, as a whole, is financially sound. All companies in the analysis were covering cost-of-goods sold with positive gross margin. Net margin was positive for all but eight sample companies and two of those companies were within 1.3 percent. The average return on assets was positive for all but three sample companies. The average return on equity was positive for all

but six companies. In terms of liquidity and long-term debt, the industry is solvent on average. However, about half of the firms analyzed had less than optimal liquidity and debt ratios. Similar to 2011, four companies stood out as having both profitability and debt challenges. Three of those four companies are the same as 2011 and all will be closely monitored as part of DoD's annual S2T2 assessments, in coordination with other DoD agencies.

In addition to the above facts, it is also well understood, based on recent S2T2 and DOC-led analyses, that a significant number of vendors in the lower tiers of the space industrial base are both critical and fragile (as described in the FaC assessment methodology in Section 3.0). Analysis of a subset of the Commerce-led Space Deep Dive assessment data has demonstrated that between 5-15 percent of the sub-tier base is financially stressed. Additional planned 2012-2013 S2T2 analyses of the Space Sector will provide data-driven insights into lower-tier vendors, with a focus on identifying those mitigation actions which may be taken to maintain the health of the sub-tier U.S. space industrial base.

Technology and Capability Concerns in the Space Sector

Affordability & Technology

Today's space systems typically consist of larger, multi-mission systems with centralized command and control. In 2011, concepts emerged for the operation and use of smaller, disaggregated, and distributed satellite constellations. The advantages of simpler spacecraft and more distributed architectures, particularly in terms of reducing vulnerability, are becoming much more well understood. The potential for the use of modular and open architectures, common standards, and more production-oriented processes and quantities hold the promise of greater affordability and reduced time-to-fielding in the future.

The DoD continues to strategically invest in critical technologies that enable the development and production of space systems. In 2012, the charter for a revitalized Space Industrial Base Council (SIBC) was coordinated. The SIBC is composed of senior leadership from each of the major space agencies and is a collaborative, inter-agency, whole-of-government forum. The SIBC is co-chaired by the USD(AT&L) and the Assistant Director of National Intelligence for Acquisition, Technology and Facilities (ODNI/AT&F). Working Groups aligned under the SIBC will focus on industry engagement, acquisition practices and policies, and strategic assessment and investment in critical space technologies and capabilities. A number of lower-level supplier councils and mission assurance forums met in 2012, identifying and implementing strategies to address sub-tier supplier issues. Early on, the SIBC recognized the need for a systematic process to assess risks in the space industrial and supply base, develop mitigation plans, and fund projects when needed to ensure access to critical technologies and capabilities in the quality, quantity, and timeframe required to support U.S. Government space programs. The Critical Technologies Working Group

(CTWG), which is aligned under the SIBC, performs this chartered function. Current CTWG projects address the following areas:

- Cadmium Zinc Telluride (CZT) substrates
- Space-qualified solar cell Germanium supply chain
- Read Out Integrated Circuit (ROIC) foundry improvement and sustainability (multiple sources)
- Space-qualified Traveling Wave Tube Amplifiers
- Complementary Metal Oxide Semiconductor (CMOS) Focal Plane Arrays (FPA) for Visible Sensors and Star Trackers (VSST), and
- Next-Generation Star Tracker System (NGSTS).

Workforce

The space industry is also very concerned about the continued sustainability of its workforce and the loss of critical design skills, particularly in an era of declining budgets. Much of today's workforce began their careers during the space race and the emergence of a true space industrial base in the late 1960s, the 1970s, and the 1980s. With the recent transition of a number of DoD space systems from development to production, there is a concern that the U.S. is investing too little in research and development. While DoD space procurement (production) funding is expected to remain level or increase slightly over the next five years, research and development (R&D) investment funding is expected to decline by approximately 25 percent. This reduction in R&D investment may not provide younger engineers and scientists experience in the design and development of technically complex systems and could eventually lead to the U.S. space industry losing its technological lead, with damaging economic and security implications.

Exacerbating concerns about the development of the future U.S. Science, Technology, Engineering and Mathematics (STEM) workforce are concerns related to the demographics of the current aerospace workforce. More than 70 percent of the NASA workforce is between 40 and 60 years old, with less than 12 percent under age 35, compared to the overall U.S. workforce, where less than 45 percent is between 40 and 60. In February 2010, the Aerospace Industries Association (AIA) testified to the House Science and Technology Committee that the average age of the U.S. aerospace industry workforce was 45 years old, and 20 percent of those personnel were retirement eligible between 2010 and 2012. A 2009 Society of Satellite Professionals International (SSPI) survey showed that the size of the 18- to 45-year-old STEM workforce is smaller than the segment of the workforce that is older than 45 years old. A 2006 National Defense Education Initiative reported that by 2013, 70 percent of DoD STEM employees will be eligible to retire. The Department of Commerce, Bureau of Industry and Security, as part of their *U.S. Space Industry Deep Dive Assessment*, using January 2013 preliminary data from over 2,000 space vendors, identified almost 15,000 unfilled vacancies for engineers, scientists, research and development staff, production workers, and test and quality control technicians. In many cases, these positions go unfilled as a result of a lack of proper skills and trained personnel in the potential

workforce. The need for tens of thousands of aerospace engineers, astronomers, and atmospheric scientists is expected to grow in the coming years. These jobs can be particularly difficult to fill due to the need for specialized skills and because many government programs can only employ U.S. citizens. Training and development of the next generation of space systems engineers and scientists, who will lead a new generation of DoD development and modernization programs in the 2020-2030 timeframe, is an area of continued focus.

Policy & Oversight

Recent changes to the International Traffic in Arms Regulations (ITAR), as part of the FY2013 National Defense Authorization Act, will have a positive impact on the U.S. space industrial base going forward allowing it to be more competitive in global markets – in particular, for lower-tier vendors. The DoC is scheduled to release new rules for multiple export categories by Spring 2013 and the current plan, after public comment, adjudication, and congressional notification, is to finalize the transition of products and components to the CCL by no later than the end of 2013. However, some believe this transfer could take as long as 18 to 24 months to complete, pushing out into 2014, and further diminishing U.S. competitiveness in global markets. To help alleviate this issue, the DoD, as required, will work closely with the DoS and DoC to ensure a smooth and timely transfer of appropriate space goods and products between the two export control regimes.

Impact of Program Terminations on the Space Industrial Base

One major space defense acquisition program was terminated in 2011 – the Defense Weather Satellite System (DWSS). The termination will not have a significant impact on the defense space industrial base in the near-term, due to other similar program efforts within NASA, NOAA, and the commercial sector. These efforts include the NOAA Joint Polar Satellite System (JPSS), scientific and international projects, and weather satellite follow-on technology development funding, which was appropriated in FY2012. This funding is being used to maintain industrial base capability and to reduce risk in support of a future space-based environmental monitoring program.

Central to the DWSS mission is the visible, infrared, and microwave radiometer sensing instruments, as well as space weather sensors. In collaboration with the Defense Contract Management Agency (DCMA) Industrial Analysis Center (IAC), the DASD(MIBP) assessed the potential capabilities affected (skills, knowledge, facilities, equipment, processes and technologies) at the prime, subcontractor and sub-tier supplier level. The primary DWSS sensors were supported by Raytheon, El Segundo, California; the Naval Research Laboratory, Washington, D.C.; and the Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland. At the prime contractor, Northrop Grumman, of Redondo Beach, California, critical personnel supporting the program (engineering, integration and test, design, scientific, and software personnel) were migrated to other efforts on similar NASA, DoD or classified programs. At sensor and sub-tier vendors, while production gaps and personnel reassignments did occur, in

almost all cases, other civil or commercial programs were able to transition personnel with specialized design skills. In addition, all of the above vendors submitted responses to the FY2012 Broad Area Announcement for the Weather Satellite Follow-on Activities (WSFA) risk reduction technology project. In selected cases, if DoD budgets for space-based weather sensing systems continue to decline, in the FY2014 and beyond timeframe, selected critical skills could be lost.

5. Defense Mergers and Acquisitions

Changing market conditions naturally result in changes to both industrial and capital structures. The Department encourages, on the whole, the market to drive such changes. The industrial capacity upon which we rely, must ultimately depend on securing capital on a competitive basis for the very innovation and creativity necessary to continue to field a fighting force necessary to meet our national security objectives.

There is no single rule to guide capital-based markets through a period of general market decline – the industrial base is more nuanced. Therefore, we must judge transaction activity on a case-by-case basis. We must balance a change in the status quo and the potential near-term harm of lost competition with the greater interest of encouraging market forces to efficiently drive industry to pursue future capabilities.

Competition is one of the key drivers of productivity and value in all sectors of the economy, including defense. A number of our specific Better Buying Power initiatives are aimed at increasing competition among all our suppliers and throughout our procurement of goods and services. Accordingly, the Department is not likely to support further consolidation of our principal weapons systems prime contractors.

In the end, robust, credible competition is vital to providing the Department with high-quality, affordable, and innovative products. The Department is mindful of the past loss of peer-to-peer competition at the prime level resulting from significant industry consolidations over the past twenty years. Increasingly, the Department finds itself evaluating proposed mergers, acquisitions, and teaming arrangements that create horizontal conflicts of interest.

The Department examines potential transactions on a case-by-case basis. During the course of a review, the Department considers a transaction's potential benefits compared to the potential harm caused by a transaction's reduction of competition, among other factors. The Department is also reviewing its merger policies and procedures as outlined in the DoD Directive 5000.62 and expects a completed revision in first quarter of FY2014.

DoD reviews several types of business combinations involving defense suppliers:

- proposed mergers or acquisitions filed under the Hart-Scott-Rodino Antitrust Improvement Act of 1976 (generally, transactions valued at more than $66M in 2011);
- other collaborations among competitors (joint ventures, mergers and acquisitions) of special interest to the Department that do not meet the Hart-Scott-Rodino Act filing threshold; and
- proposed acquisitions of U.S. defense-related firms by non-U.S. firms for which filings have been made pursuant to the Exon-Florio Amendment to the Omnibus Trade and Competitiveness Act of 1988, as amended by the Foreign Investment and National Security Act of 2007, Public Law 110-49.

The first two review types described are conducted under Major Defense Supplier merger and acquisition (M&A) reviews pursuant to DoD Directive 5000.62.

Generally speaking, DoD believes that competition in the marketplace is the best vehicle to shape an industrial environment that supports the nation's defense strategy. Therefore, DoD attempts to intervene in the marketplace only when absolutely necessary to maintain appropriate competition and to develop and/or preserve industrial and technological capabilities essential to the preservation of the nation's defense. The Department evaluates each proposed transaction on its particular merits in the context of the individual market and the changing dynamics of that market.

The Department must establish, maintain, and strengthen industrial relationships to ensure that the future defense industrial base is both healthy and vital. In doing so, the Department focuses on the need to encourage competitive forces for innovation, while acknowledging the need of companies to scale up or combine with other firms to create new industrial capabilities essential for future warfighting needs. Additionally, the Department seeks to ensure that the competitive, innovative, and cutting-edge technical support found in small- to mid-sized firms is not compromised or restricted by large firms acquiring such companies.

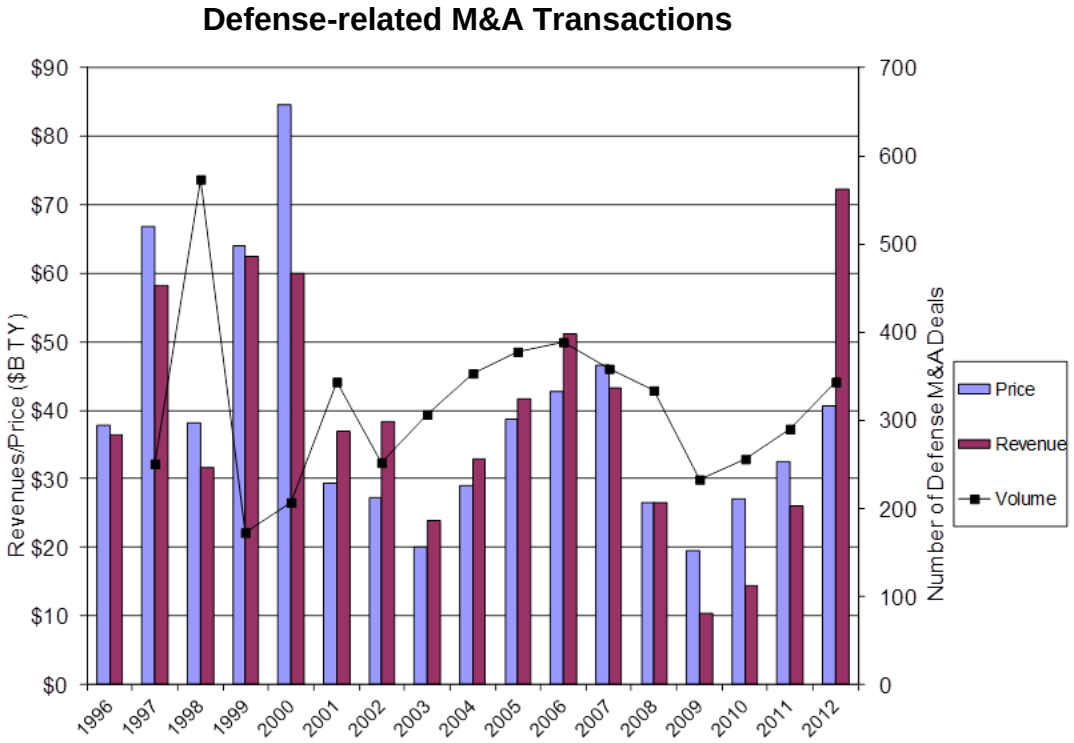
5.1 Major Defense Supplier Merger and Acquisition Reviews

The Federal Trade Commission and the Department of Justice (the "Antitrust Agencies") have the statutory responsibility for determining the likely effects of a defense industry merger on the performance and dynamics of a particular market, and whether a proposed merger should be challenged on the grounds that it may violate antitrust laws. As the primary customer affected by defense business combinations, DoD's views are particularly significant because of its special insight into a proposed merger's impact on innovation, competition, national security, and the defense industrial base. Accordingly, the Department actively works with the Antitrust Agencies, but also can independently address issues where appropriate.

Transaction reviews are structured to identify impacts on national security and on defense industrial capabilities. They evaluate the potential for loss of competition for current and future DoD programs, contracts and subcontracts, and for future technologies of interest to the Department. In addition, the reviews address any other factors resulting from the proposed combination that may adversely affect the satisfactory completion of current or future DoD programs or operations. The policies and responsibilities for assessing major Defense supplier M&A reviews are identified in DoD Directive 5000.62. While these reviews can include transactions that are also evaluated in the Committee on Foreign Investments in the United States (CFIUS) review process, the issues considered are distinct.

In 2012, the Department completed 33 significant transaction reviews out of the approximately 300 defense-related mergers and acquisitions deemed to be relevant.

The table below highlights the aggregate number and value of these transactions as reported by InfoBASE.



Source: Infobase Defense Merger & Acquisition data on publicly announced deals. Includes foreign-only deals and failed deals. (Defense Merger and Acquisition Transactions 1996-2012)

The year was dominated by several noteworthy transactions including the largest merger in the history of the defense and aerospace industry: United Technologies' acquisition of Goodrich. As a result of that transaction, United Technologies was required to divest four business units, including Goodrich Electrical Power Systems and Goodrich Pump & Engine Control Systems (GPECS). Another transaction, Carpenter Technology's acquisition of Latrobe Specialty Metals, resulted in a divestiture of the manufacturing capability for two specialty metal alloys used in the aerospace industry. Carpenter also provided certain commitments relating to a Defense Production Act (DPA) Title III investment.

Other significant transactions occurred in 2012, but were not completed in the reporting year, including GenCorp's proposed acquisition of United Technologies' Rocketdyne; and DigitalGlobe's and GeoEye's proposed merger. The latter was approved by the Department of Justice (DoJ) on January 9, 2013.

The year was also marked by the continuation of divestitures to mitigate issues related to organizational conflict of interest (OCI) regulations and to divest slower growth units.

While there were a significant number of large mergers and acquisitions in 2012, we believe that transaction activity was restrained by the continued uncertainty about the future of defense spending. Many of the large defense firms have built sizable cash positions and will likely put this cash to work in a variety of ways, including acquisitions, when there is more budgetary clarity.

5.2 Committee on Foreign Investment in the United States

Section 721 of the DPA (50 U.S.C. App. Section 2170 et seq.") authorizes the President to suspend or block foreign acquisitions, mergers, or takeovers of U.S.-located firms if the transactions pose credible threats to national security that cannot be resolved through other provisions of law. Initially enacted as the Exon-Florio Amendment to the Omnibus Trade and Competitiveness Act of 1988, Section 721 was revised by the Foreign Investment and National Security Act of 2007, Public Law 100-49 (FINSA). Under FINSA, national security reviews of foreign acquisitions, mergers and takeovers of defense-related U.S. firms under Section 721 are the responsibility of the interagency Committee on Foreign Investment in the United States (CFIUS), chaired by the Department of the Treasury.

DoD is a member of CFIUS and USD(AT&L)/MIBP is the DoD lead for the CFIUS program. As a CFIUS member, the Department evaluates the national security aspects of proposed foreign acquisitions of U.S. defense contractors and other U.S. firms indirectly impacting national defense.

Congress provided the DoD independent authority in 1992 (10 U.S.C. Section 2537(c)) to determine for each CFIUS case whether the firm being acquired possesses critical defense technology under development or is otherwise important to the defense industrial and technology base. The Defense Intelligence Agency (DIA), in connection with this 1992 statutory mandate, provides the Department with an assessment of the risks of unauthorized technology transfer and diversion. Under FINSA, the Office of the Director of National Intelligence also prepares for CFIUS a national threat assessment that evaluates many risk factors of the acquiring firm and country.

Given the statutory constraints on public disclosure of case-specific CFIUS information and the lead role that the Treasury Department plays as CFIUS Chair in communication with the Congress, both of which were refined by FINSA, the Department cannot publicly discuss specific reviews or present summary case trends. However, under FINSA, summary CFIUS trend data is provided to the Congress in annual reports by the Treasury Department as the Chair of the Committee.

6. Programs and Actions to Sustain Capabilities

6.1 The Defense Production Act (DPA)

The Defense Production Act of 1950, as amended (50 U.S.C. App., §2061 et seq.) (DPA), is the primary source of Presidential authorities to expedite supply and expand productive capacity of materials and services needed to promote the national defense. For the purposes of the DPA, "national defense" means programs for military and energy production or construction, military or critical infrastructure assistance to any foreign nation, homeland security, stockpiling, space, and any directly related activity. "National defense" also includes emergency preparedness activities conducted pursuant to Title VI of The Robert T. Stafford Disaster Relief and Emergency Assistance Act [42 U.S.C. § 5195 et seq.] (Stafford Act) and critical infrastructure protection and restoration.

Major DPA provisions include:

- The authority to require acceptance and priority performance of contracts and orders to promote the national defense [DPA section 101];

- The authority to allocate materials, services, and facilities in such manner, upon such conditions, and to such extent as deemed necessary or appropriate to promote the national defense [DPA section 101];

- Various forms of financial incentives and assistance for industry to reduce current or projected shortfalls of resources essential for the national defense or to create, maintain, protect, expand, or restore domestic industrial base capabilities essential for the national defense [DPA Title III];

- Antitrust protection for voluntary agreements and action plans among business competitors to enable cooperation to plan and coordinate measures to increase the supply of materials and services needed for the national defense [DPA section 708];

- The authority to establish a cadre of persons with recognized expertise for employment in executive positions in the Federal Government in the event of an emergency [DPA section 710(e)]; and

- The authority to review certain mergers, acquisitions, and takeovers by or with any foreign person, which could result in foreign control of any person, engaged in interstate commerce in the United States [DPA section 721].

6.1.1 Defense Production Act Committee (DPAC)

The DPAC, established by Section 722 of the DPA and further defined by Executive Order 13603 (March 16, 2012), is an interagency forum to discuss and share information about the domestic industrial base and DPA authorities and to advise the President on the effective use of these authorities in support of national defense. The DPAC's primary activities include:

- Identifying whole-of-government approaches to strengthen domestic industrial base capabilities to meet national defense supply requirements under normal and emergency conditions, using DPA authorities;

- Developing recommendations for the effective use of DPA authorities;

- Developing recommendations for changes to the DPA and Executive Branch DPA guidance and procedures to support effective use of DPA authorities;

- Developing recommendations to improve information sharing among Federal agencies on the use of DPA authority, including dissemination of "best practices" and "lessons learned"; and

- Preparing an annual report to Congress, in accordance with section 722 of the DPA.

The position of DPAC Chairperson rotates between the Secretaries of Defense and Homeland Security annually on April 1. On April 1, 2012, the Chair rotated from Defense to Homeland Security. The DPAC is comprised of:

- the Secretary of State,
- the Secretary of the Treasury,
- the Secretary of Defense,
- the Attorney General,
- the Secretary of the Interior,
- the Secretary of Agriculture,
- the Secretary of Commerce,
- the Secretary of Labor,
- the Secretary of Health and Human Services,
- the Secretary of Transportation,
- the Secretary of Energy,
- the Secretary of Homeland Security,
- the Director of National Intelligence,
- the Director of the Central Intelligence Agency,
- the Chair of the Council of Economic Advisers,
- the Administrator of the National Aeronautics and Space Administration, and
- the Administrator of General Services.

The Director of the Office of Management and Budget and the Director of the Office of Science and Technology Policy are invited to participate in all Committee meetings and activities in an advisory role. The DPAC Chairperson may also invite the heads of other Departments and agencies to participate in DPAC meetings, as appropriate.

The immediate outcome of the first DPAC meeting on April 1, 2012, was the establishment of three study groups formed to determine common unmet needs and cross-cutting vulnerabilities within the domestic supply chain in the areas of metals fabrication, telecommunication, and power and energy.

Metals Fabrication Study Group

The Metal Fabrication Study Group was charged with investigating industrial base shortfalls with respect to the sourcing, fabrication and finishing of complex metal parts. It is led primarily by the Departments of Commerce, National Institutes of Standards and Technology (NIST) and Defense, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (AT&L). The study group determined that a viable, modern domestic heavy forging industrial base is needed to guarantee the timely availability of quality parts, and the ability to scale-up production during times of national emergency. Current domestic applications of forged parts comprises aerospace platforms, including a wide range of military and commercial aircraft; space components, including external fuel tanks; shipbuilding, including nuclear-powered vessels; and terrestrial vehicles, including armored vehicles and mining equipment.

Domestic heavy forging capabilities are currently at risk because of market segmentation due to the low-volume, specialty demand of the Department of Defense. The companies that operate the forging presses face four primary challenges that threaten their ongoing viability: (1) aging forging infrastructure; (2) uncertain demand from the U.S. Government; (3) undercapitalization; and (4) limited ingot supply that inhibits their ability to diversify to serve commercial customers. The Study Group is recommending that the national defense needs in the areas of castings adaptability and machining be addressed in the near future.

Telecommunications Study Group

Consolidation of the global carrier market has forced communications equipment vendors to follow suit. Carriers expect, and large equipment vendors have become, one-stop shops with global reach and diverse product portfolios integrated with lifecycle Original Equipment Manufacturer support services. It has become increasingly difficult for vendors without a full suite of products to sell to large carriers. For its initial assessment cycle, the Telecommunications Study Group focused on (1) routing and switching equipment; (2) optical transport equipment; (3) sub-components, with a focus on application specific integrated circuits; (4) wireless; and (5) Operating System Software, with a focus on network management software.

Research conducted by the Telecommunications Study Group established that the historical dominance of U.S. telecom providers and their technology vendors is waning in several strategic areas. If domestic weakness persists within critical subsectors and gives way to foreign ascendance, not only will the United States' economic competitiveness suffer, but access to the products and technologies that enable the future of secure communication networks for both the USG and private industry could be put at risk. The consequences of the market's transformation have resulted in four overarching threats to the U.S.' telecom supply chain:

1. The U.S. is losing its production capabilities in key equipment sectors.

2. Access to competitively priced components produced by trusted and reliable manufacturers is no longer assured in all equipment subsectors and very likely will further diminish unless mitigation strategies are developed and implemented.

3. There are fewer leading U.S. vendors for agencies and universities to partner with on R&D and technology transition.

4. The options for, and opportunities to, successfully translate domestic innovation to U.S. telecom equipment production are increasingly limited.

Power and Energy Study Group

For its initial assessment cycle, the Power and Energy Study Group surveyed senior acquisition officials from across the Federal Government, which ultimately led the Group to focus on shortfalls related to: (1) fuel cells, (2) lightweight materials, and (3) gallium nitride (GaN) substrates.

Fuel Cells

Fuel cell systems are highly efficient energy conversion devices that can extend the range of batteries, reduce the number of inefficient combustion generators, and be powered with universally available logistics fuel (such as propane or methanol) to provide effective support to many of the operational energy requirements of the USG. Widespread implementation of these devices, however, has been hindered by manufacturing inefficiencies and industrial base shortfalls. These include a lack of manufacturing automation, wasted materials, real-time quality control, and inadequate component standardization due to limited production lines.

The Study Group has determined that the private sector is not adequately incentivized to respond to these issues, largely due to uncertain demand. Mitigating the technical and financial risks by addressing manufacturing shortfalls in these areas would likely increase efficiencies, reduce prices, and stabilize demand. The Study Group is currently in the process of prioritizing potential approaches to mitigating these fuel cell manufacturing shortfalls.

Lightweight Materials

Availability of advanced lightweight materials (e.g., carbon fiber) is a cross-cutting requirement crucial to improving energy efficiency. Critical government systems affected range from automotive and aircraft light-weighting to enabling effective alternative energy sources such as wind power. The Study Group's analytical team has determined that development of advanced lightweight materials and expansion of their availability has been hindered by the difficulty in accurately predicting demand. The supply uncertainty and price volatility of these materials has prevented their adoption for many commercial applications. Consequently, technical breakthroughs – such as alternative precursors, composite forming, or material joining – may be slow to develop and insufficient to spur the level of commercialization necessary to expand the availability and affordability of advanced lightweight materials to meet government needs. At the drafting of this report, the Study Group's analytical team is working with DPAC member agencies to develop solutions for addressing this industrial base shortfall.

Gallium Nitride (GaN) on Silicon Carbide (SiC) Substrates

Unique U.S. missions lead to a low-demand need for power electronic systems related to transmit-and-receive modules [e.g., electronic warfare capabilities such as counter-improvised explosive devices (counter IEDs) and active radar systems, and frequency jamming that require specialized GaN on SiC substrates. The significant capital investments necessary to develop advanced integrated circuit fabrication capabilities using GaN on SiC, however, have prevented private industry from expanding or upgrading their facilities to meet USG demand. Unless addressed, the requirements for these components are expected to increase at a pace greater than the industrial base's ability to produce these parts, and the high cost of GaN on SiC devices will limit their implementation and deployment. The efforts of DOE's Energy Efficiency and Renewable Energy (DOE/EERE) on electric drive vehicles, solar, wind, and geothermal should produce additional pressures on GaN on SiC manufacturers, since the chargers, ac-dc converters, and inverters required by these systems are expected to increasingly rely on wide bandgap (GaN and SiC) based products. To address this industrial base shortfall, the Study Group is recommending that the DPA Title III program expand its current efforts related to GaN to include GaN on SiC in order to improve industry's ability to meet government needs.

6.1.2 Defense Priorities and Allocations System (DPAS) and Special Priorities Assistance (SPA)

Title I of the Defense Production Act provides the President the authority to require preferential performance on contracts and orders, as necessary, to meet national defense and emergency preparedness program requirements. Executive Order 13603 delegates these authorities to various federal Departments and agencies.

The Secretary of Commerce has authority to manage industrial resources. To implement its authority, the Department of Commerce (DOC) administers the DPAS. The DOC has further delegated authority to the Department of Defense under the DPAS to:

- apply priority ratings to contracts and orders supporting national defense programs;
- request the DOC provide SPA to resolve conflicts for industrial resources among both rated and unrated (i.e., non-defense) contracts and orders; and
- authorize priority ratings for other U.S. federal agency and friendly nation defense related orders in the U.S. when such authorization furthers U.S. national interests.

DASD(MIBP) convenes and chairs a Priority Allocation of Industrial Resources (PAIR) task force to quickly resolve industry constraints that interfere with military operations and Warfighter readiness. The task force ensures industrial resources are allocated to national security related programs in accordance with operational priorities when emergent requirements create competing demands. The MIBP directorate works closely with the Joint Staff, Military Departments, civilian Departments, and allied foreign nations to ensure effective prioritization of materials, and to expedite delivery of urgently needed materials and services. PAIR activities resulting in SPA being provided are shown in the table below.

For example, in FY2012, a U.S. ally asked for help in expediting the refurbishment of naval vessel environmental control systems. These atmospheric controls were urgently needed by both the U.S. and the ally's navies to avoid disruptions of fleet deployments, but the contractor was limited in its ability to meet the needs of both customers. MIBP mediated the dialog between the buying activities and contractor to improve the refurbishment rate. Additional Government Furnished Equipment was supplied to the contractor to improve throughput rates and both nations' schedules were aligned to improve contractor efficiency.

DPAS Special Priorities Assistance Cases – Oct 2011- Dec 2012			
Date(s)	**Item**	**Assistance for**	**Summary**
10/11	Aerostats	U.S. Marine Corps	Provided rating authority to protect delivery dates for repairs and redeployment to theater.
12/11	Centralized Atmospheric Monitoring Systems	Coalition Partner	Provided rating authority and accelerated device repairs to protect fleet deployment dates.
12/11	Multiple Programs	Canada	Reauthorized broad use of DPAS authorities per U.S. and Canadian memorandum of agreement.
3/12	Helicopter Auxiliary Power Clutch Units	Coalition Partner	Arranged accommodation between coalition partner, Army aviation and contractor to accelerate deployment to quickly resolve an operational safety of flight issue.
6/12	Helium Gas used to Conduct Launch Vehicle Qualification	Defense Contractor	Engaged helium gas supplier on behalf of contractor to explain and enforce priority rating authority and to avoid a potential disruption in launch service.
7/12	Aircraft Hydraulic Actuators	U.S. Army	Arranged accommodation between actuator supplier, aircraft prime contractor, Army, Navy, and Joint Staff to accelerate delivery to satisfy a special operational requirement.

Source: DASD(MIBP)

6.1.3 Title III of the Defense Production Act

The availability of domestic production capabilities for critical defense technologies is an essential element of national security. The DASD(MIBP) DPA Title III Program Office is designed to create, maintain, modernize, protect, expand, or restore industrial capabilities required for national defense using the powerful DPA Title III authorities. A key objective of the Title III Program is to accelerate the transition of technologies from research and development to affordable production and insertion into defense and other government systems. To create the needed industrial capacity, Title III authorities provide the use of financial incentives in the form of purchases, purchase commitments, the purchase or lease of advanced manufacturing equipment for installation in government or privately owned facilities, the development of substitutes, and loans or loan guarantees. Title III activities strengthen the economic and technological competitiveness of the U.S. defense industrial base and can reduce U.S. dependency on foreign sources of supply for critical materials and technologies.

The Secretary of the Air Force is the DoD Executive Agent for the Title III Program. The Air Force Title III Program Office, located at Wright-Patterson Air Force Base (AFB), Ohio, executes and manages the portfolio of projects on behalf of the

Secretary of the Air Force. During 2012, the Title III Program had agreements in place with 31 domestic firms, and an additional 13 firms will have Title III agreements in the near future. Brief descriptions of active Title III projects, can be found in Appendix C.1 and the most recent report to Congress is included at Appendix D. Funding for Title III initiatives is provided in yearly Defense appropriations and from sponsoring Defense Components through transfer of funds to the DPA Title III Fund.

Potential projects are identified when the Title III program works directly with the Military Departments and Agencies, leverages DPAC and S2T2 industrial base assessments, and reaches out to industry to better understand the health and vitality of the domestic industrial base in sectors that are important to national defense. These efforts help focus future Title III industrial base investments through an identification of shortfalls in domestic manufacturing capabilities that may affect essential government requirements. Based on these efforts, the DPA Title III Program may expand or initiate new efforts in areas such as: heavy forging, nanotechnology, communications technology production, fuel cell systems, and power electronics.

6.2 DoD Manufacturing Technology Program

For over 50 years, the DoD Manufacturing Technology (ManTech) Program has demonstrated its value through process technologies that make new products possible, as well as through manufacturing process improvements that focus specifically on defense system affordability challenges. The program provides the crucial links from technology invention to production of defense-critical needs in areas beyond normal investment risks within industry. ManTech ensures technology is affordable and producible, both of which are key to the Department's Better Buying Power initiative and to making sure that U.S. military forces are more agile, deployable, sustainable, lethal, and dominant. While ManTech investments generally translate into initial system affordability improvements or cycle time reduction, investments are also made in new capabilities that provide dividends in system performance or life cycle cost that can far outweigh the initial system delivery costs.

The industrial base is significantly enhanced through ManTech Program enabled transition of S&T successes. Specifically, ManTech serves as an important mechanism for technology transition, bringing affordable technologies to acquisition program managers through new manufacturing and production processes and systems, thus bridging the gap between discovery and implementation of new capabilities for the Warfighter. Further, the DoD ManTech Program can contribute important information to MIBP's ongoing S2T2 analyses through its operational perspectives of the industrial base, as well as its deepening understanding and insights of technology-based supply chain risks. Conversely, ManTech can be used as an appropriate investment lever for targeted industrial base intervention when necessary to help the Department close newly identified, defense-critical, manufacturing technology related supply chain gaps.

While ManTech is not statutorily structured to address the entirety of defense industrial base challenges, it is a highly versatile R&D investment program that can serve as a key focal point to bring attention and technological resources to bear on the Department's most pressing requirements for affordable modernization and sustainment. The ManTech Program shares an expansive vision with the broader defense manufacturing enterprise; namely, *a responsive, world-class manufacturing capability to affordably and rapidly meet Warfighter needs throughout the defense system life cycle*. This vision captures the overriding imperative to satisfy Warfighter requirements across the spectrum of manufacturing activities, while doing so *affordably* and *rapidly*. Congress has long recognized this essential, enabling role, establishing ManTech in Section 2521 of Title 10, United States Code to:

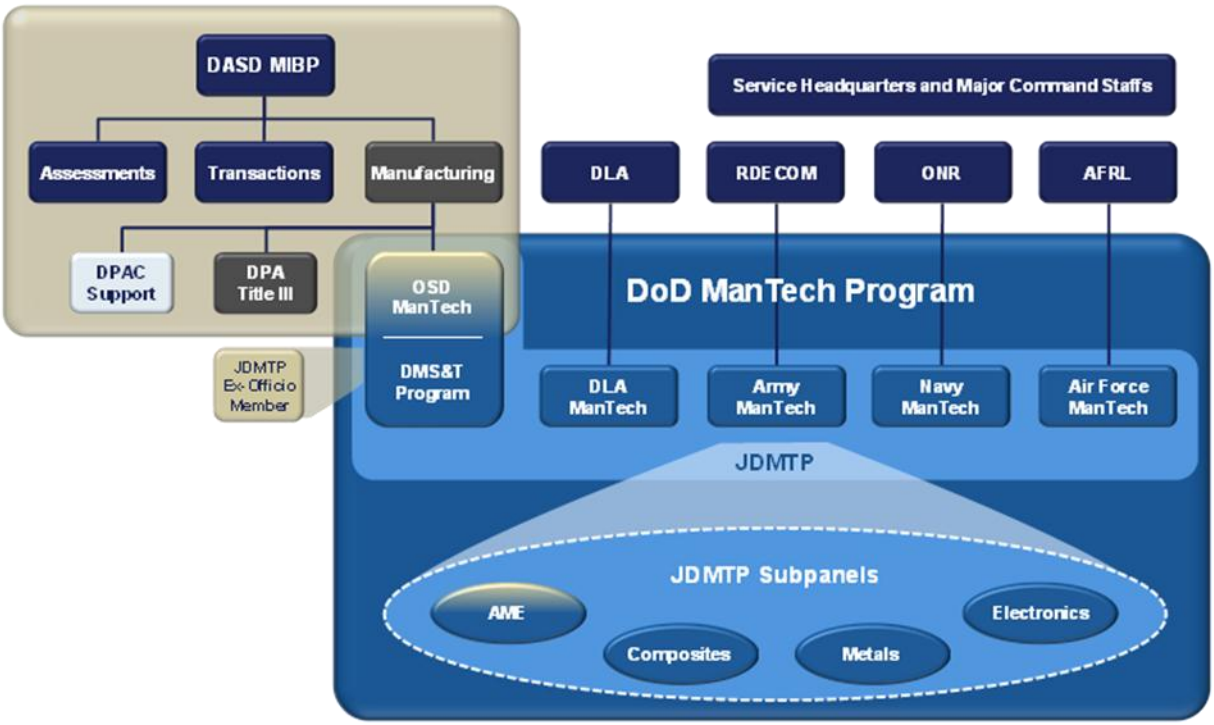
> *…further…national security objectives…through the development and application of advanced manufacturing technologies and processes that will reduce the acquisition and supportability costs of defense weapon systems and reduce manufacturing and repair cycle times across the life cycles of such systems.*[5]

The program's mission is both multi-faceted and vital; namely, *DoD ManTech anticipates and closes gaps in manufacturing capabilities for affordable, timely, and low-risk development, production, and sustainment of defense systems*. The program looks beyond the normal risk of industry and directs investments at improving the quality, productivity, technology, and practices of businesses and workers providing goods and services to the DoD. ManTech's role as a crucial link between technology development and industrial application gives the program a unique and vital position within the defense industrial base and broader strategic security environment. By its very nature, the introduction of advanced weapon systems entails the use of new product technologies that provide the performance enhancements that make the new weapon systems desirable. The ability to introduce these performance enhancements is often limited by the ability to manufacture them at an affordable cost, at an acceptable rate, and with the consistent quality that can be a matter of life and death for the Warfighter. Thus, the maturing of manufacturing processes and equipment in parallel with the maturation of the product technology is important if advanced weapon systems are to be fielded on-time, at cost, and with the desired mission performance capability. Advancement of manufacturing technology – the central focus of the ManTech Program – is thus essential to the introduction of advanced weapon system capabilities. The ManTech Program's activities not only cross multiple organizational boundaries within the Defense Department, but they also span the entire defense industrial base, including prime

[5] Title 10, United States Code, Section 2521.

contractors, subcontractors, suppliers, hardware and software vendors, industry consortia, manufacturing centers of excellence, colleges and universities, and research institutions. The DoD ManTech community also works closely with other federal agencies, representing defense manufacturing policy and building cross-agency coordination for critical manufacturing R&D needs. The ManTech Program serves the Department as a valuable resource, combining the breadth of programmatic and requirement knowledge with deep technical expertise.

Section 2521 of Title 10, United States Code (10 U.S.C. 2521) requires the USD(AT&L) to administer the DoD ManTech Program on behalf of the SECDEF, and this is further delegated to the DASD(MIBP), which exercises OSD-level oversight of the ManTech Program pursuant to 10 U.S.C. 139c. Organizationally, this is accomplished via the MIBP's Manufacturing Directorate and the Manufacturing Technology office. Component ManTech programs are individually executed by the Departments of the



Army, Navy, Air Force, the Defense Logistics Agency (DLA) and OSD.[6] These Component programs collaborate and coordinate their efforts through the Joint Defense Manufacturing Technology Panel (JDMTP). The Component ManTech programs and the JDMTP organizational structures are also depicted. The Principals of the JDMTP are senior technology managers representing the Army, Navy and Air Force, and DLA. OSD is represented as an ex-officio member of the panel to provide the communication link to OSD as well as in the capacity of manager of the DMS&T Program line. Other ex-officio members of the JDMTP include DARPA, NIST, NASA, and DoE. The JDMTP categorizes ManTech investment areas by the technology portfolios of subpanels – the

[6] The OSD ManTech Office in DASD(MIBP) executes the Defense-wide Manufacturing Science and Technology (DMS&T) Program.

current subpanels are Electronics, Metals, Composites and Advanced Manufacturing Enterprise – enabling Component ManTech programs to maximize opportunities for shared investment in initiatives and strategies with joint application, and to prevent duplication of effort.

Military Department and DLA ManTech programs comprise the majority of the DoD ManTech investment portfolio and are each overseen and managed within the S&T organizational structures of their associated DoD Component. Additionally, the DASD(MIBP), whose ManTech Office administers the DMS&T Program, is a member of the S&T Executive Committee (EXCOM) comprised of those key organizations in DoD that oversee and coordinate the S&T activities of the Department. Although all Component ManTech programs work in concert toward common goals, each has important focus areas to meet individual Component mission needs.

- The Army ManTech Program is structured around enabling manufacturing improvements of components and subsystems for ground, Soldier, air and command/communications systems.

- The Navy ManTech Program's critical goal is to reduce the acquisition cost of current and future platforms, resulting in an affordability investment strategy currently focused on four ship platforms and the F-35 aircraft.

- The Air Force ManTech Program's strategic focus is on attaining next generation agile manufacturing across multiple industrial sectors supporting several Air Force core functions. In the near-term, efforts include affordability and producibility improvements for advanced turbine engines, stealth, ISR, munitions, depot efficiencies, and space solar cells.

- The DLA ManTech Program focuses on sustaining the Warfighters and their materiel; ongoing efforts support improvements in providing a source for non-procurable microcircuits, combat rations, clothing and protective equipment, batteries, forgings, and castings.

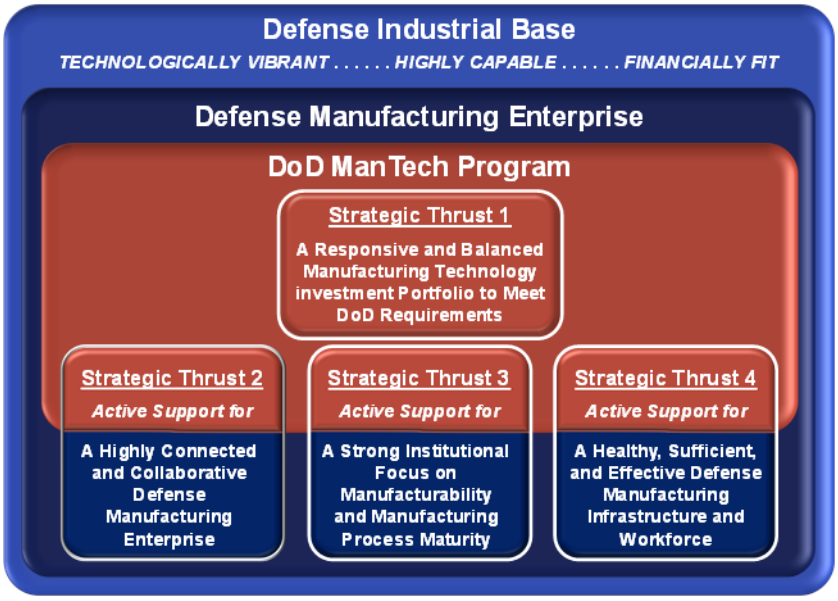
- The OSD-managed DMS&T Program takes a broad, overarching view towards closing critical gaps in cross-cutting, military manufacturing enabling technologies that will have a significant impact on multiple Military Departments or platforms.

Please see Appendix C.2. for more details on each of these programs.

The JDMTP and MIBP jointly developed a 2012 DoD ManTech Program Strategy that recognizes the ManTech Program's central role within the defense manufacturing enterprise and its extended impacts and leverage across the defense industrial base and broader national security environment. Due to its length, the full DoD ManTech Program Strategic Plan is not included as part of this report, but it can be downloaded at https://www.dodmantech.com/relatedresources/DoD_ManTech_Pgm_2012_Strat_Plan.pdf. The theme of the strategy is *Delivering Advanced, Affordable Manufacturing for the*

Warfighter, and the following four strategic thrusts (with supporting enabling goals) have been established to unify and guide the joint ManTech enterprise, consistent with the USD(AT&L)'s Better Buying Power initiatives and the defense manufacturing vision and ManTech Program mission:

- Thrust 1: *A Responsive and Balanced Manufacturing Technology Investment Portfolio to Meet DoD Requirements*
- Thrust 2: *Active Support for a Highly Connected and Collaborative Defense Manufacturing Enterprise*
- Thrust 3: *Active Support for a Strong Institutional Focus on Manufacturability and Manufacturing Process Maturity*
- Thrust 4: *Active Support for a Healthy, Sufficient, and Effective Defense Manufacturing Infrastructure and Workforce*



This framework establishes the program's core focus on ensuring responsiveness and balance across the full portfolio of manufacturing technology investments (Thrust 1), and it couples that focus with the objective to actively and collectively support broader defense manufacturing needs (Thrusts 2, 3, and 4). This approach underscores the importance of program support for these broader needs while recognizing it is beyond the program's charter and resources to fully satisfy them. Even so, each of these four thrusts directly supports the SECDEF's current strategic guidance in key ways. In particular, processing and fabrication breakthroughs enable affordable production for effective modernization; material and manufacturing investments made concurrently with S&T R&D projects deliver technological advantage to the Warfighter quickly; and enterprise level initiatives create more connected and collaborative environments, a stronger focus on manufacturability, and improved manufacturing infrastructure. All of these support the maintenance of a healthier and more resilient industrial base.

The JDMTP is moving forward with joint planning and coordination on major weapon systems. In the case of the F-35 Lightning II, four ManTech projects, two Navy and two Air Force, directly impacted F-35 affordability. With a combined investment of $14.5M, these initiatives are projected to reduce F-35 program costs by $1.1B over 30 years of production. More importantly, these technology advances can be leveraged by

current and future defense programs to reduce costs and bolster U.S. manufacturing capabilities.

Further joint planning and coordination are exercised by the JDMTP Subpanels with the current investment priorities as follows:

Composites Processing and Fabrication Technology Area
Key investment topics within the composites area include structures focused on the DoD capabilities for high temperature, light weight, marine durable and specialty applications such as conformal radomes as well as rapid / flexible response-enabling manufacturing technologies.
Electronics Processing and Fabrication Technology Area
Key investment topics for electronics include wide bandgap and silicon carbide (SiC) devices, lithium ion (Li-Ion) batteries, advanced packaging and fabrication technologies, infrared sensors and lasers and their associated components, and micro and flexible display technologies.
Metals Processing and Fabrication Technology Area
Key investment areas for metals span material processing, castings and forging, and joining. Critical application areas include ballistic armor, affordable vehicle components, and lightweight, thin-walled structures. Additional priorities include intelligent machining, titanium powder metals, and lightweight alloy initiatives.
Advanced Manufacturing Enterprise Technology Area
Key Investment areas include manufacturability tools to enable better designs, implementation of improved 3D technical data packages, intelligent manufacturing methods, supply network modeling and integration, and product/process data interoperability.

Lastly, the Administration has signaled the growing importance of advanced manufacturing to the economic and national security of the United States. Key examples include:

- the President's Council of Advisors on Science and Technology (PCAST) 2011 report, *Ensuring American Leadership in Advanced Manufacturing*;[7]
- the 2011 establishment of the President's Advanced Manufacturing Partnership (AMP) initiative across government, industry and academia;[8]

[7] Report to the President on Ensuring American Leadership in Advanced Manufacturing, Executive Office of the President, President's Council of Advisors on Science and Technology, June 2011.
[8] http://www.whitehouse.gov/the-press-office/2011/06/24/president-obama-launches-advanced-manufacturing-partnership.

- the 2012 State of the Union Address emphasis on manufacturing's importance to the nation;
- the 2012 release of the National Science and Technology Council's (NSTC) *National Strategic Plan for Advanced Manufacturing;*[9]
- the formation of the Department of Commerce-hosted Advanced Manufacturing National Program Office (AMNPO) supported by DoD and other Interagency partners; and
- the Administration's 2012 announcement of the formation of a National Network for Manufacturing Innovation (NNMI).[10]

In support of these and NNMI in particular, the OSD ManTech office, supported by several Component ManTech programs, provided key funding, technical leadership and program management support for the establishment of the DoD-led pilot Institute for Manufacturing Innovation (IMI) focused on additive manufacturing technologies. Named the National Additive Manufacturing Innovation Institute, NAMII will help inform the broader NNMI and AMP initiatives and directly support the national agenda to aggressively develop or help sustain world-leading advanced manufacturing capabilities, enabling U.S. industry to maintain its edge in a hypercompetitive global environment and to meet vital economic and national security needs.

[9] A National Strategic Plan for Advanced Manufacturing, Executive Office of the President, National Science and Technology Council, February 2012.

[10] http://www.whitehouse.gov/the-press-office/2012/03/09/president-obama-announce-new-efforts-support-manufacturing-innovation-en.

Appendix A - Annual Report Requirements

Section 2504 of title 10, United States Code, requires that the Secretary of Defense submit an annual report to the Committee on Armed Services of the Senate and the Committee on Armed Services of the House of Representatives, by March 1st of each year. The report is to include:

(1) A description of the Departmental guidance prepared pursuant to section 2506 of this Title.

(2) A description of the methods and analyses being undertaken by the Department of Defense alone or in cooperation with other Federal agencies, to identify and address concerns regarding technological and industrial capabilities of the national technology and industrial base.

(3) A description of the assessments prepared pursuant to section 2505 of this Title and other analyses used in developing the budget submission of the Department of Defense for the next fiscal year.

(4) Identification of each program designed to sustain specific essential technological and industrial capabilities and processes of the national technology and industrial base.

Section 852 of the National Defense Authorization Act for Fiscal Year 2012 requires that the annual report to Congress on the defense industrial base submitted for fiscal year 2012 pursuant to section 2504 of title 10, United States Code, includes a description of, and a status report on, the sector-by-sector, tier-by-tier assessment of the industrial base undertaken by the Department of Defense. The report is to include a description of the steps taken and planned to be taken:

(1) To identify current and emerging sectors of the defense industrial base that are critical to the national security of the United States;

(2) In each sector, to identify items that are critical to military readiness, including key components, subcomponents, and materials;

(3) To examine the structure of the industrial base, including the competitive landscape, relationships, risks, and opportunities within that structure;

(4) To map the supply chain for critical items identified under paragraph (2) in a manner that provides the Department of Defense visibility from raw material to final products;

(5) To perform a risk assessment of the supply chain for such critical items and conduct an evaluation of the extent to which:

(a) the supply chain for such items is subject to disruption by factors outside the control of the Department of Defense; and
(b) such disruption would adversely affect the ability of the Department of Defense to fill its national security mission.

The Senate Report 112-26 accompanying S. 1253, the National Defense Authorization Act for Fiscal Year 2012, noted at pages 65-66 that the Senate Armed Services Committee is interested in how the determination of DPA Title III projects will be linked to the outcome of the S2T2 assessments, which would identify sectors of the defense industrial base that may require additional resources. The committee requested the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy to submit an annual report by April 1, to the congressional defense committees containing a prioritized list of potential investments required to address industrial base shortfalls to be expected to be funded by the Department in future years through the DPA Title III program.

This report contains the required information.

Appendix B – Summary of Key Industrial Capabilities Assessments Completed During CY2011

B.1 DoD-Wide

Assistant Secretary of Defense (Research & Engineering) (ASD(R&E))

Active Electronically Scanned Array (AESA) Radars

In-line with OSD advocation, the Department is exploiting commonality among the AESA programs such as 3DELRR, AMDR, Space Fence, and G/ATOR. Common architecture and hardware are being leveraged to create common manufacturing processes that result in minimization of specialized equipment to a particular AESA program, thereby allowing materiel resources to be shared between the programs to satisfy customer demands. In addition, commonality in hardware between the different AESA programs as well as legacy radar programs also allows for simultaneous scheduling of multiple programs. Trends toward commonality in hardware have also increased the use of specialty shops or centers of excellence such as machining, electronics, and fabrication. Most prime system integrators use a Captive Manufacturing Process, drawing on the expertise of sister facilities located throughout the country, and/or the world, to provide additional support and manufacturing capacity when needed. Examples include Lockheed Martin-MS2 which utilizes a Single Factory Approach drawing on the industrial capability of ten other Lockheed Martin sites. Raytheon Integrated Defense Systems (IDS) consists of 19 Mission Centers. Raytheon Space & Airborne Systems (SAS), located in Forest, MS, is considered a “Consolidated Manufacturing Center” and the prime integrator of Raytheon’s airborne AESA radars. SAS Forest draws on the industrial capability of other Raytheon radar manufacturing sites located in El Segundo, CA; Dallas, TX; St. Louis, MO; and Andover, MA, to accomplish its mission. The one exception to this trend is Northrop Grumman Electronic Systems (NGES) located in Linthicum, MD. NGES’s manufacturing facility is unique. Almost all manufacturing of assemblies (regardless of domain) is accomplished within the Linthicum facilities. This consolidated manufacturing facility possesses the ability to manufacture AESAs in all frequency bands, for all DoD and International Community (IC) customers, and in all domains (space, air, ground, maritime) in a single facility. However, although AESA radars are produced at this single site, additional design and manufacturing capacity exists at a number of NGES sector’ sites across the nation and have been utilized when needed.

Most of the labor skills required in design, manufacture, and testing of AESA radars are not unique to the AESA industry. Essential manufacturing skills include precision fabrication, mechanical and electrical assembly, molding, testing, and inspection. These skillsets are shared across a wide spectrum of radar, electronic

systems, and Radio Frequency (RF) devices being developed by multiple primes and suppliers. Using common manufacturing processes and specialized work cells leverage the experience and expertise of highly trained personnel, allowing them to be easily/readily shifted to meet skilled labor demands between radar and other technically related programs.

The only areas of concern involving radar manufacturing are the supplier processes for high-temperature and low-temperature co-fired ceramic packages for the transmit/receive (T/R) modules and the manufacturing processes regarding precious metals. For the former, the number of manufacturing entities and the production capability of each entity in providing ceramic packaging of T/R modules will diminish stateside as volumes decrease or are outsourced to Pacific Rim countries. However, investments have been made to move from ceramic TR module packages to organic substrate packaging, and these processes are now beginning to be inserted into the AESA products. For the latter point of concern, industry is currently investigating new processes regarding precious metals. The precious metals embedded in the manufacture of these AESA products, especially gold, are driving up costs, making products unaffordable. New metals are being designed into the AESA radar systems, but have yet to be process proven or tested.

Thus, for established radar producers such as Lockheed Martin, Northrop Grumman and Raytheon, physical facilities and labor skills essential to active electronically scanning array development and production are presently sufficient to meet demand. Physical capacity already exists and can be readily expanded in the radar industrial base, if necessary, to simultaneously support all AESA and legacy radar programs. When there is a need for more personnel, there is a sufficient number of engineering personnel available in the private and public sectors, as well as recent engineering graduates who can be hired by these companies to provide the needed manpower. All of the radar manufacturing companies possess the resources (such as knowledgeable, experienced technical personnel and training programs) to impart to the new personnel the guidance and knowledge required to perform their tasks. The only areas of concern involving radar manufacturing are the high-temperature and low-temperature co-fired ceramic packaging of the T/R modules and the supplanting of precious metals with more affordable substitutes. For the former, organic substrate packaging appears to be a viable replacement. For the latter, no alternative metals have been definitively identified, although several possibilities are being investigated.

Rocket Propulsion

While 2013 is the final year of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) development, the 21st Century (RP21) follow-on is continuing for rocket propulsion science and technology (S&T) development. In FY2013, S&T investments for strategic and tactical solid rocket motors (SRMs), space launch liquid rocket engines (LRE), and spacecraft propulsion followed a proven, goal-oriented, application-focused approach. With the noted areas lacking investments consistent with

the FY2013 President's Budget Request, they will continue to be pursued, as described, into the foreseeable future.

The IHPRPT and RP21 share common solid rocket motor S&T elements of the Technology for the Sustainment of Strategic Systems (TSSS) IPT. There is a noticeable lack of TSSS investment in Submarine-Launched Ballistic Missile (SLBM) propulsion S&T.

In FY2013, the Air Force Strategic SRM S&T is currently advancing aging and surveillance (FY2013 $3.5M) and motor component technologies (FY2013 $3.9M) to address a portion of technology sustainment needs. One of the key elements in both efforts is advancing physics based modeling and simulation to provide S&T insight, reduce development costs, and be more useful during failure investigations. The aging and surveillance investment is improving our fundamental understanding of aging mechanisms and developing a non-intrusive, integrated InterContinental Ballistic Missile (ICBM) motor-by-motor surveillance approach for acquiring data. These initiatives can then be combined to provide more accurate service life predictions on a motor-by-motor basis – something that is not being accomplished today. These advanced approaches can substantially reduce life cycle cost for ICBMs (depending on real in-service life of the motors) and/or improve the reliability of fielded systems. Using these tools early in production would provide a better understanding of motor zero time health, further increasing the accuracy of service life predictions versus having post-delivery data alone. The ability to selectively extend the service life of specific stages can enable a level buying strategy (Navy model) for the Air Force ICBM fleet, thus providing a stabilizing effect on the ICBM industrial base. The aging and surveillance technology goal is to reduce motor predictive uncertainty 20 percent, and pursue implementation of this capability on a motor-by-motor basis.

The largest SRM investment for ICBM-size systems is currently in inert components to improve mass fraction and provide a hedge against materials obsolescence. Improved mass fraction can provide increased design margin, enable a smaller system for a given range requirement, and increase range and/or payload capability for ICBM-type systems. When coupled with propellant performance improvements, this can enable a system to fly as far (or farther) with one less stage. A missile with one less stage would dramatically reduce procurement and logistics costs . DoD is pursuing materials and processes for reducing manufacturing costs as well. Initiatives not currently funded include integrated S&T motor design, fabrication to work through the integration issues of advanced component S&T, and testing. The SRM technology goals being pursued are to improve motor mass fraction by 20 percent and increase specific impulse (Isp) by two percent by 2017 (over the advanced S&T motors demonstrated in 2008-2009).

The Air Force and NASA are coordinating to determine what synergies exist within Air Force SRM investments and the recently competed NASA research announcement for Space Launch System (SLS) risk reduction contract awards. The

DoD is examining any opportunities for technology development collaboration or synchronization.

In FY2013, the Army and the Navy invested $5.0M and $13.8M, respectively, in tactical rocket propulsion S&T. The goals being addressed by these investments are: total impulse increase of five percent (motor with energy management) and 22 percent (motors without energy management), respectively.

The Navy is further demonstrating previously developed tactical propulsion SRM technologies under IHPPRT for four different applications. Four future naval capability (FNC) projects are being pursued for counter air (short range (FY2013 $0.3M) and medium range (FY2013 $2.6M)), counter air defense (FY2013 $5.3M), and surface launched (FY2013 $5.6M) applications. These FNC efforts are leveraging 2010 small scale and component technology development initiatives. There are no investments currently planned in foundational technology for Navy or Air Force tactical SRM applications beyond the soon to be completed four Navy FNCs.

The Army invests in rocket propulsion to support their mission needs for extended area protection, fire support and safety. The investments for Army-unique needs are currently in controllable thrust technology, propellant development, environmental, motor diagnostics/prognostics, rocket propulsion materials, ignition systems, and propellant ingredient synthesis.

The on-going LRE investment is the Hydrocarbon Boost (FY2013 $11.1M) 250 Klbf thrust oxygen rich staged combustion (ORSC (closed cycle)) technology demonstration. Domestically, we have not developed the technology for nor produced a closed cycle liquid oxygen rocket propellant (Lox/RP) engine. Closed cycle engines are much more complex to design and operate due to coupled dynamic interactions within the engine, but are much more efficient. The Atlas V Evolved Expendable Launch Vehicle (EELV) system uses the Russian built, ORSC RD-180. The Delta IV EELV system uses liquid oxygen/liquid hydrogen (Lox/LH2) technology based on technologies used for the Space Shuttle Main Engine (SSME). In designing a clean sheet, multi-stage space launch vehicle, it is generally accepted that an ORSC Lox/RP propulsion system is preferred compared to Lox/LH2, due to easier launch operations that avoid complexities and hazards of liquid hydrogen, and low altitude performance (higher thrust to weight). The hydrocarbon boost (HCB), when complete, will result in a domestic technology base exceeding the technology represented by the RD-180. This capability provides 1) leverage to help contain escalating RD-180 engine costs, 2) the domestic capability to replace the RD-180 (if necessary), and 3) a foundation for a booster for a possible EELV replacement or other domestic space launch provider. In addition to the HCB technology demonstration engine hardware is being designed, fabricated and tested, and advanced combustion stability research and modeling is being pursued in parallel. The data from the HCB will be used to validate these combustion stability tools and previously developed advanced physics-based LRE design tools (used for HCB designs and analysis). The advanced physics-based design tools were developed on the recently completed Upper Stage Engine Technology

(USET) project where only the turbo pump tools were validated. The technology goals for the HCB demonstration include a 15 percent increase in Isp, a 60 percent increase in engine thrust-to-weight, a 30 percent engine production cost, and a 50 percent reduction of engine failure rate.

The Air Force and NASA are coordinating to determine what synergies exist between HCB and the recently competed NASA SLS NRA for SLS risk reduction contract awards. The DoD is exploring any opportunities for technology development collaboration or synchronization.

The current spacecraft propulsion S&T investment with industry is a Small Business Innovative Research (SBIR) project for advanced monopropellant ignition and advanced modeling efforts with funding of ~$1M. Previous plans and programs were designed to develop technology to increase on-orbit mission flexibility by selecting thrust and Isp to operate over the range of options more efficiently. Therefore, in addition to providing a new paradigm for on-orbit operational capability, it provides greatly increased on-orbit life (up to 500 percent increase) compared to the current state-of-the-art. The Air Force will be providing AFM 315E advanced non-toxic monopropellant for a recently funded NASA Glenn Research Center NRA contract.

The FY2013, TSSS Ballistic Missile Technology (BMT) Guidance Navigation and Control (GN&C) investment (FY2013 $3.53M AFRL, $12.20M SMC GAP) is in support of an Advanced Inertial Measurement Unit (AIMU), including a Strategic Resonating Beam Accelerometer (SRBA) and a Strategic Fiber Optic Gyroscope (SFOG). The existing Minuteman III (MMIII) ICBM GN&C hardware is expensive and requires much more maintenance than desired (including the required security forces and overhead in the field). The AIMU has a 5X increase mean time between failure, reducing maintenance actions by >80 percent and unit costs by >58 percent. Existing commercial quartz processing and fiber optics technology and processes are being used to enhance producibility and long-term viability and affordability. The performance goal of the AIMU is to meet or exceed the performance of the Peacekeeper instrument performance.

DASD(MIBP)-Sponsored

Active Electronically Scanned Array (AESA) Radar Industry Industrial Capabilities Assessment

The DASD(MIBP) tasked the DCMA IAC to perform an industrial capabilities assessment on the AESA radar industry. The purpose of this assessment was to determine whether sufficient industrial capability and capacity exists to support current and planned production schedules of five major AESA programs, concurrent with other radar programs.

The request was a result of concerns expressed by the ASD(R&E) and the Deputy Assistant Secretary of Defense, Portfolio Systems Acquisition (DASD(PSA)) that the defense related radar industrial base may not be capable of simultaneously supporting the planned timelines of five major AESA radar programs. The programs identified included the Air and Missile Defense Radar (AMDR), Space Fence, Ground and Air Task Oriented Radar (G/ATOR), 3D Expeditionary Long Range Radar (3DELRR), and the AN/TPQ-53 Counterfire Target Acquisition Radar (formally the EQ-36). Requirements assessed were specific to the radar segment and based on specific domains, platforms, and programs. Five AESA manufacturing sites were selected and visited to analyze current capabilities that could potentially support current and planned production schedules of the five major AESA programs, concurrent with other radar programs.

In 2012, AESA radar production accounted for approximately five percent of the overall global military electronics market and 25 percent of the global military radar market. Trends in military electronics are moving toward AESA technology. AESA's production in the overall industry is growing. The defense industrial base sector skilled in the design, development, manufacture, and sustainment of AESA radar systems is currently supported by several viable domestic suppliers. Sufficient industrial capacity and capabilities currently exist within this sector to support production schedules of the five planned AESA programs, along with other radar program production. Manufacturing and personnel resources required to design, build, and test current and planned AESA radar programs is sufficient. Multiple sources currently provide or possess the potential to provide the requisite industrial capabilities to produce AESA radars. Overall, industrial risk to the five planned AESA radar programs and the industrial base supporting AESA radars is considered low. In addition, DCMA FCG determined the overall financial condition of the viable domestic suppliers to be at low-to-moderate risk. The financial condition of all of these suppliers is considered to be satisfactory; with all having adequate financial resources to remain financially viable.

Consolidated Steel and Specialty Metals Trend Analysis

DASD(MIBP) tasked the DCMA IAC to update the semiannual Steel and Specialty Metals report. The purpose of the report was to provide trends and analyses to the DoD acquisition community, detailing short-, medium-, and long-term impacts of steel and specialty metals on the defense industrial base as they exert influence on, and apply to, DoD programs and systems.

The report assesses pricing, capacity utilization, and other industry factors that influence current and future conditions of the marketplace trending for steel, titanium, aluminum, copper, nickel, and stainless steel. The report also assesses pricing and industry influence on four additional metal alloys (molybdenum, rhenium, tantalum, and magnesium). The intent of the trend analyses is to assist the DoD acquisition community with current information regarding the metals industry. The report also identifies major influences on near-term, mid-term, and long-term forecasts.

Additionally, the report gives a summary view of the financial conditions of 24 major firms within the metals industry.

Using government and external data sources, the assessment focuses on base metals and alloys utilized in the production and final assembly of major DoD systems. The DCMA IAC also examined data on metals availability, pricing, and industry trends. Several reliable data sources utilized for the assessment include, but are not limited to, companies' annual reports, the American Metals Market, the Wall Street Journal, and other periodicals. The IAC also utilized insights gained from interviews with company officials during the course of normal business operations.

The metals market showed robustness during the first quarter of 2012 but it has not been sustained as global economic weakness continued into the second half of the year. Findings, pricing trend analysis, and industry assessments show overall market weakness. The economic weakness continues to depress metal prices and contribute to the industry's surplus inventory situation. The economic slowdown in North America and China, as well as the recession in Europe, contributed to low demand for intermediate and finish products manufactured from the six primary metals and the four metal alloys. In CY2012, metal prices peaked in February-March; however, since March 2012, a steady slide in metals demand produced a flat-line pricing trend through September 2012. Many major firms in the metals and mining industry continued to show profitability on record sales, but their mid-year share prices were lower than the beginning of the year. For the first nine months of 2012, capacity utilization rates neared their historical highs as many sectors increased demand for metal products. However, the capacity utilization rates for the construction and housing sectors continued to suppress the overall metal market's ability to fully recover.

B.2 Army

Army Materiel Command (AMC)

Army Industrial Base Baseline Assessment (IBBA) Phase II

The IBBA program provides the industrial base community, AMC leadership, and external organizations with an assessment of current operations, risks, and issues within the Army industrial base. This is the second iteration of the AMC IBBA report. The cyclic design of the IBBA ensures timely visibility and continuity of resolutions that mitigate risks and resolve issues. The assessment scope includes the commercial and organic portion of the industrial base. The IBBA Phase II report targets current FY2012, Budget Year FY2013, and Program Objective Memorandum (POM) cycle FY2014-18. The assessment identified current and future industrial base shortcomings. This future focus provides AMC the opportunity to address shortcomings during Budget Year FY2014 and POM FY2015-19. The IBBA's assessment methodology focuses on selected tactical defense programs managed by the AMC Life Cycle Management Commands (LCMCs) in synchronization with the Research, Development and Engineering Centers (RDEC). The IBBA provides sector/program assessment profiles, infrastructure analysis, and recommendations for industrial base sustainment. The end state is to ensure the AMC industrial base is capable of meeting Warfighter requirements through the retention and preservation of critical industrial capabilities that foster a responsive industrial base to sustain soldier readiness.

Summary of Findings:

ORGANIZATION and SUB-SECTOR	IBBA Phase I Risk Rating	IBBA Phase II Risk Rating
Tank-Automotive and Armaments Life Cycle Management Command (TACOM LCMC)		
Combat Vehicles (Tracked and Wheeled)	RED	RED
Tactical Wheeled Vehicles	RED	RED
Soldier Systems: Small Arms, Mortars, and Protective Masks	RED	RED
Organic Base	N/A	AMBER
Army Ground Equipment	AMBER	N/A
Aviation and Missile Life Cycle Management Command (AMCOM LCMC)		
Aerospace – Raw Materials	AMBER	AMBER
Missile Industrial Base	AMBER	AMBER
Missile Organic Base	GREEN	GREEN
Aviation – Rotorcraft	AMBER	AMBER

Aviation Organic Base	RED	AMBER
Unmanned Aerial Systems	AMBER	AMBER
Communications and Electronics Life Cycle Management Command (CECOM LCMC)		
Information Technology	GREEN	GREEN
Transmission and Communications Systems	GREEN	GREEN
Sensors	AMBER	AMBER
Power Systems and Products *(including RDECOM-CERDEC's Lithium Power Source Supply Base)*	GREEN	GREEN
Electro-Optics Infrared/Thermal Imaging	GREEN	GREEN
Organic Base	GREEN	GREEN
Joint Munitions and Lethality Life Cycle Management Command (JM&L LCMC)		
Ammunition	AMBER	AMBER
Supplier Health	RED	Integrated above
Chemical, Biological, Radiological and Nuclear Joint Program Executive Office for Chemical and Biological Defense (CBRN JPEO-CBD)		
CBRN Sector	AMBER	GREEN

Aviation and Missile Command (AMCOM) Life Cycle Management Command/Aviation and Missile Research, Development and Engineering Center (AMRDEC)

Raw Materials Sector Assessment

The AMRDEC Engineering Directorate's Industrial Operations Division has continued a raw material sector assessment process to periodically assess the availability status of key raw materials. In in 2011's write-up, assessments on aluminum, ammonium perchlorate, beryllium, butanetriol, copper, iron-based alloys, magnesium, molybdenum, nickel, rare earth elements, rhenium and titanium were being conducted on a regular basis. Since that time, the center has started to assess high purity nitric acid, analyzed the effects of helium on Army aviation and missile platforms, and conducted an internal study on composite fibers. High purity nitric acid and composite fibers will now be assessed regularly. Each material assessment looks at the raw material's supply sources, including geopolitical issues that can impact supply, manufacturing processes used, end users of the raw material, pricing, and AMCOM-supported weapon systems delivery schedules. The assessment serves as the initial step for further action, including collaboration with other Army industrial base groups, collaboration with industry, and investigations into a possible Title III project. Other materials are continually evaluated and considered as potential additions to the assessment, depending on their impact to aviation and missile systems.

Hot Isostatic Pressing (HIP) Capability Assessment

The AMRDEC Engineering Directorate's Industrial Operations Division completed an analysis of the hot isostatic pressing (HIP) industry supporting the Army's aviation and missile supply chain. The analysis evaluated the industry for potential capacity and capability issues. Technological advances in HIP are creating a new generation of application opportunities to improve the performance and durability of critical parts and materials. New press and furnace designs, uniform rapid cooling capability, and digital control techniques have shortened process cycle times significantly. Presses have nearly doubled in size in the past ten years, dramatically reducing per unit processing costs. HIP is more viable and affordable than ever for production of strong, long-lasting products that are increasingly demanded by competitive manufacturers in all kinds of industries. Markets served include aerospace and industrial gas turbine parts, airframe components, rocket engines, satellites and aerospace airframe castings. HIP is also used commercially for medical implants and automotive parts. The HIP process has seen steady growth in the powder metal and casting densification fields, which help address precision and complex casting and manufacturing needs. As with any technology, industry awareness is the key to growth. The AMRDEC study indicated that capacity and capabilities are sufficient to meet current and mid-term Army aerospace requirements. However, AMRDEC will continue to monitor HIP vendors through periodic market research to maintain cognizance of this critical industry partner to the aviation and missile supply chains.

Solid Rocket Motor Propellant Industrial Base Study

The AMRDEC Industrial Base Group performed a sector study of the Army's solid rocket motor propellant vendor base. The principal objective of the study was to identify company and industry core capabilities, workloads, key raw material suppliers, and capacities, along with industrial base risks/potential areas of concerns regarding the industrial base's ability to meet DoD requirements. Solid rocket motors (SRMs) have been important to DoD and other government agencies for many years. SRMs are required for DoD strategic missiles, missile defense, and tactical missile systems. Maintaining these systems through their operational lives and sustaining the industrial base that supports these systems are essential to meeting national security objectives. Many single point failures exist in the SRM industrial base, most notably at the raw material level. Materials such as ammonium perchlorate, nitrocellulose, butanetriol, and strong nitric acid are essential in the production of SRMs for Army systems, yet materials such as these are often limited to a single domestic producer capable of supplying the quantities needed to support DoD requirements. As such, AMRDEC's Industrial Base Group will continue to track SRM propellant manufacturing capability as part of our raw material assessment process.

Communications and Electronics Life Cycle Management Command (CECOM)

Information Technology (IT) Industrial Sector Assessment (ISA)

The CECOM Industrial Base Office (IBO) completed a sector study for the IT sector. The study's findings are:

- Operations Iraqi Freedom, New Dawn, and Enduring Freedom have highlighted the need for a more "net-centric" Army capable of transmitting, storing, and accessing data on the battlefield and at the home station. The past decade has also shown that as the internet age dawned, the Army and DoD as a whole no longer drive the market. The DoD only accounts for approximately 0.1 percent of the IT sector's business, while innovations in hardware and software are driven by commercial needs rather than defense-specific requirements. The vast majority of DoD IT architecture and net-centric information systems are enabled through the use of Commercial-Off-The-Shelf (COTS) technology. Thus, the Army is subject to a global IT market in which the U.S. no longer manufactures technology but rather designs and outsources it primarily to Asian nations. The IT industry as a whole is very stable and continues to provide cutting-edge technology to both the commercial and defense market. However, there are several issues that currently affect the ever-changing IT industrial base.

- The primary concern within the IT industrial base is its dependence on foreign manufacturing sources for integrated circuits. The Army utilizes semiconductors in countless applications ranging from desktop and laptop workstations to custom designed processors in aviation simulators. The majority of integrated circuits are manufactured in China, Taiwan, Singapore, and Japan.

- A second concern of utmost importance is the growing risk of counterfeit IT hardware mistakenly incorporated into military supply chains.

- A third concern is the obsolescence of IT hardware in Army weapons systems. Due to the lengthy procurement cycle, component hardware, such as processors, could be obsolete within a few years of fielding, thus making it more difficult to sustain a weapon system without an overhaul of its component parts every few years.

The study found that the IT industry is very stable as a whole, although there are several areas that the Army and DoD should continue to monitor. The sector will continue to provide cutting-edge solutions to Army programs for the foreseeable future. The overarching IT industry trend is virtualization. Whether it is hardware, software, or network virtualization, companies and users are turning to it at an increasing rate for the cost-savings benefits and increased security. Hardware will continue to shrink, become more portable, and offer increased speed for the foreseeable future. This marketplace sector is also witnessing the shift from standalone systems to cloud-based, off-site IT

resources such as storage, e-mail, databases, and even processing capability. The IT industry is an innovative and rapidly changing industrial sector. The report recommended that the CECOM Industrial Base Office should continue to monitor obsolescence, counterfeit hardware, and offshore outsourcing, but should enjoy continued low-cost commercial off-the-shelf IT products and the sustainment of Army systems for years to come.

Sensors, Electro Optics, and Communication Industrial Sector Assessments (ISAs)

The CECOM Industrial Base Office (IBO) completed three draft sector assessments in CY2012, scheduled to be finalized in August 2013: Sensors, Electro Optics, and Communication. All three assessments find the health of these sectors in a stable and, in most areas, viable condition.

Due to the sensitivity of the sensor commodity, the Army finds that its greatest areas of concern are rapid technology growth and market globalization. Erosion of the defense industrial and manufacturing base is a key concern because of its impact on the operational readiness of key weapons systems and defense platforms. The continued decline in competitiveness and technological leadership and the erosion in a wide range of manufacturing sectors that are critical to national defense require a comprehensive strategy aimed at reversing the erosion while preserving and revitalizing the nation's defense industrial base in the coming decades.

The declining technology and innovation base puts in question technological leadership in the world, which also translates into technology areas critical to national security. Of particular concern is the impact this has on the defense industrial base, and how the loss of technological leadership will affect innovations critical for the U.S. to retain its superiority and its ability to protect national interests and influence world events. Reversing this situation will require increased investments by government and defense firms, smart choices in those investments, and more effective government encouragement of companies' R&D activities, while both sectors will need to become more astute in tracking technological advances and utilizing them.

Diminishing Manufacturing Sources and Material Shortages (DMSMS) will impact the resources and material needed to build, maintain, and operate military warfighting equipment and potentially jeopardize the life-cycle support and viability of the weapon system or equipment. A healthy DMSMS management program is crucial to maintaining the readiness of weapons systems and providing the critical material and parts necessary for sustaining, replacing, and upgrading key elements of the weapon system or equipment.

Parts and component obsolescence resulting from the high costs of building and maintaining excess inventory, the emphasis on rapid acquisition strategies, rapid changes in component or material technology, uneconomical production requirements, and extended product life cycles are affecting the DoD and the many commercial

industries from which the DoD buys parts and components. If left unchecked, parts and component obsolescence could cause increased equipment downtime, reduced operational readiness and decreased reliability, thereby hindering the ability of our Warfighters to accomplish their mission.

Sensors

The sensor industry as a whole is stable and continues to provide cutting-edge technology to both the commercial and defense market; however, there are several issues that currently affect the ever-changing defense industrial base and, therefore, also affect the sensor industrial subsector, including:

- the need to partner with industry and academia to develop enabling technologies for many important weapons systems; and
- the need to apply commercial technologies and products to reduce costs and improve availability of key military components.

Electro-Optics

The electro-optics industry as a whole is very stable, fiscally-healthy, and continues to provide cutting-edge technology to both the commercial and defense market. However, there are several issues that currently affect the ever-changing electro-optics industrial base:

- budget cuts;
- U.S. defense science, technology, engineering and mathematics workforce;
- exporting of infrared products; and
- migration of electro-optics manufacturing.

Communications

The Department accounts for approximately 25 percent of the transmission and communications sector's business. Many European and Asian governments have been increasing their funding of commercial communications satellite R&D efforts. The U.S. Government is benefitting from the significant R&D activity that is occurring in the private sector. There is a critical and growing need for new innovation in this technology-intensive industry, particularly in regards to:

- information security and
- interoperability.

Communications and Electronics Research, Development and Engineering Center (CERDEC)

Lithium Power Source Supply Base Production Capabilities Review

The focus of the CERDEC assessment was on non-rechargeable lithium manganese dioxide, lithium sulfur dioxide, and rechargeable lithium ion batteries currently under contract to the Defense Logistics Agency (DLA). DLA is the responsible activity for awarding DoD battery contracts that supply batteries to all the Military Departments.

One objective of the review was to conduct an assessment of the lithium ion battery domestic industrial base production capability to: 1) determine if this capability is in danger of not having enough business to remain financially viable due to projected budget reductions resulting from the drawdown of DoD forces and (2) determine if DoD is in danger of losing the capability to purchase the batteries it needs.

CERDEC found that there is no risk of losing the current capability and that the battery industrial base is financially healthy overall, driven by its commercial business. It is the loss of capacity to rapidly produce/assemble batteries to meet immediate wartime demands that is at moderate risk. Capacity could be significantly reduced if demands fall too low. CERDEC will continue to monitor and re-evaluate the battery industrial base.

Even though DLA forecasts indicate a reduction in unique military battery demands from the previous two years, the current Army battery acquisition policy is expected to force an increased use of rechargeable batteries. Due to this phenomenon, it appears that the rechargeable battery demands may remain stable (at actual DLA demand data for the last two years); however, the current producers remain sensitive to reducing production capacity due to fluctuating demands. Primary battery producers are more sensitive to reduced demands. Therefore, the uncertainty of demand forecasts plagues both battery type producers.

Since the outlook for future business is unclear, battery producers have already indicated that they are at a crossroads for maintaining their portion of the industrial base. Battery producers may cease production if demands drop significantly from current levels to the point of falling below the level of profitability. This is especially true of the primary battery producers.

Therefore, developing a long-term forecast for both battery types and outlining the direction the military is taking on battery usage for at least the next five years, should be immediate Army priorities. This would allow for development of a clearer acquisition strategy for the next several years and give industry an indication of the size of future business.

If there is a reduction or total loss of capacity, the battery industrial base has the capability to reconstitute and provide the capacity needed by DoD, given enough time and funding. The major drawback during the period to reconstitute is that the delivery of peacetime requirements will be delayed, the capacity to surge would be reduced or temporarily lost, and surge capacity ramp-up time would increase.

The importance of delays in surge capacity was illustrated during Operation Iraqi Freedom (OIF), where the demands for BA-5590 batteries approached 300,000 per month. The BA-5590 industrial base required seven months to reach approximately 200,000 BA-5590 batteries per month. This was a significant shortfall and such shortfalls, if they exist, are critical to the success of any future warfighting. This information must be made available to war planners.

In conclusion, CERDEC recommends that another review of the military-unique battery industrial base should be conducted to determine if this part of the base is beginning to approach a situation where there may be a loss of capacity.

Edgewood Chemical Biological Center (ECBC)

Joint Life Cycle Management Review (JLCMR)

The ECBC Industrial Base Office (IBO) was instrumental in developing the industrial base assessment method that supports the Joint Program Executive Office-Chemical Biological Defense (JPEO-CBD) Joint Logistics Advisory Council's JLCMR.

The objective of the CBD Industrial Base Working Group's mission is to increase visibility of the Chemical, Biological, Radiological, and Nuclear (CBRN) industrial base, with a focus on assessing capabilities and identifying risks in order to preserve industrial base capabilities. The JLCMR process provides the Program Executive Officer visibility into the performance of key manufacturers that support CBRN programs. The JLCMR process is centered on the assessment of a manufacturer's quality performance, financial condition, and industrial base capabilities.

In FY2012, the industrial base working group's core assessment areas included CBRN items linked to their systems, the organic industrial base, and critical CBRN manufacturers. By utilizing standardized criteria, the assessments revealed that the overall health of the CBRN industrial base is very capable, with risks identified in the ability to maintain future organic capabilities. A "common operating picture" matrix methodology of the current and future state of the commercial and organic industrial base's capability responsiveness was used to identify immediate risk and the injection of acquisition strategies. The JLCMR is an enabling process that supports program sustainment and preservation of critical industrial base capabilities that maintain the readiness of the Warfighter.

Technical Procurement Product Improvement

The ECBC–Rock Island (ECBC-RI) Industrial Base and Engineering Offices developed the electronic technical procurement product (TPP) input review form

automating the industrial base market research and a portion of the engineering data research for CBRN items. The information is then included in the technical data package for submission in the acquisition process. The electronic form has improved and standardized the TPP process for CBRN technical data packages by consolidating the industrial base and engineering market research analyses data entry and by automating the process within industrial base assessment system (IBAS) for electronic access and repository. The form utilizes direct and indirect data feeds from the industrial base data warehouse, IBAS, business identification number cross reference system (BINCS), Dunn and Bradstreet, procurement history databases, and others to provide the most current information available to assist the Army Contracting Command-Warren (ACC) with making sound purchasing decisions. The process change was in coordination with the interagency process development team, which included ACC-Warren, TACOM-Warren item managers, ECBC's engineering, industrial base analysis, and the industrial base information technology offices. Combining the engineering and industrial base portions into a single form reduced a large redundancy issue, resulting in a time/cost savings. This effort is an ongoing effort towards continuous improvement initiatives within the organization.

Calgon Carbon Corporation (CCC) and Activated Carbon Market Sector Assessment

The ECBC-RI Industrial Base Team is providing an industrial base market sector assessment for the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD) at the request of the JPEO-CBD Industrial Base Working Group. The assessment is in support of the DPAS Title III project to improve military-grade impregnated activated carbon manufacturing capabilities within the U.S.

The assessment and follow-on DPAS Title III proposal will enable commercial industry to meet DoD's current and future supply requirements, while improving readiness through the insertion of improved production capabilities and capacities. The improved readiness and industrial base responsiveness will greatly reduce risks to soldiers and first responders who face chemical, biological, radiological, and nuclear hazards. The project also brings the probable realization of cost stabilization, since the potential to operate both facilities at an optimal – rather than at maximum – production rate will result in improved product quality and consistent outputs. The establishment of this dual production base allows for growth within the sector to meet projected requirements, while enabling the base's ability to reach DoD/National security surge capacity requirements. Based on the assessment of the current production base's relevance to numerous platforms and applications, the growing threat of terrorist activities, and the projected product demand, the assessment recommends the approval of a Title III effort to establish a second production facility in order to ensure a responsive industrial base is present to ensure Warfighter readiness.

The following table, FaC Assessment, provides an overall assessment of these manufacturers with a rating of 4.0, which indicates the loss of this capability would greatly impact Warfighter readiness.

Criteria	Rationale	Rating
Criticality		4.5
Defense Unique	ASZEM-TEDA impregnated carbon is a critical filtration component of DoD respirators.	5
Relevant to Many Platforms	Product sustains over 70 platforms, which include the soldier's protective mask, collective shelters, and combat vehicles.	5
Uses Highly Skilled Labor	The loss of the production and laboratory workforce at CCC would create a "learning curve" of approximately 60 days.	4
Design-Intensive Activity	The firms in the sub-sector need to build on experience and familiarity with unique defense design parameters – specific application-related requirements not familiar to design and industrial engineers outside the current defense bases.	4
No Alternatives Available at Reasonable Cost, Schedule, and Performance	CCC is a single source manufacturer; therefore, the qualification of a second manufacturer and/or the recreation of the production line would create a gap in product availability.	4
Certain Future Demand	1) Current and future filtration systems utilize this product. 2) Growing terrorist threat, availability of CBRN agents, non-traditional agents, and increase in rogue states and/or groups ensure a future demand for this product.	5
High Reconstitution Cost	CCC's rough order of magnitude is 19.0 million to establish the impregnation process at an existing production facility.	4
Production Surge Capability	1) Single point failure – Only qualified source 2) Limited ability to surge to meet contingency demands 3) Aged production line 4) Quality degradation at maximum production rate	5
Fragility		3.6
Suppliers' Finances Weak	CCC financials are very robust with minimal risk.	2
Few Firms in Market	CCC is the only qualified source for ASZM-TEDA Carbon – single source.	5
Production Near Minimum Sustaining Rate or operating at maximum production rate	Per CCC – the Neville Island production facility is currently operating at 100 percent capacity when both DoD ASZM-TEDA carbon and commercial production is combined. Source: 2012 CCC Industrial Base Survey	5
DoD Reliance	CCC is not reliant on DoD contracts for financial stability.	2
Age of Facility	Although the Neville Island production site was upgraded during the 1990s, the base facility was established during the 1940s and 1950s.	4
	Overall Assessment	4.2

Tank-Automotive and Armaments Command (TACOM) Life Cycle Management Command

Heavy Brigade Combat Team (HBCT) Government Furnished Material (GFM) Industrial Base Analysis

The TACOM Life Cycle Management Command GFM industrial base analysis addresses a PM HBCT-selected segment of the Abrams, Bradley, and M88 Hercules GFM supply chain. A total of 25 GFM suppliers were analyzed: 18 of these suppliers support the M1 Abrams program, 13 support the Bradley program, and 6 support the M88 Hercules. The 25 suppliers analyzed may, in some cases, support a combination of Abrams, Bradley, and M88 Hercules depending on the GFM item supplied.

The overall findings reflect the following production impacts that will be realized as M88 Hercules production continues at trickle-rate volumes (for an undefined period of time), and Abrams and Bradley platform production winds down and zeros out in the 2013/2014 timeframe. Abrams Low Rate Initial Production (LRIP) is projected for FY2017 and the Bradley production re-start date is undetermined. The same problems outlined below extend beyond GFM and will also be experienced between the original equipment manufacturers (OEM) and their direct supply chain:

Many GFM suppliers' total workload is heavily dependent on Abrams and/or Bradley production support. The zeroing out of Abrams and/or Bradley production will have a direct impact on these companies' ability to remain financially solvent and could result in companies going out of business. If GFM production were to cease, some suppliers may retain manufacturing capabilities while in a cold base status. Existing floor space could be utilized, as needed, for other business operations, and the suppliers would not necessarily retain platform-unique specialized equipment, tooling, fixtures, test equipment, etc. Significant costs/lead times would be required to support a re-start.

If GFM production were to cease, some suppliers indicated their unwillingness to retain manufacturing capabilities and would not re-enter Abrams/Bradley production support in the future. There will be a significant impact on the retention of critical and experienced skill sets associated with the GFM production and related engineering support. Layoffs and reassignments would occur. Institutional program knowledge will be lost.

Detailed sub-contractor and sub-tier supplier information was not provided. However, the GFM manufacturers indicated that there would be a significant loss of support if platform production were to cease for an extensive period of time. The need to locate and qualify new suppliers, as well as re-qualifying those suppliers willing to support future production requirements, will in all likelihood arise. Extensive lead times and costs will be associated with this effort.

With production going cold for an extensive period of time, engineering support will be lost. This will have a direct effect on (1) the ability to incorporate technology advancements into the hardware and (2) an increase in GFM obsolescence issues.

Loss of either Abrams or Bradley production operations would have a direct effect on the ability to support future sustainment requirements. Loss of either Abrams or Bradley production operations could affect the ability of the manufacturers to support other military programs.

Based on the lead times required for the GFM suppliers to re-enter production from a cold base scenario, the Abrams and Bradley OEMs would need to place their orders with the GFM suppliers in excess of two years prior to the re-start of any platform production. This is due to the need for acquiring and qualifying new suppliers, re-qualifying previous suppliers, first article testing, incorporating technology advancements into the hardware, and resolving obsolescence issues.

Surveys indicated:

- 32 percent of GFM suppliers are rated red, creating a latent possibility that these manufacturing capabilities could be lost indefinitely.

- 28 percent of suppliers are rated yellow and will require extensive costs and lead times to re-start production from a cold base.

- 40 percent of GFM suppliers are rated green and, due to product diversification, reflect no major risk in supporting future production ramp up.

A smooth Abrams/Bradley program re-start and ramp-up is questionable if the industrial base (for the identified GFM) is not maintained during the FY2013-17 timeframe. Although many suppliers are indicating a willingness to retain manufacturing capabilities during a cold base scenario, the economic climate could dictate the need for bringing commercial work into their facilities. This would have a direct impact on the ability of the GFM suppliers to re-start Abrams/Bradley production in the 2016-2017 timeframe. Also, the concerns outlined above need to be taken into consideration.

PM Stryker GFM Industrial Base Analysis

In November 2011, GDLS completed the Stryker minimum sustaining rate (MSR) study to assess their ability to maintain the Stryker Family of Vehicles (FOV) at a contractor-defined MSR. In conjunction with this analysis, DoD requested TACOM's Industrial Base Management Group (IBMG) assess a limited number of PM Stryker Brigade Combat Team (SBCT)-selected GFM. The IBMG performed the above analysis in the November to December 2011 timeframe.

The eight PM SBCT-selected GFM suppliers that were analyzed are:

- Chemring Joint Services Lightweight Standoff Chemical Agent Detector (JSLSCAD) DRS-Reconnaissance, Surveillance, and Target Acquisition (RSTA),
- Drivers Vision Enhancement (DVE) DRS-Sustainment Systems,
- FSV Mission Equipment Package (MEP) Kit,
- DRS-Training & Control Systems,
- TOW Missile Launcher HDT,
- General Purpose (GP) Precleaner Miltope,
- Mortar Fire Control Station S&K Electronics, and
- NBC Heater Watervliet Arsenal M68A2 105mm Barrel.

Of the eight GFM suppliers covered in this assessment, most are predominantly defense-oriented with little or no commercial business base. Overall findings reflect the following supply chain impacts that could be realized as Stryker production winds down and zeros out in the 2014 timeframe:

- Most suppliers indicated that they would bring production operations back from a cold base, although significant increases in costs and lead times would materialize.
- The MSRs that each supplier identified through the FY2013-17 timeframe are unlikely to be fully supported based on forecasted sustainment volumes.
- Although detailed information relative to the suppliers sub-tier vendor base was not provided, excessive lead times and costs would be associated with any production re-start after a cold base in excess of one year.
- Restart issues for all suppliers/sub suppliers could be affected if commercial work is brought into the facilities and government-related equipment is excessed. In addition, there will be extensive costs and lead times associated with parts obsolescence.
- Six suppliers are rated green, reflecting no immediate impacts/risks. However, this could change as production for numerous platforms comes to an end around the FY2014 timeframe.
- Two suppliers are amber due to, but not limited to, low sustainment requirements and potential obsolescence issues. This must be given immediate attention.

B.3 Navy

Cartridge Actuated Device/Propellant Actuated Device Industrial Base Assessment

About every five years, the Cartridge Actuated Device/Propellant Actuated Device Joint Program Office (CAD/PAD JPO) contracts with the DOC to conduct and record an extensive assessment of the CAD/PAD industrial base. This assessment provides an overview of fiscal status, demographics, capabilities, and recommendations of industrial companies that regularly enter into USG contracts to produce CAD/PAD assets. The most recent assessment was conducted throughout CY2012 and had 22 respondents.

The JPO has established ongoing initiatives with the industrial base as a result of these industry assessments. The CAD/PAD joint program now allows some industrial partners with approved testing capabilities to conduct lot acceptance testing on site, versus shipping samples back to the Naval Surface Warfare Center, Indian Head Division (NSWC IHD). The contractor testing is witnessed by a government representative from NSWC IHD. This practice saves the contractor shipping time and costs, and can result in up to 60-days quicker product release and product delivery to customers.

The CAD/PAD JPO has also entered into agreements with industrial partners who want to become second source suppliers of CAD/PAD devices. The contractors invest their own funding to build qualification units. The government pays for government oversight, qualification testing, and service release. Establishing a second source of supply creates competition, and often saves the program 25 to 40 percent on the acquisition cost of CAD/PAD devices on the out years. With the help of government radiography experts from NSWC IHD, the CAD/PAD industrial base is making a transition from wet film x-rays to digital and computed radiography systems. This change saves funding, since wet film chemicals are becoming scarce and more expensive. Digital and computed radiography systems also produce less waste, and thus are more environmentally friendly. So far, four industry companies have come on line with digital x-ray.

The CAD/PAD JPO's practice has been to host two bi-annual meetings with the CAD/PAD industrial base. The CAD/PAD Technical Exchange Workshop provides a forum for government and industry to meet to discuss new developments and the latest technical issues impacting the industry. The CAD/PAD Industrial Summit affords government and industry personnel an opportunity to meet to discuss governmental updates, business, and contractual issues. Both of these meetings are widely attended, and ensure government and industry have open communication on a regular basis.

B.4 Air Force

Air Force Annual Industrial Base Assessment

This assessment evaluated industrial base sectors consisting of relatively complex supply chains that support Air Force materiel requirements. Each sector analysis within the report highlights the trends, issues, and concerns relative to that sector and, in some cases, crosscutting trends, issues, and concerns that affect multiple sectors.

Aircraft – DoD aircraft budgets are projected to decline through 2016, with funds shifting from systems nearing completion of production to systems in development, test, and pilot production. Problems that delay fielding these new systems could put pressure on companies to layoff personnel with critical skills and place key suppliers at risk. Supply chain vulnerabilities will pose a risk to new systems reliant on foreign sources for strategic materials and components. Some portions of the domestic industrial base will be sustained because the sales of commercial aircraft and engines are forecast to increase through 2020 as airlines re-capitalize.

Space – DoD budgets for space related RDT&E will decline significantly through the remainder of the decade. Consolidation of satellite and launch vehicle companies responsible for the design, integration, and test of military space systems has resulted in concerns regarding competition and innovation. As the number of sole and single source lower-tier suppliers increases, domestic demand is often insufficient to sustain more than one company operating at an efficient capacity. This is further constrained by requirements for space system components that place significant financial and technical barriers to entry on firms wanting to become qualified sources.

Missiles and Munitions – Projected DoD budget reductions will impact missile RDT&E and procurement. Joint Military Department acquisition programs across all missile and munition categories have reduced the number of active production lines and streamlined the supply chain. This supply chain is composed of smaller, more-specialized firms providing items such as thermal batteries, rocket motors, inertial measurement units, fuzes, and warheads. In most cases, the suppliers provide common components to multiple end items. The result is a specialized and efficient industry with limited capacity for near-term surge production.

The issues identified in the report fell primarily into two categories. The first category centers on issues presenting a risk to existing materiel requirements. In many cases, steps to mitigate these risks have been taken and a periodic review of progress toward resolution is required. The second category is those issues that need to be understood and monitored for their potential impact to the DoD as an enterprise in the

future. These include the vulnerabilities associated with materials and components supplied by both domestic and foreign manufacturers and concern about the continued availability of scientifically educated, trained, and experienced personnel.

The Air Force is working with OSD to identify specific technologies, materials, components, skills, and suppliers critical to current and future Air Force requirements and monitor these capabilities to ensure that they are viable and not vulnerable to disruption. Specific efforts include looking across programs and/or portfolios of programs such that industrial base risks are considered and documented, evaluating procurement strategies in terms of costs and benefits, and investing in selected infrastructure capabilities or capacity.

Air Force AESA Radar Assessment

This assessment characterized current and evolving AESA radar subsystem and component manufacturing technology thrust areas. The assessment evaluated constraints that radar sub-tier suppliers face in developing key technologies and the impact of these constraints on supply chain relationships.

The market for AESA radars is forecast to increase as multi-functional designs provide expanded capabilities that have both airborne and ground system applications. The global market is dominated by two U.S. companies that combined have an estimated 85 percent share of total sales. Supply chain concerns identified by radar subsystem and component suppliers centered predominantly on capabilities within the industrial base to design and fabricate electronic devices.

To meet projected functional requirements, the maturation of several key technologies residing at lower-tier suppliers will need targeted investments to ensure both capability and capacity are available through one or more viable domestic sources. These technologies include affordable and reliable reprogrammable circuits and apertures throughout the airframe; highly reliable and accurate analog-to-digital (A/D) converters; advancements in metamaterials engineering and manufacturing; and significant processor advancements. Current business practices limit the DoD's and the OEMs' ability to incentivize innovation at many of the niche suppliers in the lower-tiers.

This assessment is supporting ongoing advanced development investment planning within the Air Force. The assessment has broader implications to overall DoD research and development portfolios within the Military Departments, including gaining additional leverage from investments by companies located in the lower-tiers of the defense industrial base.

Communication Antenna Assessment: Airborne Directional and Omni-Directional Antenna Industrial Base

One challenge for Remotely Piloted Aircraft (RPA) is the availability of sufficient radio frequency spectrum and bandwidth for both flight control and sensor data transmission. The assessment identified opportunities to improve the size, weight, and power characteristics; bandwidth flexibility; affordability; and lead-times associated with the design and manufacture of directional and omni-directional communication antennas.

In characterizing this industry segment, a small number of large avionics manufacturers supply a majority of the systems. Demand for RPAs and associated data links and antennas is expected to increase over the next decade as the DoD and other government agencies adopt these systems and fund development efforts to integrate their capabilities into ongoing missions. To meet this growing demand, a number of innovative small- and medium-sized firms have promising technologies that will require opportunities to demonstrate their capabilities outside of existing market relationships.

Antenna designs that combine functional subcomponents (amplifier, transceiver, modem and controls) into the body of the antenna assembly offer reasonable trade-offs for RPAs over more complex or costly technologies, such as mechanically-steered beams (gimbal assemblies) or phased arrays for beam-pointing. The domestic supply chain for communications antennas has adequate competition, technical expertise, and capacity. In evaluating critical suppliers for multiple antenna manufacturers, less than ten percent were common to and used by these primes, primarily in the areas of Monolithic Microwave Integrated Circuits (MMICs) and RF printed circuit boards.

This assessment is supporting ongoing advanced development investment planning within the Air Force. Identified projects were analyzed and ranked based on performance and producibility objectives in order to provide recommendations to investment managers.

Aerospace Investment Castings and Forgings Industrial Base Analysis

The aerospace casting and forging manufacturing base has consolidated significantly over the past two decades. This is in part due to complex geometries, unique alloys, and high quality standards for precision metal forming that all serve as barriers to entering this market. The majority of the casting and forging companies have well-established customer-supplier relationships with airframe and aircraft engine manufacturers.

The aerospace investment casting and forging companies are currently robust and financially healthy. Market sales are forecast to increase through 2015. The cost and availability of some raw materials and alloying agents continue to fluctuate driven

by external factors such as commodity markets, energy prices, and intermittent demand for military repair and replacement parts. Maintaining a skilled and experienced workforce is an ongoing concern within an industry that relies heavily on proprietary knowledge for product identity and quality.

Process opportunities common to both casting and forging product lines include: modeling and simulation from material selection through inspection; improvements in tooling durability and accuracy; improved energy efficiency; advanced process controls, including sensors, evaluation algorithms and correction mechanisms; end-to-end data flow for parts and processes; and rapid prototyping for new product development. Government leadership and participation in collaborative research initiatives with the casting and forging industry is focused on communicating technical and procurement requirements throughout the supply chain, and identifying investment priorities within the defense community.

This assessment is supporting investment planning within the Air Force and broader DoD research and development communities. The Air Force is working with OSD to develop and maintain a list of specific technologies, commodities, components, skills, capabilities, and suppliers critical to current and future Air Force requirements and to monitor those areas critical to the aerospace casting and forging industry.

Space Satellite Thruster Industrial Base Study

The Air Force Space and Missile Center Engineering Directorate sponsored this study to evaluate government requirements for satellite thruster technologies and current industrial capabilities to design and manufacture these systems. Satellite thrusters provide the means for both putting satellites in their operational orbital positions and keeping them in position for the life of the satellite. Orbital missions use a mixture of both chemical and electric propulsion systems.

The study evaluated new electric thruster designs that could both complement and possibly replace some chemical thrusters. While there are a small number of domestic producers of satellite thrusters, the overall demand is relatively constrained and tied directly to satellite sales and production. In terms of supply chain constraints, chemical and electric thrusters rely on a number of materials and components of concern to other subsystems within the satellite and launch community. These supplier concerns include space-qualified versions of high-temperature composite fibers, propellant and binder chemicals, solar cells, and batteries.

The Air Force expects the thruster industry to remain stable throughout the next decade. Long-term concerns identified by several satellite prime contractors include: limited investment in R&D, making innovation and insertion of new technology difficult; insufficient funding for qualification of new suppliers of materials or components; high entry barriers for new manufacturers; and an aging workforce. With limited development of new products, maintaining a robust engineering and production

workforce will be difficult. If there are gaps in production programs, replacing skilled, experienced employees such as welders, machinists, and electro-mechanical technicians, will be difficult.

The Air Force will continue to monitor this critical industry as individual decisions are made regarding procurements, as well as overall market conditions impacting domestic production operations. The Air Force is working with OSD to develop and maintain a list of specific technologies, commodities, components, skills, capabilities, and suppliers critical to current and future National Security Space requirements and monitor those areas critical to the satellite thruster industry.

Space Precision Bearings and Lubricants Industrial Base Study

This study characterized the current and projected state of the precision bearings and lubricants industrial base with an emphasis on those domestic manufacturers whose products are qualified for space applications. Bearings and lubricants are used in a wide array of components and systems, such as solar panels, pumps, gyros, and reaction wheels. The materials used must function for the life of the orbiting satellite in the challenging operating environment of space.

While overall annual growth for the bearings and lubricants industry is expected to average eight percent through 2016, projected growth for space-qualified items remains flat. Manufacturers of precision bearings and lubricants generate the majority of their revenues from non-space customers. The domestic industrial base for space-qualified products consisted of a couple of large bearing manufacturers and a number of small niche technology firms. Foreign bearing suppliers were identified, but not considered, in assessing the risks to national security space systems, unless they were a critical part of the supply chain.

Concerns and challenges in this industry included flat growth and episodic demand, low production yields, long lead times, and difficulty in stockpiling. This assessment identified several emerging technologies but, given their current maturity, a significant research and development investment would be required over the next decade. Technologies such as hybrid and magnetic bearings will most likely provide incremental improvements and take a significant amount of time to fully implement.

This assessment is supporting investment planning within the Air Force and broader DoD research and development communities. The Air Force is working with OSD to develop and maintain a list of specific technologies, commodities, components, skills, capabilities, and suppliers critical to current and future National Security Space requirements and monitor those areas critical to the precision bearing and lubricants industry.

Infrared Focal Plane Arrays Industrial Base Study

This follow-up assessment to a 2008 Air Force Focal Plane Array industrial base assessment was conducted to look at the effect of changes to the market as DoD budgets decline, following a decade of significant growth in non-space night vision procurement. The assessment evaluated the long-term viability of the domestic focal plane array manufacturers' base on projected sales forecasts, production facilities, overlapping product lines, performance characteristics, and technology investments.

The focal plane array industry forecasts marginal growth of three to four percent annually over the next ten years across both commercial and military markets. The government will continue to be the largest customer of focal plane array products, but budget cuts are expected to result in a slight decline in near-term purchases of infrared sensors. Suppliers, while concerned, are planning to maintain existing product lines.

Manufacturing for non-space and space (or un-cooled and cooled) product lines share some common design, fabrication and test operations within the companies' facilities. Over the past decade, the non-space product lines have provided steady revenue, enabling expansion of a skilled production workforce and facility investments. The space focal plane array segment has driven technology in terms of performance characteristics, materials evaluation for substrates and semiconductor devices, and investments in process maturation for large format arrays. Depending on changes to the projected sales forecasts, retention of critical design, engineering, and production skills may become an issue.

The Air Force will continue to monitor this critical industry as individual decisions are made regarding procurements and overall market conditions impacting domestic production operations. The Air Force is working with OSD to develop and maintain a list of specific technologies, commodities, components, skills, capabilities, and suppliers critical to current and future National Security Space requirements and monitor those areas critical to the infrared sensor/focal plane array industry.

B.5 Defense Contract Management Agency

DCMA Assessments for the Army

MQ-1C Gray Eagle Unmanned Aircraft System Industrial Capabilities Assessment

The Army Medium Altitude Endurance (MAE) Product Office, UAS Project Office (Redstone Arsenal), tasked the DCMA IAC to perform an industrial capabilities assessment on the MQ-1C Gray Eagle UAS to support its full rate production decision in March 2012.

The DCMA IAC analysis of the prime contractor and its critical component suppliers concluded that the industrial capabilities to produce the MQ-1C Gray Eagle are a high risk, due to the fact that three critical components supplied to the prime integrator are considered high risk. Each has been determined to be unique, endangered, and high risk. The financial viability of each sole source company that currently possesses the essential capabilities to produce their respective components is endangered, and there are no potential alternative qualifiable sources available within acceptable schedule and cost parameters. The IAC recommended that the Army continually monitor each company's financial condition and consider qualifying an alternate source.

DCMA Assessments for the Navy

Radio Frequency Passive (Chaff) Countermeasures Industrial Capabilities Assessment

The Naval Air Systems Command (NAVAIR) Program Manager Air (PMA) 272 requested the DCMA IAC perform an industrial capabilities assessment of the radio frequency (RF) passive (chaff) countermeasures industry. The purpose of the assessment was to determine if the domestic industrial base had the ability to support the manufacturing of chaff countermeasures and to determine requirements to recreate domestic chaff manufacturing capability, including costs and lead times, should the only domestic chaff producer exit the business due to small procurement requirements.

Chaff is manufactured to different specifications and requirements for each of the Military Departments. Currently, the Military Departments' requirements are minimal; purchases are primarily small amounts of training rounds. The Army does not have any chaff requirements for buys in FY2013 and beyond. Limited procurement of chaff puts industry capabilities for producing chaff at risk. The study assessed three current chaff manufacturers (one domestic and two foreign), two non-chaff manufacturers, and two potential organic chaff manufacturers' current capabilities to potentially support the chaff industrial base.

Based on industrial capabilities risk criteria, chaff manufacturing is considered a high risk. The current domestic producer of chaff has the requisite industrial capabilities necessary to research, develop, and manufacture chaff. However, it is the sole qualified domestic producer of chaff, and its financial risk is high. Without additional requirements for chaff, the current domestic producer will probably exit the chaff business. Mitigating this risk, however, is the long shelf life of chaff. There is also sufficient inventory to support military requirements for approximately five to seven years. The Army does not have any chaff requirements for buys in FY2013 and beyond. These factors and analyses allow sufficient time to qualify an alternate source, if required. From a global perspective, DCMA identified two potential alternative sources that have the capabilities to manufacture chaff. In addition, two Government facilities have an interest in manufacturing chaff. Based on this, the DCMA IAC recommended the following: establish a Joint Services Chaff IPT to manage current issues, cultivate organic and foreign capabilities, consider life of type purchases of chaff, and continue to monitor financial health of the domestic sole source producer.

Advance Digital Data Set (ADDS) Industrial Capabilities Assessment

The Naval Air Systems Command (NAVAIR) Program Manager, Air Combat Electronics (PMA 209), tasked the DCMA IAC to perform an industrial capabilities assessment on Advance Digital Data Set (ADDS) in support of a Milestone B decision in February 2013. The purpose of the assessment was to assess the domestic avionics industrial base's capability to develop and produce mission and flight recorder related systems supporting the CH-53K and MH-60R helicopter programs.

At completion of the ADDS industrial capabilities assessment, NAVAIR had not yet released the contracting request to industry. Therefore, the awarded prime and subcontractors for ADDS could not be determined at the time the study was completed. Therefore, the ICA performed a comparative analysis of the avionics industrial base's ability to produce products with similar capabilities. The IAC, in coordination with NAVAIR, identified five small and seven large businesses as potential contract candidates for ADDS.

There are currently no contractors doing all phases of the required workload for a single company ADDS solution. There are multiple non-finalized teaming agreements, with undisclosed partnerships under discussion between the 12 ADDS competitors assessed. The contractors would not share their finalized teaming agreements until NAVAIR released the final ADDS technical specifications and contracting requirements. Each contractor analyzed can support additional workloads at this time, and it is assumed this capacity will be available to support future ADDS workloads. The capabilities resident at the contractor sites visited are common throughout the electronics and avionics industrial base and are considered replaceable within acceptable time and cost considerations to meet program requirements. The ADDS program is considered a low risk since, for the components and systems analyzed,

there are several sources currently providing the requisite industrial capabilities, with potential alternative qualifiable sources available.

RQ-21A Small Tactical Unmanned Aerial System (STUAS) Industrial Capabilities Assessment

The Department of the Navy, Naval Air Systems Command (NAVAIR) PMA-263 (Patuxent River, MD), tasked DCMA IAC to perform an Industrial Capabilities Assessment (ICA) on the RQ-21A Small Tactical Unmanned Aerial System (STUAS) to support its DAB Milestone C review in 1st Quarter of 2013. DCMA IAC, in coordination with NAVAIR PMA-263, identified the prime and six key component subcontractors to be assessed.

DCMA IAC analysis of the prime contractor and its critical component suppliers concluded that the requisite Industrial Capabilities (skills, knowledge, processes, technology, facilities, and equipment) necessary to research, develop, manufacture, test, and evaluate the RQ-21A STUAS exists within the UAS industrial base. Although, the RQ-21A STUAS industrial base is considered a moderate risk as the prime is the single qualified source, with no alternative qualifiable sources identified within acceptable cost and schedule parameters. For most of the components/systems analyzed, there is only one reliable source currently providing the requisite industrial capabilities.

Silver-Zinc (AgZn) Battery Industrial Capabilities Assessment

Crane Division, Naval Surface Warfare Center (NSWC Crane) tasked the DCMA IAC to perform an ICA of the silver-zinc (AgZn) battery industry to determine its ability to support current and future U.S. Government (USG) programs that rely on AgZn batteries for their applications. The purpose of this assessment was to identify sole, single, and foreign sources; long lead times; and financial risks.

The U.S. AgZn battery industry has experienced decreasing sales since the mid-1980s, due largely to the transition from systems that rely on AgZn batteries to other battery types. Historically, similar situations experienced in other industries have resulted in eventual industry consolidation to a single source-of-supply. This possibility represents potential future risk to USG programs that cannot readily transition to other types of batteries without major redesign, testing, and qualification efforts. The Military Departments' current aggregated demand is for approximately 2,330 AgZn batteries required for various subsystems through 2017. The DCMA IAC, in coordination with NSWC Crane Division, selected six AgZn battery prime contractors and five key component subcontractors for the assessment.

The AgZn battery industry is currently considered a low risk. The industrial base has the capabilities to produce reserve, primary, and secondary AgZn batteries and the

key subcomponents (gas generators, cellophane, and silver powder). There are several sources currently providing the requisite industrial capabilities, with potential alternate qualifiable sources available. However, if demand continues to decline and/or replacement technology proves effective, the risk could increase. Military Department stakeholders should engage with industry to understand and assess future supply and demand issues to ensure AgZn battery industrial capabilities are maintained and available post 2017-2030.

Printed Circuit Board Industrial Base Capability Assessment

The Naval Surface Warfare Center/Crane Division (NSWC/CR) Department of Defense Executive Agent for Printed Circuit Board Technology tasked the DCMA IAC to participate in the development of their ICA of the Printed Circuit Board (PrCB) industrial sector and the provision of analytical support for this analysis. The ICA is intended to be an update of the 2005 National Research Council (NRC) study of the industry, with subsequent 2008 DoD concurrence, which identified that the domestic defense PrCB industry's technical acumen, process capability, and manufacturing capacity are in decline relative to China, Taiwan, and Korea.

During the analysis, DCMA IAC found that the recommendations from the 2005 NRC report and subsequent 2008 DoD concurrence are still valid in light of continuing degradation of this vital industrial sector. The findings of both the current assessment and the 2005 report show that calculated steps should be taken by the DoD to avoid adverse consequences, such as the loss of technical competency, product unavailability, unintended technology transfer, theft or infiltration, and the loss of technological advantage. Moreover, the DoD should also develop and regularly evaluate industrial base indicators identified in this report to better coordinate joint prioritization and resolve DoD PrCB issues.

DCMA Assessments for the Air Force

A-10 Wing Replacement Program Production Rate Analysis

The A-10 Wing Replacement Program Office (OO-ALC/GHAPC) tasked the DCMA IAC to perform a production rate analysis of the A-10 center wing panels. The purpose of the analysis was to determine the prime's services and support capability to meet full rate production requirements and contract schedule.

The program has experienced delays and deficiencies that include improper mating of outer and center wing panels and the incorrect application of internal fuel tank sealant that prohibits installation of the main landing gear. A team was established consisting of the DCMA IAC and customer subject matter experts to assess the production issues. Based on customer requirements, the following functional areas were assessed at the prime facility: design, process capability and control, quality,

workforce attributes/personnel, capacity, manufacturing planning, scheduling and control, and supply chain management.

The analysis concluded that the company has demonstrated processes in the functional areas examined. The analysis resulted in 11 findings in seven functional areas and 14 recommendations for the prime, DCMA, and the A-10 Wing Replacement Program Office. Specific recommendations were made to improve functional area processes to support schedule and to DCMA and the A-10 Wing Replacement Office for program oversight.

DCMA Assessments

Industry Economic Assessment – Space

DCMA IAC conducts an annual economic analysis of the defense space sector. The purpose of the assessment is to review industry trends and the economic outlook for FY2012-2013 and make projections through FY2023. The assessment addresses the macroeconomic and federal budget outlook as the demand factors, and contractor production schedules and industrial base issues of the major space subsectors (launch and satellites) as the supply factors.

The demand for space systems, as measured by the budget, is significantly less over the next decade because of a declining top line DoD budget, while there is significant overcapacity and change on the supply side. For FY2013 through FY2023, the DoD space investment budget is projected by the Tech America Foundation to decline by 14 percent by 2023, with a compound annual growth rate (CAGR) of -1.4 percent in constant dollar terms (as of 10/2012). There have been several significant program cuts/cancellations in the FY2013 Budget/POM, including DWSS (Defense Weather Satellite System) and RBS (Reusable Booster System). The lean budget environment is likely to force the DoD to use smaller and cheaper micro or even nano satellites, rely on commercial satellite systems, and substitute UASs for some satellite missions. Global production of satellites is forecast to decline over the 2012 to 2021 period by 53 percent as the pace of space launches slows from recent highs. Launch vehicle production is forecast to decline slightly. The difference between satellite and launch vehicle production rates is due to less stable satellite (particularly civil) demand beyond five years out. Other applications accounting for this difference include non-orbital remote sensing and space tourism. Additionally, more nations are developing their own space launch capabilities for launching payloads that are often not included in Forecast International and other forecasts. There is still likely to be significant overcapacity in the launch market and possible product consolidation globally (reduction in the number of vehicles and options offered). The U.S. space industrial base is likely to see a shift in employment and capabilities over the next decade. While overall employment is stable, jobs and production capabilities are likely to continue migrating from high cost areas such as California to low cost areas in Alabama, Texas, and Florida. Newer launch vehicles, manned spacecraft, and satellites are likely to use

liquid, hybrid, or electric propulsion systems instead of solid rocket motors. The demand for large solid rocket motors and legacy thruster systems will probably continue to decline, leading to further consolidation and possibly jeopardizing production capabilities for these systems.

Industry Economic Assessment – Aircraft

DCMA IAC conducts an annual economic analysis of the defense aircraft sector. The purpose of the assessment is to review industry trends and the economic outlook for FY2012-2013, and make projections through FY2021. The assessment addresses the macroeconomic and federal budget outlook as the demand factors, and contractor production schedules and industrial base issues of the three major aircraft subsectors (fixed wing, helicopters, and unmanned aerial systems) as the supply factors.

For FY2013 and FY2014, the top-line Air Force and Navy budgets are projected to decline within a range of five to ten percent per year from FY2012 top-line Air Force and Navy budgets. Following this initial decline and going forward after FY2015, the DoD budget (to include Air Force and Navy budgets) is projected to grow between two to three percent per year – just enough to keep pace with the inflation rate. The current budget projection for FY2013 calls for an across-the-board, even distribution percentage reduction throughout the DoD. However, the aircraft investment accounts (procurement and RDT&E) are projected to decline disproportionally within the Air Force and Navy top-line budgets**.** According to the Tech America Foundation*,* for FY2013 through FY2023, aircraft investment accounts (i.e., fixed wing, unmanned, helicopters) are projected to decrease by 12 percent, by from $40.4B to $36.6B respectively. Forecast International projects global production of military fixed wing aircraft to increase over the 2012 to 2021 period by 54 percent. However, excluding JSF, global production of military fixed-wing aircraft is projected to decrease 15 percent over the same time period. The lean budget environment and the eventual redeployment from Operation Enduring Freedom – Afghanistan will likely adjust the military aircraft sector's demand downward. The Air Force is expected to terminate the C-130 Avionics Modernization Program and the C-27 Joint Cargo Aircraft program. The Navy is expected to seek savings from program restructuring to the MV-22 Osprey, P-8A Poseidon, and the E-2D Advanced Hawkeye. The military aircraft sector's downward demand impact on industry will affect fixed-wing aircraft programs more so than UAS programs. The funding for helicopter programs are likely to decline through FY2014 but are scheduled for increased funding from FY2015 through FY2017. The increased funding for helicopter programs in FY2015 and beyond is likely due to recapitalization of the fleet after redeployment from Operation Enduring Freedom – Afghanistan. The U.S. aircraft industrial base is likely to see a three percent drop in employment from 2010 through 2020. However, industrial capacity will likely rationalize and output is projected to increase 29 percent over the next seven years.

Industry Economic Assessment – Shipbuilding

DCMA IAC conducts an annual economic analysis of the defense shipbuilding sector. The purpose of the assessment is to review industry trends and the economic outlook for FY2012-2013 and make projections through FY2042. The assessment addresses the macroeconomic, federal budget outlook, and naval shipbuilding plans and strategies as the demand factors, and contractor production schedules and industrial base issues of the four major shipbuilders as the supply factors.

For FY2013 and FY2014, the top-line Navy budget is projected to decline within a range of five to ten percent per year from the top-line Navy budget of fiscal year 2012. Following this initial decline and after fiscal 2015, the Navy's budget is projected to grow between two to three percent per year – just enough to keep pace with the inflation rate. The lean budget environment calls for an across-the-board, even distribution percentage reduction throughout the DoD. The Navy's investment accounts (procurement and RDT&E) are projected to be proportional with the top-line DoD budget. The eventual redeployment from Operation Enduring Freedom – Afghanistan will not likely adjust the military shipbuilding demand downward. Although the DoD as a whole is a target for budget reduction, it is unlikely that the fiscal year 2013 Naval shipbuilding plan will be a major target for reduction, as opposed to other procurement accounts (i.e., aircraft, MDA, vehicles, and space systems). According to the Tech America Foundation, for FY2013 through FY2023, the Naval shipbuilding investment budget is projected to increase by eight percent, from $20.3B to $21.9B respectively. Although the shipbuilding investment budget will likely increase over the next ten years, there will probably be significant saving initiatives going forward (i.e., Ohio Class replacement submarine). Forecast International projects global production of warships (i.e., aircraft carriers, surface combatant, submarine, etc.) to decrease over the 2012 to 2021 period by 12 percent. However, the production of U.S. warships is projected to increase by 40 percent over the same time period. The increased Naval investment – as opposed to a reduction in the budget - is due to Naval shipbuilding and conversion accounts which are different than other procurement accounts. Shipbuilding requires long-term commitment and planning. Ship and submarine manufacture requires five years for completion, instead of one year, and the majority of the funding is required for the first year. The FY2013 Naval shipbuilding plan's impact on industry suggests a shortfall with mid-size ships such as cruisers, destroyers, and amphibious ships. In addition, the Naval shipbuilding plan, coupled with the lean budget environment debate, may lead to increased monitoring of the shipbuilding industry's cost structure. The resultant effect on industry will likely be that the primes will request more price concessions from their supply chain partners. The shipbuilding industrial base in the U.S. is likely to see a two percent increase in employment from 2010 through 2020. However, industrial capacity output for the same timeframe is projected to increase 66 percent as a result of working through a production backlog and capitalizing on technological advances.

Industry Economic Assessment – Ground Vehicles

DCMA IAC conducts an annual economic analysis of the defense ground vehicles sector. The purpose of the assessment is to review industry trends and the economic outlook for FY2012-2013 and make projections through FY2022. The assessment addresses the macroeconomic and federal budget outlook as the demand factors, and contractor production schedules and industrial base issues of the three major ground vehicles sub-sectors (combat, tactical, and unmanned vehicle systems) as the supply factors.

After drastic declines in recent years due to program cancellations and completions, the DoD ground vehicles budget and production are forecast to be stable. The forecast budget for the next decade is considerably less than the estimated requirements to recapitalize a military vehicle fleet worn out by wars in Iraq and Afghanistan. Because of this lean budget, there will be few, if any, new program starts and most programs, such as the GCV (Ground Combat Vehicle) and AMPV (Armored Multi-Purpose Vehicle), will probably not reach production until after 2022. The JLTV (Joint Light Tactical Vehicle) is the only new production vehicle likely to start prior to 2020. Some pundits believe that the JLTV may be a target for cancellation if the budget constricts any further. Current systems such as the Stryker, Abrams, and Bradley are likely to remain in service indefinitely. Because of the lean budget environment and the success with the Stryker (LAV – Mowag Light Armored Vehicle), DoD is considering foreign systems for the GCV, AMPV, and MPC (Marine Personnel Carrier). Unmanned ground vehicles are a growing area, but lean budgets will slow any further growth. Production forecasts by Forecast International for ground vehicle systems over the 2012 to 2021 period show flat trends for ground vehicles, both in terms of market value and unit production. After falling significantly in recent years, the U.S. market share is forecast to rise over the coming decade, mainly because of the JLTV. With few new starts and as programs reach production, the number of contractors is likely to consolidate, leading to reductions in production capacity and employment at both prime and some sub-tier producers. Many current vehicle producers are likely to expand into the growing UGV market because of reduced budgets.

B.6 Defense Logistics Agency

This year's response to the Annual Industrial Capabilities Report to Congress includes the Defense Logistics Agency's (DLA) CY2012 industrial capability guidance, methods, and analyses for assessing the industrial base and those actions taken in each applicable class of supply. DLA's Industrial Capability Program conducts broad strategic assessments, maintains proactive working relationships with industries and customers, and performs finite item-by-item assessments on the go-to-war requirements.

During CY2012, DLA's Warstopper Program continued its highly successful investments in medical material and Nomex® fiber. The program re-invested in both a specialty steel buffer and airfield matting after revalidating requirements. A new investment for a titanium buffer was also initiated in CY2012.

The Warstopper Program had an active year of industrial base studies. The completed studies included ones for a Joint Industrial Capability Analysis Process (JICAP), F-15 Heads Ups Display industrial analysis, UH-60 Supply Chain Analysis (with focus on bearings), and a Raw Material Annual Report.

DLA piloted a new JICAP with the Military Departments, including two pilot efforts with Naval Air Systems Command (NAVAIR) and Army Materiel Command (AMC). These were to develop a process for using available DLA logistics data to identify top industrial base at risk items and suppliers to do proactive risk mitigation and planning. Phase I, completed in FY2012, focused on developing standard risk metrics and processes with the Military Departments using a Microsoft Access database tool to facilitate the analysis. Phase II will focus on a root cause analysis in collaboration with the Military Departments and DCMA. The ultimate goal is to have a collaborative end-to-end process so DLA can move from risk identification to root cause analysis, and then to risk mitigation, quicker and more effectively by collaborating across DoD.

DLA also completed a Supply Chain Study on an F-15 Heads Up Display (HUD), which included conducting a supply chain analysis of Rockwell Collins' (Ann Arbor, Michigan) production of the F-15 HUD and identifying a buffer investment at a sub-tier supplier for raw glass that would reduce the lead-time from 374 days to 40 days. The F-15 HUD has significant backorders so this investment would have significant impact to meeting Warfighter requirements.

DLA completed a UH-60 Supply Chain Analysis study that found (using Warstopper Program funds) three critical UH-60 bearings where Lean Six Sigma improvements and government investment in a raw material buffer could reduce lead-times for surge orders by 53 to 75 percent. Study recommendations were based on discrete event simulations performed using the ProModel® supply chain simulation model.

Finally, a new Raw Material Annual Report was developed to document and track efforts to identify at-risk raw materials that represent risks to the DoD that should be considered for buffer investments.

In FY2012, DLA Energy awarded four alternative fuel contracts. A contract for 350,000 gallons of hydrotreated renewable marine diesel (HRD76) and for 100,000 gallons of hydrotreated renewable aviation fuel (HRJ5) was awarded in support of the Navy's Green Fleet demonstration during RIMPAC 2012. A contract for 30,000 gallons of alcohol for jet fuel for Wright-Patterson Air Force Base was awarded, and its option for an additional 15,000 gallons was exercised in support of the Air Force's testing/certification program. A contract for 4,500 gallons of hydrotreated renewable jet (HRJ8) for delivery to Southwest Research Institute was awarded to support the Army's certification/qualification program. Lastly, a contract was awarded for 15,000 gallons (with two unexercised options for an additional 25,000 gallons each) of direct sugar to hydrocarbon marine diesel (DSH76) for delivery to Naval Air Station Patuxent River, Maryland, to support the Navy's test/certification program.

Significant new investments were made by the DLA Warstopper Program. In FY2012, the program developed requirements and conducted a business case analysis for buffers of Titanium (3A1-2.5V, 5Al-2.5Sn, 6AI-4V, COM PURE GRD 1-4), 300M steel, and Bearing Grade steels (M50, 440C, 52100). The program completed FY2012 buffer investments for each of these materials. The buffer material is self-executing, based on business rules with the buffer vendor. DLA can direct the buffer if needed. The lead-time for buffer material is reduced by the queue time for an order to reach the melt plus the production time through the ingot/billet production stage. The buffer delivers finished product shapes and sizes as required for specific vendors. The buffer material is rotated and mix melts are maintained to ensure the latest material specification is available within the buffer. The customer pricing of the buffer material is either the established customer pricing for existing customers or standard pricing for new customers. No expedited or up-charges for early delivery are applied to material released from the buffer. The material transfers to the vendor purchasing it, with full titles and warranties required by the supply chain. The buffer material is not Government Furnished Material. DLA funds an inventory holding fee and management fee to the mill for the material availability.

Another investment that the DLA made was in AM-2 matting, with a 2012 contract award for AM-2 matting that included a $3.5M Warstopper investment in lead-time materials to reduce order-to-ship times by 84 days, significantly improving the capability to meet surges in demand during wartime. Material requirements were validated using a supply chain simulation model. Similar investment in the previous contract proved invaluable during surges in demand to support combat forces in Afghanistan. Additionally, a well-founded exit strategy on the previous contract provided 800 landing mat sets at contract expiration and ensured uninterrupted support to the Warfighter during a contract gap (over 600 sets shipped during the break between contracts).

DLA conducted 386 capability assessments of Class IX (repair parts) supplies covering 3,033 items. Investments were made for one Class IX contract to reach adequate industrial capability coverage. There were also 13 capability assessments within Class IV (construction and barrier material) supplies covering 147 items with one contract investment requested.

In addition, DLA funded the development of a new information technology tool, the Sustainment Risk Criteria (SRC) tool. DLA completed Phase I of the SRC tool - a web-enabled tool that provides a risk assessment dashboard for Warstopper items and suppliers. The tool was developed to enable a comprehensive and proactive risk assessment by DLA Industrial Specialists and the Military Departments. The next Phase of the tool will incorporate the risk metrics developed as part of the JICAP process and piloted with the desktop Microsoft Access tool.

A table summarizing FY2012 DLA investments in industrial capability is provided below:

Project Title	**Investment Amount**
Medical Readiness	$17,677,004
Nuclear, Biological, and Chemical Defense (Nerve Agent Antidote Autoinjector, Joint Service Lightweight Integrated Suit Technology Ensemble)	$10,735,221
Industrial Readiness (examples: Batteries, Meals Ready-to-Eat, Bastions, Tents)	$22,819,881
FY2012 Investment Grand Total	$51,232,106

DLA maintained an active Industrial Capability Program throughout the year, with full-time teams at each of DLA's Supply Chains and the Headquarters staff office. DLA began its first intern program for industrial specialists in 2012. The program is expected to hire one industrial specialist intern per year. DLA's Industrial Capability Program provides the Agency with a champion for supplier-based solutions within acquisition strategies. The Headquarters and field staff executes the operational elements for the program to ensure coverage of critical go-to-war material and administers statutory programs, including managing the Warstopper investments. DLA's new intern program for industrial specialists is recruiting and training future leaders of industrial base planning, benefitting the entire agency.

CY2012 Technological and Industrial Capability Guidance Issued

DLA's policy specifies that surge and sustainment (S&S) provisions for critical go-to-war requirements must be included in all new business arrangements, with particular emphasis on long-term contracts. In addition, DLA's policy calls for the contractors' S&S plans be validated to ensure their accuracy and ability to be executed successfully. The DLA policy implements broad defense planning guidance and War

Reserve Material policy that requires the Agency to provide uninterrupted support to the Warfighter in peacetime and during contingencies.

CY2012 Industrial Capability Assessments

Military Batteries

DLA R&D leveraged the Battery Network (BATTNET) program during 2012 to support eight projects designed to improve the availability, quality, capability, and affordability of batteries within the DoD supply chain. These projects are focused on advancing battery manufacturing process technology, transitioning new battery technology to the DoD marketplace, and making the battery supply chain more flexible. DLA's total battery procurement in FY2011 was $185M.

BATTNET completed a project with Eskra Technical Products (ETP, Saukville, Wisconsin) that prototyped a lower cost, flexible dry coating manufacturing technology for lithium-ion (Li-ion) rechargeable batteries. The new process eliminates environmentally hazardous solvents; reduces related process steps, cycle time, and costs; and it improves electrode quality. The program is planning to initiate a second phase of this project with ETP that will transition the dry coating technology into the production processes of domestic battery manufacturers. This commercialization phase will test the dry coating production process, complete the equipment designs, and implement domestic industrial capabilities.

The BATTNET program recently completed a project with Quallion LLC (Sylmar, California) that developed modular component designs for use in a variety of military batteries. The modular designs enable the expanded use of the Li-ion technology in larger formats through more cost effective, standardized, battery components. Implementing the standardized module designs will encourage flexible manufacturing and will allow battery manufacturers to quickly and inexpensively produce multiple battery configurations without the need for retooling production lines.

BATTNET launched projects with Ultralife (Newark, New York) and EaglePicher (Joplin, Missouri), to develop military lithium carbon monofluoride (Li-CF_x) battery manufacturing capabilities. These Li-CF_x batteries for communications-electronics systems will provide significant improvements in both operational energy and supply chain surge capabilities by increasing the energy density and adding a domestic production capability for a widely used military battery.

The program initiated a project with Quallion LLC to transition Zero-Volt technology, currently used in medical and space battery applications, into military Li-ion applications. This innovative technology solves several of the traditional shortcomings of Li-ion batteries and will make them safer, reduce their maintenance requirement, and extend their storage life.

BATTNET launched two projects using the Industrial Base Innovation Fund (IBIF) to advance domestic battery production capabilities. The first project, with Quallion LLC, is leveraging a cost-share agreement with the California Energy Commission to optimize the manufacturing design of a Li-ion 6T vehicle battery to enable its production on a highly automated cell and module manufacturing process. Compared to the lead acid batteries they will replace, the Li-ion version will offer improved energy capacity and reduced weight. The second IBIF project, with Saft America (Cockeysville, Maryland), will modify and improve an existing Li-ion battery manufacturing line to produce a superior field-portable energy source for the Long Range Scout and Surveillance System to achieve lower life-cycle costs and increased mission support time from the power source.

The BATTNET program completed a detailed analysis of the technical and supply data associated with DLA managed batteries. The objective of this assessment was to effectively characterize the DLA battery supply chain and establish recommendations for new R&D initiatives.

Microcircuits

Microcircuits are key critical components in virtually all weapon systems. At the same time, the microcircuit industrial base is driven by the telecommunication, computer, and consumer market segments, with DoD-related aggregate demand less than 0.5 percent of the total market. Because DoD needs have become a lesser portion of the integrated circuit market, the industry capability to meet military-specific requirements has been severely reduced.

DLA uses a variety of techniques to determine what microcircuit technologies are required by its customers. DLA is actively involved with the DoD community in the Diminishing Manufacturing Sources and Material Shortages Working Group. In addition, DLA collaborates with the program managers for several major weapon system platforms (e.g., B-2, KC-135) to obtain a clear picture of device requirements, policy direction, and Engineering Support Activity support trends. DLA has also obtained, characterized, and analyzed the microcircuit data from the Federal Supply System to analyze trends and identify at-risk items.

DLA has chartered the Microcircuit Emulation program to develop and provide on-demand form, fit, and function equivalent microcircuits that meet our customers' non-procurable microcircuit requirements. This program develops the characteristics of microcircuits with supply problems through measurements and available technical data. This forms the basis for emulating the microcircuits through a generic design process, allowing modern microcircuit production with standard commercial tools. A microcircuit design library is maintained to shorten future design lead times. DLA maintains ongoing surveillance of the microcircuit industrial base through its government technical agents and support contractors to determine trends and directions affecting current and future microcircuit supply issues. These diverse data sources are integrated into the

Microcircuit Emulation program office and are used to refine and update the program's technology roadmap.

To date, the Microcircuit Emulation program has focused almost exclusively on digital microcircuits because they constitute the most immediate risk to readiness and redesign/maintenance cost. As successive "families" of digital microcircuits were discontinued, new families were introduced which provided improved performance in speed and power consumption, but which operated with the same power supply voltage (five volts). The performance and economic requirements necessary to meet consumer demands for battery life in portable electronics (e.g., cell phones, Global Positioning System, portable games) eventually required lower power supply voltages. The resultant pressure on the suppliers of analog products to support the shift in power supply voltage led them to abandon the manufacturing capacity to produce five volt parts in favor of developing the capacity to produce progressively lower voltage analog parts. As a result, the Microcircuit Emulation program office will be beginning a new technical thrust to address this emerging requirement.

Counterfeit Prevention

The spread of counterfeit goods has become global in recent years and the range of goods subject to infringement has increased. Subject matter experts suggest that the extent of counterfeiting of parts is significant and growing in both defense and commercial industry sectors. One of the worst trends to emerge in military systems spare parts involves counterfeit electronic parts—those that appear genuine, but which actually are substandard, altogether different, or simply empty packages. With Logistics Technology R&D investment (PE-0603712S), DLA demonstrated a capability to assure the source of microcircuits, which will be a huge step in defeating counterfeiters, and will be far less expensive than the current approaches to guarantee the source of parts. Known as DNA marking, the technique uses custom botanical DNA marks, tags, or codes that are applied to parts during normal business operations. On August 7, 2012, DLA announced to industry its intent to require the use of DNA marking by suppliers of microcircuits sold to DLA. In the case of microcircuits, the DNA is mixed with the inks or paints used to mark chips. To test authenticity, the DNA can be swabbed or otherwise extracted from the part for testing at an off-site laboratory. The DNA is usually paired with an infrared or ultraviolet compound to provide a local "quick-read" capability that is less reliable than the DNA, but provides a first, easy check. These marks can be applied during manufacturing, packing, storage, handling, receipt inspection, or any other point in the supply chain. The mark would be unique to that entity and would prove that the part had been through that process.

Castings and Forgings

The casting and forging industries face significantly similar challenges for supporting military weapon systems throughout their complete life cycle. Foundries and

forges are usually second-tier or third-tier suppliers within the supply chains. Issues relating to castings and forgings arise when the weapon system completes its original life cycle production run. What had been deterministic demand patterns (fixed requirements) become probabilistic patterns (variable requirements). Without a focused effort to intervene, the change in demand patterns ultimately results in production obsolescence. Typical production issues, such as undocumented production processes, aging equipment, lost or scrapped tooling, and technical data packages, accumulate and add to the complexity of maintaining a sufficient industrial base. The lack of general business resources available within the casting and forging supply chains, and barriers to maintaining fresh production capabilities, may result in backorders (unfilled orders), no bids, and possible vulnerabilities to the industrial base.

To combat the distinct issues within the casting and forging industries, DLA has taken a two-pronged approach. First, DLA has formed partnerships with best-in-class suppliers in both industries. These groups, known as the American Metalcasting Consortium and the Forging Defense Manufacturing Consortium, together with the Military Departments' Engineering Support Activities and DLA's Supply Centers, have put together teams of problem-solving experts to continually assess technology issues and solve problems related to hard-to-source cast and forged parts. Second, DLA has established internal teams with casting and forging expertise at both DLA Aviation and DLA Land & Maritime to assess and modify its internal process of procuring items with cast and/or forged content by putting notices directly in solicitations stating that an item may or does contain a casting and/or forging; and tooling is typically required.

The Consortia programs include specific ManTech projects, such as developing casting die coatings that are non-wetting/non-sticking and self-lubricating to eliminate the need for a die lubricant, developing processing guidelines for welding of high strength steels in order to retain the mechanical properties of the weld, and determining and validating mechanical properties of the casting alloys (A201, A206, and Ti6Al4V). Other projects include automating the linking of our casting tooling database to active DLA solicitations for reduced lead times and costs, use of Ceramic Stereolithography to directly fabricate airfoil cores eliminating the need of costly acquisition lead time for core dies, and Job Shop Lean to computerize industrial engineering charts and spreadsheets for product flow within manufacturing plants.

Regarding DLA's internal processes, by inserting the notices directly in solicitations and providing engineering advice, our actions have led to a total savings of $3M/year with an average 16 percent price reduction and a decrease of 74 days in administrative lead time (ALT)/production lead time (PLT) on items with known cast and/or forged content.

Some of our R&D projects have also resulted in savings to parts procured by the DLA for the Military Departments. For instance, one casting project matches exiting tooling at foundries to new DLA solicitations, providing $2M in savings over the last five years and an average 12-week reduction in PLT when fully engaged.

The DLA R&D program is also sharing and collaborating with the Military Departments on casting and forging industry projects. Military Department connections made through the Metals sub-panel of the JDMTP enables collaboration on projects that may be too large or too expensive to fund in whole.

Operational Rations

DLA's Combat Rations Network (CORANET) was developed in response to the need to assure that the industrial base is capable of providing sufficient quantities of combat rations when demand is higher than normal (surge). Industrial base assessments continue to indicate an opportunity to implement newer, more advanced processes and methods into current Operational Ration manufacturing plants. The CORANET combines a portfolio of projects and a community of practice to bring stakeholders from throughout government, industry, and academia together in a forum that identifies common issues, provides solution sets, and increases the visibility and dissemination of information through workshops and robust discussion.

CORANET continues to expand a proven technology, "Microwave Assisted Thermal Sterilization (MATS)," to meet surge demands by tripling the rate of production capacity at the manufacturer. CORANET is a key enabler to transition other significant technological industry advancements such as ultrasonic sealing technology, horizontal forming, filling, and sealing technology, and non-destructive seal testing protocols that have reduced destructive sampling, increased production, and improved inspection methods. CORANET was also instrumental in the introduction of the Polymeric Tray and upgrades to equipment to increase industry production. In addition, DLA's technology insertion efforts have made possible the introduction of a number of menu items not previously offered, such as whole muscle meat items. The technology refreshment efforts improved the quality of the products, reduced the manufacturing cycle time as compared with preformed pouches and pumped food items, and introduced new packaging systems.

Military Clothing

The Customer Driven Uniform Manufacture (CDUM) program explores the application of advanced technologies to manufacturing, business processes, and other initiatives to greatly improve the end-to-end production and management of military clothing and individual equipment (CIE). The scope of CDUM is from the raw material supplier through disposal. The capabilities developed and demonstrated are beneficial applications across the entire range of CIE items. These benefits apply to management of critical items such as individual protective equipment (IPE), body armor, aviation clothing, and extended cold weather clothing systems, as well as less challenging items, like battle dress uniforms. Demonstrated improvements are transitioning with procedures appropriate to the technology.

The CDUM Pilot at Lackland AFB (San Antonio, Texas), Travis Association for the Blind 3PL Depot (Austin, Texas), and clothing manufacturers have developed and demonstrated supply-chain wide, item level, Radio Frequency Identification (RFID) technologies that link to the case and pallet level.

Many subsectors of the U.S. clothing and textile industrial base are shrinking and struggling to survive. They have become less competitive in the global marketplace for a variety of reasons. Transferring clothing and textile program functions from Military Departments to DLA is part of the Department's process for managing the life cycle and monitoring this sector.

DLA Small Business Innovation Research (SBIR)

DLA's SBIR program develops revolutionary manufacturing technologies for producing weapon system spare parts in ways that are better, cheaper, and faster. The program also initiated two new solicitations in 2012 for Advanced Battery Manufacturing and Advanced Forging Manufacturing, in conjunction with DLA's respective battery and forging manufacturing technology programs. R&D efforts funded under SBIR involve a degree of risk where the technical feasibility of the proposed work has not been fully established. These projects have significant potential in improving the capabilities of the Defense Industrial Base. Phase II projects, which continued in 2012, include: Advanced Lightweight Materials for Vehicle Parts Manufacturing (Advanced Powder Solutions); Cryogenic Grinding System for the High Productivity Grinding of Advanced Materials (Creare, Inc. (Hanover, New Hampshire)). Phase II projects initiated in 2012 include: Rapid Additive Manufacturing of Low Cost 3-Dimensional Titanium Alloy Components (Materials & Electrochemical Research); Method for Reducing the Cost and Improving the Quality of Aerospace Bearing Production (Coventry Associates (West Boylston, Massachusetts)); and Stretch Roll Forming (Fairmount Technologies (Wichita, Kansas)).

Assessments Leading to Budget, Acquisition, or Logistics Support Decisions

CLASS I – Subsistence

Meals Ready-to-Eat (MRE) and Unitized Group Rations (UGRs)

Several awards were made by DLA Troop Support Subsistence in FY2012 to provide continued surge production support for MREs and UGRs to the Warfighter. First, to eliminate a shortfall in retort racks used in cooking meals, an award was made to preposition additional quantities of racks at vendor facilities. Additionally, a new formulation was used in these racks to enable them to last longer than the previous formulation. Second, awards were made to update retort controls on Government Furnished Equipment (GFE) to provide better data on the day-to-day usage of the equipment. In addition, an award was made to install monitoring equipment on all GFE

so usage can be recorded and cook times analyzed. Finally, in coordination with Rutgers Center for Advanced Food Technology (CAFT, Piscataway, New Jersey) (and the Combat Rations Network (CORANET), a project has been initiated to ascertain whether or not heat given off during the cooking process can be re-utilized to shorten cook times and increase output.

Computer Model Simulations

DLA Troop Support Subsistence used two computer simulation models to better show the MRE production and assembly process and the overall supply chain for the MRE and the UGR. The first model shows the production floor of one vendor and, over time, provides a clear picture of the production and assembly process for the MRE. Using a map of the Continental United States, the second model shows the supply chain for the critical items in each ration. The models can be used to run "what if" scenarios to gauge how breaks in various parts of the supply chain affect the production of the end item and ultimately the support to the Warfighter.

Evaluation of GFE Inventory

DLA Troop Support Subsistence, in partnership with Rutgers CAFT, completed the evaluation of the GFE currently in use to support surge production of Operational Rations. Industrial Specialists are now conducting market research by visiting trade shows and contacting companies to obtain estimated prices and expected output from equipment with modern and more efficient technology. Some of the current GFE in use is over 15 years old. Upon completion of market research, funding requests will be generated, which will include a Business Case Analysis, with the goal being to initiate procurements in FY2014 or FY2015.

CLASS II – Clothing, Individual Equipment, Tools, and Administrative Supplies

Joint Service Lightweight Integrated Suit Technology (JSLIST)

Customer requirements have steadily declined for the last several years. OSD requested a validation of the filter fabric production minimum sustainment rate in the FY2010 Resource Management Decision. DLA completed the JSLIST Filter Fabric Industrial Capability Minimum Sustainment Rate Assessment in August 2010. The study recommended an Industrial Base Maintenance Contract (IBMC) with Tex Shield Inc. to maintain critical production capabilities in their Eastport, Maine facility. The IBMC appears necessary to mitigate future industrial base shortfalls if the vendor is forced to reduce capacity or terminate production completely. The IBMC maintains a warm industrial base during periods of lower demand and keeps vital infrastructure in place in the event of a surge in requirements. The IBMC was not executed in FY2012, as planned. DLA received a purchase request for JSLIST near the end of FY2012, which sustains the vendor's normal operations.

Nomex® Supply Chain

Nomex® is the registered brand name of a flame resistant aramid fiber and is a sole source product from DuPont Advanced Fiber Systems (Richmond, Virginia). Material made from this fiber is heat and flame resistant and provides significant protection from fire. Nomex® material is required for several military clothing items, including coveralls, gloves, and jackets. These items were traditionally worn by the aviation and combat vehicle communities. However, due to increasing threats from improvised explosive devices and resulting burn casualties, the need for flame resistance spread to non-traditional users including wheeled vehicle operators and ground troops.

Increasing requirements for Nomex® items during wartime led to the discovery that the supply chain had some inherent constraints limiting its ability to meet surges. The typical production lead time for end items with Nomex® material is six months, and includes the production of fiber, spinning the fiber into yarn, weaving the yarn into fabric, finishing the fabric, and producing the end item.

Based on the results of an industrial base assessment of the Nomex® Supply Chain in 2008, DLA made a Warstopper investment in 2009 for Nomex® Sage Green and Desert Tan fiber. This acquisition was handled through a contract with DuPont. Under this contract, DuPont established a strategic buffer stock of fiber, which will not only allow the industrial base to surge in response to contingency requirements, but also reduce overall production lead-time for end items using this fiber.

Additional fibers were incorporated into the current buffer stock contract's first year option. The fibers include flame resistant natural staple. These additional fibers are used to manufacture material for the Army Aircrew Combat Uniforms, Improved Combat Vehicle Crewman Coveralls, Flame Resistant Army Combat Uniforms, Flyers' Drawers, Flyers' Shirts, and Flyers' Balaclavas (hoods).

The current buffer stock contract will expire in December 2012. A new contract is being prepared to maintain the buffer stock. Buffer stock inventory target levels are being monitored to ensure the levels are adequate and that the levels are being maintained.

Body Armor

DLA completed an industrial base analysis in FY2012 to re-baseline the industrial capability and determine if any additional industrial preparedness measures are required for surge. Military Department-wide demand for body armor plates has dropped from approximately 92,000 per month at the peak to the current monthly demand of approximately 14,400. Monthly demand is anticipated to drop even further to approximately 10,000 per month.

In FY2012, the Military Departments continue to hold a large inventory. Considering the projected demand, there is overcapacity in this industrial base and a right sizing of the industrial base is anticipated. DLA will continue to monitor the demand and surge requirements for this item.

Tents and Shelter Systems

DLA funded Minimum Sustaining Rate (MSR) Contracts during FY2007 through FY09 as an industrial preparedness measure to maintain a viable industrial base for the current MIL-SPEC tents and shelter manufacturers. The MSR Warstopper investment was an effective measure to maintain the tent and shelter industry and provide S&S coverage through protected Warstopper inventory. However, even with the investment, declining requirements, supplier reliance on DoD business, and the penetration of commercial tents in the market still threaten military tent manufacturers. An industrial capability assessment of the military specification tent and shelter industry was completed in January 2012. The study recommended awarding contracts to two of the three large tent manufacturers. However, this strategy compromises DLA's surge capability. To mitigate this, the study recommends establishing buffer stocks of greige goods placed before the coating process in the supply chain. There was no further investment in the Soldier Crew tent as current inventory levels are considered adequate. In FY2012, the decreased demand of MIL-SPEC tents and shelters and adequate levels of inventory could not justify a Warstopper investment in this industrial base.

Ballistic Helmet

The DLA Industrial Capabilities Program Office completed an Advanced Combat Helmet (ACH) Production Lead Time (PLT) Reduction Assessment. The purpose of the study was to assess opportunities for PLT reduction for the ACH and an implementation plan, including the assessment of Warstopper opportunities, in order to improve wartime readiness. A ProModel® (decision-assisting software) simulation was developed to assess the impact of buffer materials in the supply chain during a wartime scenario and to identify the optimum buffer size and location. DLA is in the process of releasing a two-year solicitation for the ACH. Any potential Warstopper investments will occur after the new contract is in place. A Warstopper investment of approximately $9.5M was made for ACH in September of FY2012 providing for 39,584 helmets. No further industrial base preparedness measures are anticipated in this industrial base.

CLASS III – Petroleum, Oil, and Lubricants

DLA Energy continues to support DoD and the commercial satellite industry with uninterrupted delivery of the two liquid propellants critical to the U.S. space program, hydrazine (N_2H_4) and dinitrogen tetroxide (N_2O_4). Both products have a limited domestic industrial base from a production perspective but are supported under a long-term contract (ten-year base plus two five-year options) with reliable suppliers. There

were no interruptions of supply during FY2012 for either product. In addition to the commodity supply, DLA Energy manages the transportation component of the supply chain for both products. DLA Energy delivered 100 percent of its hydrazine and N_2O_4 shipments to customers without incident.

In FY2012, DLA Energy awarded four alternative fuel contracts. These included 350,000 gallons of hydrotreated renewable marine diesel (HRD76 and 100,000 gallons of hydrotreated renewable aviation fuel (HRJ5) in support of the Navy's Green Fleet demonstration during RIMPAC 2012, and 30,000 gallons of alcohol to jet fuel and its option for an additional 15,000 gallons to support of the Air Force's testing/certification program. Also included were 4,500 gallons of hydrotreated renewable jet (HRJ8) to support the Army's certification/qualification program; and 15,000 gallons (with two unexercised options for an additional 25,000 gallons each) of direct sugar to hydrocarbon marine diesel (DSH76) to support the Navy's test/certification program.

DLA Energy continued to support the Air Force in FY2012 by supplying Turbine Fuel, Aviation, Thermally Stable (JPTS), for use in its highflying U-2 aircraft. DLA Energy currently has only two suppliers for JPTS: one in the Continental United States and one Outside the Continental United States. NuStar Marketing LLC (formerly AGE Refining Inc., San Antonio, Texas) supplies approximately 4,074,000 gallons of JPTS per year, and SK Energy Co. Limited (Ulsan, Korea) supplies 750,000 gallons annually. The JPTS contracts are for a two-year base performance period, with three one-year option periods. NuStar delivers fuel on a free on board (f.o.b.) destination basis via railcar to Beale AFB, California, and Seabrook, Texas. The NuStar contract also includes an f.o.b. origin truck line item for delivery to various locations. SK delivers by truck to Osan Air Base, Korea. It is noted that NuStar Energy LP recently indicated that it has initiated a sale process for its 14,500-barrel/day niche San Antonio refinery in Texas.

CLASS IV – Construction Materials

Rapid Wall, Force Protection Barriers

Over the last few years, the production of HESCO (Suffolk, United Kingdom) bastions and the geo-textile intermediate material production at Propex Corporation (Chattanooga, Tennessee) have become more efficient such that normal production can readily exceed surge requirements. In fact, the new long-term contract awarded to HESCO in June 2012 contained no surge requirements, and the exit strategy for the 2008 contract required HESCO to buy out the remaining pre-positioned stock of Propex fabric. Recently, HESCO announced that a new manufacturing plant will be established in the U.S. This action will further increase production efficiencies as the transportation of Propex materials will be reduced to mere hours from formerly a five weeks' journey. Despite the new efficiencies, this program will continue to be monitored on an annual basis owing to its importance to the Warfighter. Any reduction in capability will initiate a complete review.

N95 Pandemic Respirator Mask

DLA is conducting an industrial base study of N95 respirator manufacturers. The purpose of the study is to identify domestic N95 manufacturers, collect production capacity data from those manufacturers, determine Military Department requirements during a severe pandemic, and assess the risk to the Military Departments. Any gaps between Military Department requirements and industry capacity will be investigated as a potential opportunity for a Warstopper investment.

AM-2 Landing Mat

The long-term contract with Warstopper investment in lead time materials expired August 2011. Prior to the contract expiring, a pre-defined exit strategy was identified with the contractor directed to convert the $6.1M of pre-positioned materials to finished AM-2 pallets and to ship to DLA facilities. This action ensured full recovery of the industrial investment. Relating to the expired long-term contract, the vendor also reimbursed the government $262,388 for the buyback of 1,400 extra end frames.

A new AM-2 matting long-term contract was awarded in July 2012, with a $3.5M Warfighter Program recommendation for buffer stock. This recommendation was based on customer demand, stock levels, current production capabilities, and was supported by modeling/simulations provided by Bättra, LLC (Signal Mountain, Tennessee). The AM-2 matting investment will continue to be monitored on an annual basis to assess its need.

Acrylic Sand Bags

A new long-term contract for acrylic sand bags was awarded in May 2012. At that time, a demand analysis relating to stock availability and production capability demonstrated that surge can be met without Warstopper funding. However, this program will continue to be monitored on an annual basis. If conditions change, and an industrial capability investment required, a study will determine the best solution to mitigate any supply chain constraint(s) identified by the vendor or sub-tier vendors.

CLASS V (Ammunition), CLASS VI (Personal Demand Items), and CLASS VII (Major End Items)

Not applicable to DLA.

CLASS VIII – Medical Materiel

Pharmaceutical, Medical/Surgical, and Medical Equipment

DLA currently has contracts in place that guarantee immediate availability of up to $370M in medical materiel for S&S. This coverage increases to a total of $880M, over a six-month period, if all "refresh" options are exercised. The basis for medical contingency contracts is the Medical Contingency File (MCF) database that consolidates and aggregates the Military Departments' time-phased wartime requirements. Once the requirements are known, contract coverage for contingency materiel is sought to meet the response times and levels defined by the Military Departments. The commercial coverage of $880M represents the amount of the total requirement identified in the most recent MCF update that is owned or under contract by DLA for the specific purpose of initial outfitting or re-supply upon deployment.

Nerve Agent Antidote Autoinjectors (NAAA)

DLA Troop Support has an IBMC with Meridian Medical Technologies (MMT, Columbia, Maryland) to retain a capability to satisfy the Military Departments' wartime S&S requirements for NAAA. NAAAs are military-unique items designed for rapid self-administration through clothing upon exposure to a nerve agent. MMT, the sole U.S. Food and Drug Administration approved manufacturer of NAAA, produces five types of NAAAs that fall under the Nuclear Biological Chemical Defense Program. The IBMC pays MMT to maintain a warm base and to rotate prepositioned components in order to increase production capacity to satisfy the Military Departments' wartime requirements for NAAA. An industrial base assessment study of the IBMC was conducted during 2007. The study concluded the IBMC is vital and should be funded. DLA invested $10.7M during FY2012 for the IBMC with MMT.

CLASS IX – Repair Parts

Matching Acquisition Strategies to Industry Capabilities

Phase I of the pilot program, Market Intelligence for Strategic Decisions, has evolved into Phase II and is now named Matching Acquisition Strategies to Industry Capabilities (MASIC). The program goals remain constant: to build automated tools and an integrated strategy to improve success of Long-term Contracts by building industry relationships to better understand suppliers and attract more vendors. This is accomplished by tailoring solicitations to industry standards and by grouping NSNs to attract more bids. The goal enables improvements to delivery lead times and decreases in costs. Phase II will build upon Phase I effort to design and evaluate the scalability of three automated tools to assist the Contract Specialist and to attract vendors to DLA solicitations. The first tool will be an online tool that helps group National Item Identification Numbers (NIINs) and identify potential suppliers. The second tool will be an online translation of DLA solicitations that allows potential suppliers to quickly understand the solicitation and develop a quote. The third tool will be a system that automatically matches solicitations to suppliers. To demonstrate scalability, DLA has included five Federal Supply Classes (FSC) in the program (FSCs

1005, 2540, 2510, 2530, and 6140). Phase II is scheduled for completion September 2013.

Integrated Circuit Emulation Rapid Manufacturing Improvements

Approval for $1.8M has been obtained for wafer inspection, acceptance and reliability testing improvements for the emulation wafer manufacturing process at SRI International, Princeton, New Jersey. The investment involves the purchase and installation of specialized testing, inspection, and support equipment for an existing wafer manufacturing process. Microcircuits are used on numerous weapon systems including the F-15, F/A-18, F-22, C-17, AEGIS, Phalanx, Abrams M1A1 and the Bradley Fighting Vehicle. SRI has supplied over 90,000 microcircuits to date, in support of over 350 unique weapon system applications. There are nearly 620 systems supported by about 70,000 NSNs in FSC 5962(Microcircuits, Electronic). This investment will add to the capability of SRI to support a larger number of NSNs in this FSC by improving the capability to accurately inspect and test the finer geometries of more complex Integrated Circuits (ICs). The industrial capacity improvement that will be achieved through the implementation of the improved wafer inspection and reliability testing capability is a significant reduction in the wafer production time and an improvement in yield due to the reduction in the amount of manual handling and the elimination of current destructive product wafer inspections. This will be accomplished through a reduction in the number of inspections and the amount of time currently required for performing such inspections. The total wafer manufacturing cycle-time will be decreased by 70 percent from 35 days to 10 days. The new equipment and improved procedures will also enable the expansion of the current emulation wafer manufacturing capability to support surge requirements.

F-15 Heads Up Display

DLA initiated a study focused on reducing Production Lead time for the F-15E Heads Up Display (HUD), using a systems approach to evaluate the supply chain's current state, designing improved processes, and providing recommendations for implementing strategic and tactical solutions. The study evaluated production bottlenecks/excess capacities, technology, and financial constraints at the Rockwell Collin's, Kaiser Optical Systems facility (KOSI) in Anne Arbor, MI. The F-15 HUD has an historical production lead-time of 374 days. Raw glass was identified as the primary constraint with a production lead time of 180 days. Once the glass and rails are received at KOSI, it takes approximately 181-194 days to manufacture the assembly followed by delivery to DLA Distribution Warner Robins. The team developed Simulation Models of the combiner's supply chain(s) and performed what-if scenarios to look for improvement opportunities. The models identified two opportunities to create buffers of raw and semi-finished glass materials to reduce overall lead time by as much as 180 days. The simulations clearly demonstrated opportunities for DLA to leverage buffer solutions to reduce working capital requirements, while maintaining a higher customer fill rate. DLA Aviation's Procurement group is exploring options to implement the study recommendations with Rockwell.

Rotary Wing Supply Chain Analysis and Improvement

DLA initiated a study focused on reducing Production Lead time and increasing production capacity of three UH-60 bearing NIINs supplied by SKF (Jamestown, New York). These items were selected because they provided an opportunity to positively impact the UH-60 Blackhawk program and the potential for increased demand during wartime. The study was performed by the University of Alabama in Huntsville's Office for Enterprise Innovation and Sustainability. They have partnered with the Army's Aviation and Missile Command and DLA on several previous projects. The project used ProModel® simulation software to replicate the current state production and supply chain processes. The model was developed by a combination of data collection through observation and collaborative input from the manufacturer. The validated model was used to perform what-if scenarios based on changes in demand variation, supply constraints, inventory levels, and material flow methodologies. The project identified several prospects for improvement and potential Warstopper investment opportunities. DLA is engaged in discussions with SKF to determine if the proposed solutions can be implemented.

Metal Buffers

In FY2012, the program developed requirements and conducted a business case analysis for buffers of Titanium (3A1-2.5V, 5Al-2.5Sn, 6Al-4V, COM PURE GRD 1-4), 300M steel and Bearing Grade steels (M50, 440C, 52100). The program completed FY2012 buffer investments for each of these materials. The buffer material is self-executing based on business rules with the buffer vendor. DLA can direct the buffer if needed. The lead-time for buffer material is reduced by the queue time for an order to reach the melt plus the production time through the ingot/billet production stage. The buffer delivers finished product shapes and sizes as required for specific vendors. The buffer material is rotated and mix melts are maintained to ensure the latest material specification is available within the buffer. The customer pricing of the buffer material is either the established customer pricing for existing customers or standard pricing for new customers. No expedite or up-charges for early delivery are applied to material released from the buffer. The material transfers to the vendor purchasing it with full titles and warranties required by the supply chain. The buffer material is not Government Furnished Material. DLA funds an inventory holding fee and management fee to the mill for the material availability.

Manufacturing Base Analysis

DLA Aviation negotiated "No Charge" Surge coverage on 47 new FY2012 contracts covering 48 NIINs. This coverage represents a cost avoidance of $831,244 in funds that neither DLA nor the Military Departments will have to expend to ensure that critical war/contingency items will be available. DLA Aviation conducted 99 assessments of industry proposals on how they could meet surges in demand for Class IX items. These evaluations included five site visits to validate that surge agreements

were in place on five existing long-term contracts covering eight NIINs. All of the evaluated contracts were determined to be in compliance with the surge provision.

DLA ensured that the manufacturing base was considered in the development of DLA Aviation's sourcing strategies by reviewing 492 Aviation acquisition plans and performing over 114,057 Defense Priority and Allocation System reviews. Additionally, DLA Aviation performed four Industrial base Impact Assessments for long-term contracts projected to exceed the five-year performance threshold. These assessments included an analysis of the number of potential manufacturers that produce the same or similar items based on Taxonomy classifications (items that share comparable manufacturing processes). None of the industrial base sectors involved in the four assessments was determined to be at risk (have negative impact to the industrial base) due to the proposed acquisition strategy.

Industrial Base Extension (IBex) Program

The Industrial Base Extension (IBex) Program provides a window into global logistics providers' Outside Continental United States (OCONUS) capabilities, allowing the DoD to leverage vendors' knowledge and visibility of a region's supply chain, transportation arrangements, cultural nuances, customs protocol, logistical support, and storage capability. This knowledge is especially important in times of military engagement, natural hazards, or man-made disasters.

Currently, there are eight blanket purchase agreement holders and 25 trusted vendors who compete to create detailed reports on their company's commercial logistics capability for a particular country or region. These reports improve DLA's readiness posture by having private businesses with extensive OCONUS experience provide technical expertise rather than relying upon limited DoD knowledge of remote or isolated geographic locations. The IBex program provides a flexible and efficient approach for Combatant Commanders, the DLA Enterprise, and Military/Government planners to identify new solutions and innovative concepts to logistical problems.

Past and recent successes of the program include:

- Support to Haiti (food, water, and shelter) in response to earthquake
- Sourcing of steel for Iraq
- Water support for Tsunami relief
- Kosher/Halal food supplies for Pakistan earthquake
- OCONUS steel production for Mine-Resistant Ambush Protected vehicle
- Cold storage containers for Southwest Asia
- Increased transportation capability in the Philippines

General Industrial Analysis

DLA conducted 386 capability assessments within Class IX (repair parts) supplies covering 3,033 items. These identified one contract investment needed to ensure adequate industrial capability coverage of S&S requirements.

DLA obtained "no charge" surge coverage on 934 contracts. This coverage represents a cost avoidance of $76,438,870 that neither DLA nor the Military Departments will have to expend for supplies to ensure that critical war/contingency items will be available.

Strategic Materials

Reconfiguration of the National Defense Stockpile

The Strategy and Critical Materials Stock Piling Act (50 U.S.C. § 98) provides guidance, procedures and authorities under which risks and vulnerabilities associated with supplies of materials for military, industrial and essential civilian needs during a national emergency are identified and addressed. Recently, however, in response to Congressional inquiries, the National Defense Stockpile (NDS) began a transformation, moving away from a static list of materials and the "buy and hold" approach of the past, toward a more flexible and dynamic materials risk management model. Reconfiguration was necessary to allow the NDS, operated by the DLA's Strategic Materials (SM), to better understand and respond to evolving materials requirements. This would also allow SM to more quickly adapt to world market conditions in an era of economic globalization characterized by rapid economic growth and ever increasing consumption of raw materials in China and other emerging economies. Pending changes include enhanced authority to acquire and release material. It would also entail an expanded mission beyond traditional stockpiling in which alternate mitigation strategies can be utilized to ensure the availability of materials.

Incremental implementation of the reconfiguration of the stockpile is well under way. DLA SM recently established a Directorate of Strategic Planning and Market Research to serve as the focal point for matters involving or affecting composition and disposition of the stockpile. The new Directorate will conduct research into defense and essential civilian and industrial base material requirements. It will provide advice with regard to the consumption, availability, and supply chain stability of strategic and critical materials. Strategic planning and market research will also provide recommendations regarding the type, form, and quantity of materials to be added to or deleted from the stockpile. The Directorate will be responsible for developing acquisition, rotation, conversion, and disposal strategies for materials held in the stockpile and incorporating these plans and recommendations into the Annual Materials Plan.

The form in which materials are held in the stockpile is often of great significance. The general aim in stockpiling is to store materials in their highest homogeneous form,

permitting maximum flexibility in use while accommodating technological changes. When practicable, it is prudent to store materials that are sufficiently processed in a manner that will allow for quick use and infusion into the supply chain. DLA SM awarded multiple contracts for the upgrade of inventoried materials to make them more suitable for use in current applications. Cast germanium metal ingots are being converted into epitaxial wafers for use as substrates for photovoltaic solar cells used in National Security Space (NSS) applications. The demand for germanium wafers for terrestrial solar applications has altered market forces, adversely affecting the supply of qualified materials. Beryllium metal as hot pressed powder billets is also being upgraded to forms better aligned with current specifications for many modern DoD applications.

Recent studies have shown that rare earth materials are essential to the production, sustainment, and/or operation of U.S. military equipment. There is the possibility of interruptions or shortages in the supply of certain rare earth materials as a result of actions or events outside the control of the Government of the U.S.[11,12] Although sufficient supplies of most of these special elements are likely to be available for defense purposes in the present, the 2015 time frame, and beyond, concerns with regard to the supplies of certain "heavy" rare earths, along with associated higher-value added metals, compounds, and other processed materials, persist. DLA Strategic Materials has consequently awarded three research projects focused on domestic supplies of heavy rare earth elements and associated supply chains. One research project will investigate an ore body with a very complex mineralogy. This effort will evaluate extraction of the heavy rare earth elements from the mixture, utilizing an advanced separation method that incorporates nanotechnology to improve selectivity and efficiency. The other projects will more closely examine requirements for "processed" materials containing heavy rare earth elements, such as yttrium and dysprosium, in important applications. These initiatives will address gaps in the supply chains, technical hurdles, intellectual property concerns, and other issues that affect the domestic availability of materials and components.

Assessment of Feasibility and Advisability of Establishment of Rare Earth Material Inventory

As required by Section 853 of the FY2012 National Defense Authorization Act (NDAA) [subsection (a)], the Administrator of the DLA Strategic Materials completed an assessment of the feasibility and advisability of establishing an inventory of rare earth materials necessary to ensure the long-term availability of such rare earth materials.

Previous studies confirmed that rare earth materials are strategic and that there are concerns regarding shortages in the supply of certain rare earth materials. Based upon the findings of these assessments and the projection of materials requirements

[11] Rare Earth Materials in Defense Applications, Under Secretary of Defense for Acquisition, Technology and Logistics, March 1, 2012, as required in FY11 National Defense Authorization Action, Section 843.
[12] GAO-10-617R, Rare Earth Materials in the Defense Supply Chain.

and vulnerabilities analyzed during the FY2011 requirements process to the 2015 timeframe, it was concluded the establishment of a rare earth materials inventory utilizing the legislative authorities of the Stock Piling Act is feasible. However, the study concluded that it is not advisable for the Department to acquire and hold an inventory of rare earth materials at this time, with two possible exceptions - ultra-pure yttrium oxide and dysprosium metal. The supplies of these two materials are potentially vulnerable. Hence, risk mitigation solutions were evaluated and are being advanced, employing processes prescribed within the Stock Piling Act.

Rare earth material shortages for U.S. defense requirements at the raw material level were not predicted. However, there were uncertainties about the sufficiency and reliability of the supplies of certain heavy rare earth raw materials along with associated high purity oxides, related compounds, and semi-finished products.

It was recognized that global market forces are leading to a number of positive changes in global rare earth supply chains including new mining, extraction, and separation activities underway in the U.S., Australia, and elsewhere; potential expansion of domestic rare earth metal and alloy production; and recently announced plans for a firm in the U.S. to re-start NdFeB magnet production. Though it is generally believed that a sufficient supply of most of these special elements will be available to meet Department needs in the present and future,[13] there are concerns with regard to the supplies of certain “heavy” rare earth elements and compounds, specifically yttrium oxide and dysprosium metal.

The heavy rare earth elements are present in minute concentrations in the ore currently being mined and processed at domestic facilities. Therefore, the U.S. supply of these materials is and will continue to be limited. Minerals containing higher concentrations of the heavy rare earth elements are available from domestic sources but, unfortunately, these minerals also contain significant concentrations of thorium, a naturally-occurring radioactive element, which complicates handling and processing, and thus are not viable near-term sources of rare earth materials. Due to these factors, the acquisition of quantities of high-purity yttrium oxide and dysprosium metal was recommended and will be pursued in the near future.

Feasibility and Desirability of Recycling, Recovery, and Reprocessing of Rare Earth Elements

This report was prepared in response to page 718 of the House Report 112-329, to accompany H.R. 1540, the National Defense Authorization Act for FY2012.

The conferees required the Secretary of Defense to submit a report to Congress on the feasibility and desirability of recycling, recovering, and reprocessing rare earth elements (REE), including fluorescent lighting in DoD facilities, batteries, and

[13] FY12 National Defense Authorization Act, Section 853: Assessment of Feasibility and Advisability of Establishment of Rare Earth Material Inventory, September 2012.

neodymium iron boron magnets. The assessment concluded the recovery, recycling, and reprocessing of rare earth bearing materials from some but not all components in use by the Department is both technically feasible and desirable.

The Department imposes stringent requirements regarding the acquisition, control, protection, and disposition of government property. Therefore, DoD possesses an extensive accountability, collection, and storage infrastructure that is amenable to recycling of components. Recovery of rare earth materials from military-specific systems and components is, however, complicated by a number of factors. Most rare earth-bearing materials are used in advanced applications found in newer systems that will be in service for decades and thus are presently unavailable for recovery, or in expendables such as munitions and missiles, from which the materials cannot be recovered.

Military-specific systems and components are also subject to tight disposition regulations, including demilitarization, that complicates collection, recycle, and recovery processes.

While many defense-specific items may not be readily available for recycling and the recovery of rare earths elements, “commercial” products in use by the Department are potential near-term sources for these important materials. Of the three components specifically referenced by the legislation, two are determined to be viable candidates. These are fluorescent lighting from DoD facilities, e.g., Commercially Available Off-the-Shelf (COTS) linear fluorescent lamps; and batteries - more specifically, nickel metal hydride (NiMH) batteries such as the military-specific BB390A/U battery.

The recycling, recovery, and reprocessing of rare earths from neodymium iron boron magnets in small motors and actuators, COTS hard disk drives, and other electronic and microelectronic components and devices, although technically feasible, is not deemed practical or desirable. This is due in part to the economic costs that would be involved in such programs. Recycling of these components in a manner that would support select materials’ recovery would require costly and extensive dismantling. In addition, collection of hard disk drives from defense computers is complicated by strict controls associated with the disposition of information technologies, especially those that are used to store data. This serves to further limit these components as a viable resource.

Implementation of recycling, recovery, and reprocessing programs for the referenced DoD products and materials could yield modest volumes of REE -bearing metals and oxides, which could serve to mitigate some supply chain requirement concerns. Many technological and logistical challenges remain with respect to the recovery (collection) and recycling of components, but viable and profitable domestic ventures exist where a wide range of materials are collected and subjected to recycling processes. Hence, a broad and integrated strategy, combining the expertise and resources of industry and government, will be crucial to the recovery of these materials and other important materials from spent or end-of-life components.

Appendix C – Related Activities

C.1 Title III – Defense Production Act Summaries

Defense Production Act Title III Program Execution

During CY2012, the Title III Program had 34 projects underway, three of which were in the acquisition phase to select domestic firms. At the end of 2012, 31 domestic firms are under agreement/contract, with an additional 13 firms expected to be added in early 2013.

Funding for individual Title III initiatives is provided by the Joint or Military Department Program Offices of Record, Defense Agencies or other Federal Agencies as funding offsets for specific Title III efforts. Projects are developed in response to specific Government requirements and associated funding that is provided for these efforts.

Current DPA Title III Projects

Advanced Carbon Nanotube Volume Production

This Title III project is providing infrastructure for the world's first manufacturing production facility of carbon nanotube (CNT) yarn and sheet material. Project emphasis is on expanding flexible, scalable, and modular production processes; improving product quality and yield; and reducing manufacturing costs. Carbon nanotubes exhibit extraordinary strength and unique electrical properties, and are highly efficient thermal conductors. They are the strongest and stiffest materials discovered in terms of tensile strength and elastic modulus respectively. CNT materials conduct electricity, shield from electro-magnetic interference and electromagnetic pulses, and enhance ballistics protection, while being impervious to corrosion, heat, or sunlight degradation. CNT yarn and sheet material can operate in a much broader temperature envelope than conventional materials.

A pre-pilot facility, made operational through this project, has begun producing CNT material for test and evaluation purposes. Hundreds of feet of sheet material and hundreds of kilometers of yarn made in this facility have been delivered to customers. CNT sheet material from this contractor is also flying in outer space on the JUNO spacecraft launched in August 2011.

This project was funded through Congressional increase to the Title III budget. DPA Title III funding is $2.16M, augmented by $2.16M of contractor cost sharing. This was a competitive solicitation.

Advanced Complementary Metal Oxide Semiconductor (CMOS) Focal Plane Arrays (FPA) for Visible Sensors for Star Trackers Project

This project will expand and enhance the domestic industrial base's ability to produce visible imagers manufactured using Advanced Complementary Metal Oxide Semiconductors (CMOS) technology. Advanced CMOS imagers are designed to enable flexible visible imaging systems for use on-board satellite and other systems for Department of Defense and other U.S. Government needs. The contract award was accomplished in May 2012, with a kickoff meeting held at the vendor's facilities in June 2012. STELLAR chip specification and testing framework acceptance has been achieved.

Total government funding for this project is $12.54M, augmented by $4.24M of contractor cost sharing. Government funding is provided by members of the Space Industrial Base Council's Critical Technologies Working Group, under the terms of a MOA with the Title III Office. This effort was sourced through a competitive solicitation.

Advanced Drop-In Biofuel Production Project (ADBPP)

The objective of this project is to form one or more Integrated Biofuels Production Enterprises (IBPEs) comprised of partnerships that establish the complete value chain capable of producing drop-in replacement biofuels. The project was initiated in support of the President's Blueprint for a Secure Energy Future, which directed the Departments of the Navy, Energy and Agriculture to partner with private industry to accelerate the commercialization of drop-in biofuels for military and commercial use. "Drop-in fuels" can utilize existing infrastructure, are delivered to DoD fully blended with conventional petroleum product counterparts JP-5, JP-8 and/or F-76, and are ready for use with no modification to distribution or aircraft/ship systems.

In response, the three Departments developed a plan to invest over multiple years to spur private industry and financiers to match Title III funds for the construction or retrofit of multiple commercial-scale integrated biorefineries, each capable of producing at least 10 million gallons of neat fuel annually from domestic feedstocks at a competitive price. Proposed integrated biorefineries must be based in the U.S. or Canada and use renewable biomass from domestic sources.

A two-phased approach is being executed. In Phase 1 of the program, the Department of Defense, acting through the Air Force, DoD's Executive Agent for the DPA Title III Program, expects to award multiple contracts totaling $24M for approximately one year to accomplish project planning, engineering design, and initiation of regulatory approvals for the biorefineries. A total of 15 months is planned for Phase 1. The Phase 2 proposals will be due ten months from the date of Phase 1 award and cover project planning, engineering design and initiation of regulatory

approvals for the biorefineries. Each Phase 1 contractor is required to match government funding with its own funds on a 1:1 basis.

Assuming the technical evaluation warrants the decision to proceed to Phase 2, the government anticipates one or more awards totaling up to $136M for up to half the cost of building and commissioning the facilities, with any selected contractor required to match this funding with its own funds on a 1:1 basis.

On June 27, 2012, a Funding Opportunity Announcement was published soliciting proposals for the project. Technical evaluation of the Phase 1 proposals was completed on October 31, 2012, and Phase 1 contract awards are anticipated to be made on or about May 1, 2013. Phase 2 awards are anticipated approximately one year later.

ALON® and Spinel Optical Ceramics

Aluminum oxynitride (ALON® Optical Ceramic) and spinel (magnesium aluminate spinel) are extremely durable optical ceramics with excellent mechanical and optical characteristics. ALON and spinel components have optical and mechanical properties similar to sapphire; however, they are producible in larger sizes, higher quantities, more complex geometries, and at lower costs. This is primarily due to the manufacturing processes, which utilize well-understood, conventional ceramic powder processing techniques.

ALON® Transparent Armor represents the state of the art in ballistic windows, providing the highest level of protection at half the weight and thickness of conventional glass laminates. In addition, the transmission of ALON® Transparent Armor offers a 45 percent improvement over low lead glass laminates for Night Vision Goggles. ALON® Transparent Armor was inserted into a commercial airplane requiring the highest level of performance, for which FAA certification was obtained, ALON® Transparent Armor is currently being purchased for a number of military helicopters, with production ramping up in 2013. ALON is also one of the advanced transparent ceramic materials being evaluated for future ground vehicle platforms such as the Joint Light Tactical Vehicle (JLTV).

Future systems such as the Joint Air-to-Ground Missile (JAGM) and the Common Infrared Counter Measures (CIRCM) program require ultra-durable and affordable IR transparent dome materials. Both ALON and spinel are candidate materials for these applications. ALON has producibility advantages over spinel, while spinel transmits further into the IR than ALON, making it the material of choice for systems that require extended MWIR transmission. The contractor recently completed a multi-year delivery of ALON® Reconnaissance windows to a NATO ally, and anticipates a follow on order in late 2013/early 2014. ALON® windows are also being used for sensor and laser systems on a number of military/commercial platforms because of its combination of transparency and durability.

Title III has and is continuing to support an initiative to establish an integrated, flexible manufacturing process capable of producing ALON® and Spinel Optical Ceramic components in the shapes and sizes required for aircraft transparencies, missile domes, reconnaissance windows, and transparent armor applications. To date, impressive accomplishments have been made. Highlights of these accomplishments are listed below:

- 70 percent improvement in powder utilization for small components (~6-in diameter)
- 40-50 percent increase in powder utilization for large plates (~15x27-in)
- 50 percent increase in the maximum size of ALON plates that can be produced in large quantities
- 300 percent increase in throughput for large ALON plates
- Ability to consistently produce large ALON blanks and windows suitable for reconnaissance applications
- 10x improvement in homogeneity
- 6x reduction in stress induced birefringence
- 700 percent increase in capability for polishing ALON® Transparent Armor.

Going forward, emphasis will be placed on increasing size, quality, yield, and affordability of both ALON and spinel materials, and on facilitating component evaluation, qualification, and insertion.

This project was initially funded through a Congressional increase to the Title III budget. Funding from the Air Force, Army, Navy, and the Industrial Base Innovation Fund (IBIF) added to the effort. Total Government funding is $18M, combined with $3.5M in cost sharing by the contractor. This was a sole-source solicitation.

Atomic Layer Deposition Hermetic Coatings Project

Atomic Layer Deposition (ALD) is a deposition technique that lays down protective films, one atomic layer after the other, directly onto essential circuits, thus eliminating the need for costly and inefficient protective encapsulates. The purpose of this program is to establish and expand a domestic industrial base capability to apply near-hermetic quality environmental coatings to both military and commercial microelectronics. Compared to traditional hermetic enclosures, microelectronic protection through ALD coatings will result in increased corrosion protection and operational life of the circuits, as well as reduced size, weight and protection cost. A viable ALD hermetic coatings process has been demonstrated, and environmental and reliability testing of the ALD MMIC wafers for the transition-to-production (TTP) phase of the program is underway and proceeding well. By the conclusion of the project in March 2013, the ALD process will transition to production, and the DoD will have a qualified, domestic source for the ALD hermetic coating.

Total government funding is $5.4M, augmented by $0.5M of contractor cost sharing. Additionally, outside of the Title III contract, the contractor has invested millions of dollars, demonstrating commitment to developing the ALD coatings technology. This was a sole source solicitation as only a single domestic source was identified for the specific technology of interest.

Bio-Synthetic Paraffinic Kerosene (BSPK)

The objective of this project is to establish a domestic, large-scale, commercial, feedstock flexible, manufacturing capacity of Bio-Synthetic Paraffinic Kerosene (BSPK). Appropriate feedstocks which can be employed include: camelina, canola, jatropha, soybean, palm, coconut oil and a variety of animal fats and algal oils. The anticipated output from this project will be 18 to 26 million gallons per year of distillate products such as renewable diesel and renewable jet fuel. This output will be achieved by retrofitting an existing oil refinery located in Paramount, CA. The retrofit is a $17.4M cost share venture between the U.S. Government and the partnership of UOP, AltAir Fuels and Alon, Inc. The retrofit will consist primarily of revamping/installing hydro-processing units and other supporting equipment. The Technology Investment Agreement (TIA) was executed September 21, 2012.

This project was funded through a Congressional increase to the Title III budget. Total Title III funding is $3.6M, augmented by $13.8M of contractor cost sharing. This was a sole source solicitation as only a single domestic source was identified for the specific technology of interest.

Coal-Based Carbon Foam

Coal-based carbon foam is an inexpensive, lightweight, fire-resistant, impact-absorbing material that can be fabricated in a variety of shapes, sizes, and densities. It replaces conventional materials that are higher cost, of lower structural capability, are hazardous for fire, and are heavier. Its electrical conductivity can be varied over nine orders of magnitude, and it has a low coefficient of thermal expansion. Carbon foam's applications include lightweight tooling, blast mitigation panels, and hot structure applications. It exhibits similar properties as other materials, but at a lower cost, and outperforms other products in noise reduction, fire resistance, impact resistance, energy absorption, and thermal properties. The goal of this Title III effort is to expand the domestic production capability for coal-based carbon foam to meet the Department's needs for blast mitigation, hot structure applications, and low-cost tooling. In 2012, a large horizontal autoclave was installed, increasing capacity three-fold.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $10.5M, augmented by $0.9M of contractor cost sharing. This was a sole source solicitation as only a single domestic source was identified for the specific technology of interest.

Conductive Composites

This Title III project is establishing a domestic source for high performance chemical vapor deposition (CVD) coated materials for DoD current and future Warfighter materials problems. The project is scaling up coatings capabilities utilizing commercially available materials (nickel, carbon substrates) to construct nickel-coated nano-materials that can be subsequently blended into a normally non-conductive substrate (i.e., polymers, paints) to make them conductive. Tasks include a comprehensive production expansion plan, evaluation (and implementation) of critical processes for optimization, and improvement of product quality, yields, and production cost reduction. Title III also focuses on business and marketing planning to monitor long-term growth of project vendor(s). Emphasis is being placed on business planning and activities that will support sustainable economic viability.

To date, the project has installed a second nickel-CVD (NiCVD) fiber coating machine, increasing capacity fourfold. Additionally, a modified and upgraded NiCVD nonwoven coating machine has increased capacity fivefold. A new organo-metallic gas synthesis unit was installed, doubling capacity.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $3.2M. This was a sole source solicitation as only a single domestic source was identified for the specific technology of interest.

Extremely Large Domestic Expendable & Reusable Structures (ELDERS)

The objective of this project is to ensure a dedicated source for the manufacture of larger-scale diameter composite structures to satisfy defense and non-defense U.S. space industry requirements. The project includes the evaluation and modification of current production facilities and the procurement; installation, startup, qualification, and operation of an advanced machining center; an automated ultrasonic inspection system; and a combined Automated Tape Laying & Fiber Placement Machine [better known as a Dockable Gantry System (DGS)], as well as other support equipment.

Driven by the need for improved fuel efficiency and operability, composite materials are commanding an important role in airframe, engine structures, and space launch vehicles. Automated composite technologies and improved non-destructive inspection techniques are all being implemented to deliver affordable, high performance parts and assemblies for the DoD and the U.S. aerospace industry. Several DoD and NASA programs will benefit through the efficient and expanded production of larger scale components. Such programs include those applications requiring crew and heavy-lift cargo transport capabilities. These systems will provide mission support for continued crew transfer and logistics supporting the International Space Station, current and future space crew exploration vehicles, and payload/satellite deliveries.

Recent accomplishments include: finalizing the design of the DGS, initializing site preparation and machine fabrication; installation of an improved camera system, and release of the Belotti Machining Center to production.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $14.3M, augmented by $9.1M of contractor cost sharing. This project is being executed as an amendment to the agreement for "Integrated Advanced Composite Fiber Placement" project that follows.

Gallium Nitride Advanced Electronic Warfare Monolithic Microwave Integrated Circuit Producibility

The objective of this Title III project is to assess, improve, and validate production ready processes for Ka-Band Monolithic Microwave Integrated Circuits (MMICs) and ensure a domestic source of supply for GaN MMICs. The overarching goal is to achieve a manufacturing readiness level of eight (ready for low-rate initial production) through the application of Six Sigma techniques to reduce process variation and demonstrate repeatable MMIC performance, life, and reliability. A single contract is anticipated for award in January 2013 in response to a competitive 2012 BAA solicitation.

This project is funded in part with offsets transferred to the Title III budget from the Navy. Total government funding is $8.6M. The amount of contractor cost sharing will be determined upon final negotiated contract terms.

Gallium Nitride Radar and Electronic Warfare Monolithic Microwave Integrated Circuit Producibility

The objective of this Title III project is to assess, improve, and validate production-ready processes for S-Band and Wideband Gallium Nitride (GaN) Monolithic Microwave Integrated Circuits (MMICs), and ensure multiple domestic sources of supply for GaN MMICs. In addition to GaN's high power density, another important benefit is the high input and output impedance that GaN offers. This high impedance directly translates to wider bandwidth power amplifier designs that maintain higher power and efficiencies than existing semiconductor technologies. The overarching goal is to achieve a manufacturing readiness level of eight (ready for low-rate initial production) through the application of Six Sigma techniques to reduce process variation and demonstrate repeatable MMIC performance, life, and reliability.

Both contractors have completed baseline Manufacturing Readiness Assessments (MRAs) and are in the middle of the "refine and improve" phase of the project.

This project was funded in part with offsets transferred to the Title III budget from the Navy. To date, total government funding is $35.4M, combined with $3.6M in cost sharing/contribution by the contractor. This project was awarded to two contractors through a competitive solicitation.

Gallium Nitride X-Band Monolithic Microwave Integrated Circuits

The objective of this project is to assess, improve, and validate a domestic source of supply for X-Band (8 GHz to 12 GHz) GaN MMICs, thereby creating a production-ready process for insertion into future defense systems. GaN technology significantly enhances the Warfighters' capabilities by increasing radar ranges, sensitivity, and search capabilities. GaN transistors operate at higher temperature levels and produce higher output power than those of current technology transistors of comparable size. The most advantageous property of GaN is its high power density. It is ten times higher than that of silicon or gallium arsenide. Defense applications include communication systems, radar applications, electronic warfare, imaging, and sensor systems.

This project was funded in part with offsets transferred to the Title III budget from the Missile Defense Agency, plus other funds that were transferred from the Missile Defense Agency. Total government funding was $9.0M, augmented by $2.3M in cost sharing by the contractor. This was a sole source award to expedite the technology insertion by capitalizing on prior government investments in a production process that was already demonstrated and capitalized, thus enabling the Title III project to efficiently utilize its limited resources to focus primarily on manufacturing improvements.

The project has achieved all key performance parameter goals for production yield, MMIC performance and reliability and will be completed in the first half of 2013.

Heavy Forgings Capacity Improvement Project

The purpose of this Title III project is to upgrade and refurbish equipment at the single domestic source for heavy forgings. DoD applications include propulsion shafts for surface and sub-surface naval vessels, periscope tubes, ring forgings for bull gears, and reactor vessels. Heavy forgings are unique and require a 10,000-ton open die forging press (the largest in North America) in order to produce parts that begin with ingots that are up to 11 feet in diameter and weigh up to 600,000 lbs. In addition to the press, other special requirements include ingot manipulators, forging ovens, building foundation and structural capacity to support the processing of such heavy ingots. The focus of this Title III project is to address production constraints and single points of failure that are critical to maintain the supply of heavy forgings to the DoD. This project is critical to shore up the single domestic source for heavy forgings.

Major accomplishments in 2012 include the upgrade of a vertical boring mill to eliminate a single point of failure and to rebuild of the contractor's 10,000 ton open die forging press, the only one of its kind in North America.

In October 2012, a Phase II effort was initiated and will include activities to increase capacity, provide new capabilities, and address potential high consequence events. These activities are expected to begin in the second quarter of calendar year 2013.

The total project funding level is $3.27M, which includes Government funding of $2.89M and Contractor Cost Share of $0.38M. Additionally, outside of this project, the contractor has invested millions of dollars, demonstrating commitment to the heavy forging business in support of the DoD. This was a sole source solicitation.

High Homogeneity Optical Glass

This Title III project is structured to increase the manufacturing capacity, optimize production yields, and ensure greater availability of affordable High Homogeneity Optical Glass (HHOG) products. HHOG blanks are the basic building blocks in the fabrication of high precision optical lens systems, which are key technology drivers for several commercial, defense, and national security related applications. H4 grade and higher HHOG blanks are characterized as possessing a maximum refractive index variation across the entire optic of ±1.0 x 10-6. If the refractive index is non-uniform, or non-homogeneous, then light rays passing through the material at different locations will be bent in random directions and in an amount approximately proportional to the non-homogeneity. This can have several effects depending on the application. Project goals will be achieved via improvements to raw materials and enhancements to production processes and associated control systems. Of particular concern to the DoD are lens products required in optical designs for aerial, satellite and other space surveillance equipment.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $5.8M, augmented by $5.3M of contractor cost sharing. This was a competitive solicitation. Raw material combinations were improved with new blending and testing techniques. Improved forming equipment for larger optical glass discs was designed and procured.

Integrated Advanced Composite Fiber Placement Program (IACFPP)

The objective of this project is to expand the U.S. domestic industrial base capability for the production of large aerospace composite products employing advanced fiber placement technologies.

Fabricating and installing state of the art production equipment will provide manufacturing efficiency improvements of 30 percent or better. Automated Fiber Placement technology enables the efficient placement of composite fibers directly onto complex geometry tooling such as that required for a wing contour. The automated fiber placement process includes the ability to mechanically place composite material in a convex contour at any angle. Unlike other manufacturing processes, it applies a band of material in individual tows or tape directly normal to the surface of the part while applying pressure and heat to enhance the laminate properties. These features are suitable for the fabrication of composite structures where complex contours are required, performance and weight are critical parameters, and precision application of material in specific orientations is desired.

Several complex aerospace parts such as wing skins, ducts, nacelles, and fuselage skins are fabricated using advanced fiber placement processes. Other DoD systems anticipate the use of these advanced materials and design concepts for munitions, armaments, and hull structures for manned and unmanned robotic vehicles.

The project is creating commercially viable production capabilities, and will share manufacturing enhancements with the commercial composite production community as appropriate. Recent accomplishments include: installation of a large format autoclave and its release for production; design and fabrication of two state-of-the-art fiber placement machines, and initiation of their installation.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $27.1M, augmented by $15.3M of contractor cost sharing. This was a sole source solicitation as only a single domestic source was identified for the specific technology of interest.

Light-Weight Ammunition

The objective of this effort is to establish a domestic source for the production of light-weight ammunition cartridge casings using a high-strength polymer material. Ammunition casings produced with this material may provide significant advantages over traditional brass casings, such as decreased combat carrying weight for ground and air operations, with cost savings obtained through reduced fuel consumption, as well as lower transportation/shipping and material costs. Other potential benefits may include increased muzzle velocities, improved weapons accuracy, and prolonged barrel and weapon life. The initial focus of the project is the development and qualification of lightweight 0.50 caliber machine gun rounds that can be utilized in conventionally fielded weapon systems at a comparable cost to standard brass ammunition.

A baseline prototype design has been developed and demonstrated for the polymer-cased 0.50 caliber ammunition, which weighs approximately 25 percent less than standard brass ammunition and has a brass base. Qualification testing is underway. Ten thousand rounds have already been delivered and tested by Naval

Surface Warfare Center Crane in the M2 gun, with good results overall. Further, several successful live-fire demonstrations have been held in Quantico, VA; Fort Drum, NY; and Crane, IN (NSWC). A baseline prototype design has been developed and demonstrated for the polymer-cased 0.50 caliber ammunition, which weighs approximately 25 percent less than standard brass ammunition and has a brass base. Qualification testing is underway. Limited 0.50 caliber precision (sniper) round testing has been conducted, and the initial results have been very positive. A pilot-scale facility has been established.

This project was funded through Congressional increase to the Title III budget. Funding of $3.0M was also added from the Marines. Total government funding is $12.M, augmented by $10,000 of contractor cost sharing. This was a sole source solicitation as only a single domestic source was identified for the specific technology of interest.

Lithium-Ion Battery Production for Military Applications Project

This project will establish a long-term, viable, world-class domestic manufacturer of high-energy density lithium-ion (Li-ion) batteries that is responsive to customer requirements with respect to performance, reliability, quality, delivery, and price.

High energy density Li ion batteries are suitable for a number of military systems including enhancing the endurance of Unmanned Aerial Vehicles (UAVs) and providing portable power to support the mission for the dismounted solder, long endurance autonomous systems, tactical vehicles, unattended sensors, and reconnaissance and surveillance systems. The Li-ion cells of interest will have an energy density ≥ 250 Watt-hour/kg at 250 Watts/kg continuous (i.e. 1C rate) for military applications. The intent is to create a flexible production line capable of multiple battery form factors for both military and commercial applications to effectively reduce the cost of high energy density Li-ion batteries by leveraging increased combined assembly line volumes, even at low production runs of individual battery form factors. There will be commensurate improvements in power density, discharge rate, temperature range and safety and delivery of sample cells/batteries to the Government for independent testing. A key overall objective will be to achieve a Manufacturing Readiness Level (MRL) 8, capable of supporting Low Rate Initial Production (LRIP).

This project is planned as a multi-phase effort in which the initial phase (Phase I) is a 12-month effort, and the second phase (Phase II Option) is a 36-month effort. Multiple Phase I Contract awards are expected early in 2013.

This project was funded through Congressional increase to the Title III budget. DPA Title III funding is $24.4M. Cost sharing/contribution by the contractors is dependent on negotiated terms of the agreements. Competitive solicitations were the basis for execution of this project.

Lithium Ion Battery Production for Space

This Title III program is supporting the development of a domestic source for prismatic lithium-ion cells and their constituent active materials for spacecraft use. Lithium-Ion (Li-Ion) rechargeable battery technology provides higher power for longer durations with lower weight and favorable space constraints when compared to Nickel Cadmium (NiCd) or Nickel Hydrogen (NiH) rechargeable batteries. The Li-Ion battery offers the highest energy and power package of developed batteries today. Additional advantages include better recharging capability with no memory effect and increased temperature operating ranges. This technology offers designers a weight savings option compared to other battery types for overall weapon systems performance. Major accomplishments in 2012 include qualification of the cell assembly line, facility construction, and equipment installation for the mesocarbon microbead (MCMB) anode production line.

This project was funded initially by funding provided from the DoD Title III budget, plus other funding that was transferred from the Air Force and another government agency. A $1M Congressional increase for Title III was provided during project execution. Total government funding is $53.4M, augmented by $11.7M of contractor cost sharing. This was a competitive solicitation.

Low Cost Military GPS Receivers

Military GPS receivers are a vital piece of equipment for soldiers on the battlefield. GPS receivers allow the Warfighter to perform both strategic and tactical maneuvers with a high degree of confidence of success. Without secure, reliable GPS receivers, soldiers lack both their specific positioning on the battlefield and that of their fellow soldiers. The primary objectives of this Title III project are to create domestic production capabilities for essential subcomponents for the Defense Advanced GPS Receiver (DAGR) and to pursue methods for reducing their weight, size, power-consumption and cost, while improving performance capabilities.

The Title III industry partner transitioned DAGR GPS receiver production to the new Selective Availability Anti-Spoofing Module (SAASM) 3.7 version. Ninety-seven MicroDAGR S3.7 prototypes were delivered in July 2012 to the Commonwealth of Australia Land Forces for evaluation.

This project was funded through Congressional increase to the Title III budget. Total government funding is $7.9M, augmented by $12.4M of contractor cost sharing. This was a sole source solicitation as only a single domestic source was identified for the specific technology of interest.

Military Lens System Fabrication and Assembly

This Title III program is establishing a domestic resource for mono-spectral and advanced multi-spectral optical systems and lens components. This effort will develop a manufacturing capability for design, fabrication, finishing, coating, assembly, and testing of mono- and multi-spectral night vision optical systems that can be integrated into military and commercial surveillance systems. Multi-spectral systems are shared aperture systems that allow widely separated wavelength bands to be transmitted through a common aperture, and share common elements in the optical train. They offer considerable advantages for the Warfighter, including weight and volume reduction, by allowing them to carry fewer pieces of equipment; improving performance, by allowing both bands to utilize the full aperture of the systems; and optimized system design for a larger set of operating conditions/environments.

The industry partner exceeded the optical lens coating yield key performance parameter by achieving a 96.5 percent yield. Advanced optical lens processing equipment was installed to increase the capacity of a-spherical and spherical lenses. A new dedicated 30,000 square foot facility will house the Title III optical lens manufacturing equipment.

This project was funded through Congressional increase to the Title III budget. Industrial Base Innovation Fund (IBIF) also added funding of $0.9M. Total government funding is $8.8M, and is augmented by $2.5M of contractor cost sharing. This was a competitive solicitation.

Mini-Refrigerant Compressors for Man-Portable Cooling

Title III has collaborated with industry to establish a domestic low-volume production facility for mini-refrigerant vapor compressors. The program's industry partner purchased a production facility, and Title III assisted with plant facilitation, to include the purchase of manufacturing, assembly, and test equipment. The mini-compressor weighs 1.3lb, has a diameter of 2.2", and a height of 2.7". The compressor is contained within a hermetically sealed case; has a sensor-less, brushless motor; operates on 12, 24, or 48 volt DC power; and interfaces with an external motor drive board. Two models of the mini-compressor are available with slightly different displacement cooling capacities: a 1.4cc and a 1.9cc product to meet different user requirements. Applications for personal cooling systems encompass aircrew cooling; soldier cooling, both dismounted and within ground vehicles; and personal protective equipment cooling, such as Explosive Ordinance Disposal and Chem/Bio-Hazard suits. The compactness of these mini-compressors enables them to be installed within electronics cabinets to provide active cooling of components. This increases the performance, reliability, and life of mission-critical electronics systems in high temperature environments.

Today, miniature refrigeration compressors are providing cooling to critical electronic

components installed within Electronics Transit Cases. More than 1,500 MIL-hardened Electronics Transit Cases have been fielded to date in Mine Resistant Ambush Protected (MRAP) armored fighting vehicles operating in support of Oversees Contingency Operations.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $11.8M, augmented by $0.6M of contractor cost sharing. This was a competitive solicitation.

Next Generation Star Tracker System, Phase 0

The purpose of this study is to conduct technical, business, marketing and programmatic analysis of the market for a Next Generation Star Tracker System (NGSTS). Specifically, the Title III Program Office is interested in determining the feasibility of producing a modular, NGSTS that uses domestically-produced Complementary Metal Oxide Semiconductor (CMOS) detectors.

Total government funding for this project is $475k. Government funding is provided by members of the Space Industrial Base Council's Critical Technologies Working Group, under the terms of a MOA with the Title III office. This effort will use a competitive source solicitation.

Non-Aerospace Titanium for Armor and Structures Transformation Project

The excellent strength-to-weight and corrosion-resistance properties of titanium make it useful for many structural applications. It also has excellent ballistics properties that, along with the low weight, make it ideal for armor. Due to large increases in commercial aerospace demand for titanium, lead times for titanium have grown to over one year, while costs have more than tripled. By working outside the aerospace titanium supply chain, this Title III program will help reduce cost and shorten delivery lead-times for structural titanium and titanium armor. The initial effort will focus on implementing the capability to direct-roll titanium in widths and thicknesses that can be used for armor tiles on military ground vehicles.

Orders have been received to process armor brackets and JLTV prototype parts, including components for retrofitted racking systems on DoD vehicles.

The project team is considering a potential improvement/expansion of the facility's capability to process rolled sheet.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $12.8M, augmented by $2.1M of contractor cost sharing. This was a competitive solicitation.

Radiation-Hardened Cryogenic Readout Integrated Circuits

Title III resources are being utilized to establish a viable, domestic foundry for commercial production of less than or equal to 0.18 micron deep sub-micron Complementary Metal Oxide Semiconductor (CMOS) Radiation-Hardened Cryogenic Readout Integrated Circuits (ROICs). These microelectronics are a critical technology employed in the manufacture of focal plane arrays (FPAs) that are utilized in high altitude and space-based imaging and missile systems. The next generation imaging requirements are dependent on the availability of advanced ROICs that provide high density with analog components, smaller pixels (increased resolution), and increased functionality through on-chip processing. Additionally, ROICs need to be physically larger (enabled through stitching technology) for increasing focal plane array size requirements, reducing particle counts that improve production yields, and improving fabrication cycle times. These improvements will collectively increase the mission capability of the systems.

The contractor now has the capability to produce a 0.18um Large Format (LF) ROIC device per vendor design. ON has achieved yields of 27-32 percent in small lots, exceeding legacy yields between 2-13 percent. As part of the Title III effort, the contractor has attained Trusted Foundry certification.

This project was funded through a Congressional increase to the Title III budget. The Air Force added other funding to the effort. Total government funding is $13.0M, augmented by $19.7M of contractor cost sharing. This was a competitive solicitation.

Silicon Carbide Powder Production and Ceramic Armor Manufacturing

High-purity silicon carbide (SiC) powder, specifically submicron alpha SiC powder, is a critical item for national defense. This refined form of SiC powder is the key ingredient required to produce high-quality, light-weight, and cost-effective SiC ceramic armor for the Warfighter. Primary applications include armor for land, air, and naval platforms and lightweight body armor. This Title III project is increasing the domestic production capacity for both submicron alpha SiC powder and SiC ceramic armor.

Powder capacity has been expanded from 588,000 kg/yr to >800,000 kg/yr, including a cost reduction from $5/kg to $3.28/kg. New capacity for flat ceramic tiles increased from 17,000 sq ft/yr to over 42,000 sq ft/yr, including a cost reduction from $30/tile to $12/tile.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $4.9M, augmented by $6.2M of contractor cost sharing. This was a competitive solicitation.

Small Secure Satellite Communication (SATCOM) Transceiver

This Title III project is establishing a domestic capability for the manufacture of Small Secure Satellite Communication (SATCOM) Transceivers. A SATCOM Transceiver is a critical technology item that will be used to locate and recover U.S. Department of Defense and Allied/Coalition Isolated Personnel (IP) in harm's way. The project is introducing manufacturing technology, production processes and procedures, and automated production systems to expand the U.S. industrial base production capacity for this critical technology item. The project is also striving to achieve quality and affordability objectives, and it will ultimately provide greatly improved and more secure personnel recovery capabilities for the Warfighter.

Two critical internal components were assessed at Manufacturing Readiness Level 8 in 2012, indicating Low Rate Initial Production capability.

The U.S. Army, Force XXI Battle Command, Brigade and Below Program Office provided Title III funding for this project. Total government funding is $5.0M, with no contractor cost sharing. This project was awarded via a competitive solicitation.

Terahertz Spectrometer

This project will leverage prior work performed in conjunction with the Army Research Laboratory in the development of a THz Spectrometer capable of detecting hazardous materials – specifically hazardous chemicals, explosives, and chemical warfare agents. The intent of this project is to reduce the size and weight of the current unit, ruggedize it, and develop the necessary production processes and procedures to increase the manufacturing readiness and affordability of the unit. At the conclusion of this project, the THz Spectrometer will be portable, ruggedized, capable of autonomous operation, and suited to operating in field (non-laboratory) environments.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $3.6M, augmented by $0.69M of contractor cost sharing. This was a sole source solicitation as only a single domestic source was identified for the specific technology of interest.

Thermal Battery Production

The objective of this Title III initiative is to strengthen and expand the only domestic source for Cobalt Disulfide thermal batteries. Military unique, high performance batteries are the only viable power source for many strategic and tactical missile systems. The Missile Defense Agency and Military Department program offices identified high performance Cobalt Disulfide battery technologies as having insufficient domestic capacity and capability to meet program requirements. The focus of this Title III program is to scale up production capacity and expand capabilities required by military customers. The applicability of these batteries to a wide variety of DoD missile

systems offers Army, Navy, and Air Force Program Offices the ability to greatly enhance system performance.

Major accomplishments in 2012 include the continued refinement of processes, including the installation of a new cobalt disulfide synthesis line to ensure the long-term domestic availability of this critical material, the installation of an automated battery stack and wrap station that uses a vision system to prevent stack errors, and the installation of an automated pellet quality control inspection station.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $16.9M. This was a competitive solicitation.

Titanium Matrix Composites

Titanium Matrix Composites (TMCs) and Enhanced Titanium (ETi) offer material properties that enable aircraft designers to engineer components that are stronger, lighter, and more durable than existing steel and pure titanium components. These improvements can expand U.S. air superiority margins over opposition forces by increasing lethality for U.S. munitions, increasing survivability for the Warfighter, and ultimately increasing mission success rates. Title III funding will enable expansion of the domestic production capacity of TMCs and ETi to support the Warfighter and assist in the development of a database of TMC and ETi material characteristics and the processes required to produce TMCs and ETi.

Major accomplishments in 2012 include the installation of the Plasma Arc Melt and Electrode Induction-melting Gas Atomization machines, providing the domestic capability to produce both titanium and enhanced titanium powder.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $28.9M, augmented by $1.3M of contractor cost sharing. This was a sole source solicitation as only a single domestic source was identified for the specific technology of interest.

Traveling Wave Tube Amplifiers (TWTA) for Space

Phase I (Complete): Traveling Wave Tube Amplifiers (TWTAs) are a critical component aboard communications satellites used to transmit microwave signals. Space qualified TWTAs are low mass, compact, and highly efficient while exhibiting large bandwidth, strong signal strength, low failure rate (less than 1 in 10 million hours), and extremely long lifetimes (>15 years). The long-term trend in the space communications industry has been steady evolution towards higher output power and higher frequency to increase data rates. K-band, 18-21 GHz, is the primary communications band for high data rate Government military, scientific, and national security space communications. DoD satellites using these K-band TWTAs will support

the growing need for real-time information and controls among deployed assets. The primary objective of this Title III project was to improve, sustain, and grow production of K-band TWTAs at the only domestic space qualified production source.

One of the first K-Band TWTAs produced during this project has attained credible space heritage by accumulating more than 88,000 in-orbit operating hours on a commercial satellite. Additional accomplishments include design, development, and equipment installation to update the infrastructure required to efficiently produce state-of-the-art space-qualified K-band Traveling Wave Tube Amplifiers (TWTAs) designed for next generation commercial and government applications.

This project phase was funded through Congressional increase to the Title III budget. Total Title III funding was $5.3M, augmented by $5.3M of contractor cost sharing. This was a sole source solicitation, as a determination was made that only a single space-qualified domestic source existed.

Phase II: Phase II of this project builds on the previous accomplishments by developing the infrastructure required to domestically produce advanced space-qualified K-band Traveling Wave Tube Amplifiers (TWTAs) designed for next generation commercial and government applications. Establishing a globally competitive domestic source for next-gen high power, space qualified, K-band TWTAs is necessary for the DoD to obtain high quality components, on time, and at a fair market price. The objectives of this project will greatly reduce the schedule, performance, and cost risk to government satellite programs that are inherent with having only one supplier. Recent accomplishments and activities center on finalizing material purchases and kiting them for the TWT pilot production builds.

Total government funding for this project phase is $7.6M, augmented by $7.6M of contractor cost sharing. Government funding is provided by members of the Space Industrial Base Council's Critical Technologies Working Group, under the terms of a Memorandum of Agreement (MOA) with the Title III office. This is a follow-on effort to the Phase I sole source solicitation.

Radiation-Hardened Microprocessors

This Title III project is scaling up production capacities for high-performance radiation-hardened microprocessors. This will provide for a progression from radiation-tolerant to radiation-hard. The much higher clock rates will lead to significant cost and weight savings for space systems. Higher performance means greater on-orbit processing capabilities and reduced ground support requirements. As with the other Title III radiation hardening projects, these microprocessors will enable spacecraft to operate in the challenging radiation environments of nuclear threats and long-term natural radiation.

This project was funded through Congressional increase to the Title III budget. Other funds were added by other government agencies. Total government funding is $15.4M, augmented by $4.2M of contractor cost sharing. This was a sole source solicitation as only a single domestic source was identified for the specific technology of interest.

Read Out Integrated Circuit Foundry Improvement and Sustainability

There are a number of challenges related to the design and fabrication of Large Format (LF) Read-out Integrated Circuits (ROICs). As detector arrays grow in size and number of pixels per array (> 1 million), the complexity of the ROIC also increases and adds to the challenges of the foundry that must now utilize advanced CMOS processing techniques at 0.18 micron and below, with competitive wafer sizes (8 inches). Other factors affect the design, processing, and performance of the ROICs for government space programs. The ROIC must exhibit very low noise to avoid contributing substantially to the noise of the sensor. Defect density in the ROIC reduces yield during manufacturing and may affect the operability of the sensor once it is hybridized. In addition to the low yields due to defect density, wafer size, and design complexity, there can also be long periods of time between orders due to the relatively small market for LF ROICs, resulting in production gaps. As a result, it is difficult in this environment to keep equipment and staff running at peak performance. The scope of the Title III ROIC Foundry Improvement and Sustainability Program is to maintain minimal but adequate production capabilities at domestic foundries to assure the necessary supply of strategic ROICs deemed useful for government space programs. The primary goal is a sustainment initiative where, in addition to running continuous production, there is the added objective of making continual design and process improvements so that more aggressive yields can be realized in a timely manner. The first of two vendors for this project has attained yields in 2012 ranging from 27 to 33 percent in small wafer lots, demonstrating continued process improvement. Prior yield achievements before project initiation were between 2-13 percent. A second contractor is expected to join the project in early 2013.

This project was funded with offsets transferred to the Title III budget from the Air Force, Missile Defense Agency, and another government agency. Total government funding for the project is $10.5M. Cost sharing/contribution by the contractors is dependent on negotiated terms of the second contract. Competitive solicitations were the basis for execution of this project.

Space Qualified Solar Cell Germanium Substrate Supply Chain Improvement Project

The purpose of this project is to enhance and expand the ability of the domestic industrial base to produce space-qualified germanium substrates for use on Government satellite systems. All NSS satellites use solar cells grown on germanium

(Ge) substrates. Commercial-grade Ge substrates do not possess the quality necessary to produce high-reliability space solar cells. Germanium substrates are used for existing state-of-practice 28 and 30 percent efficient solar cells, and are projected to be used for state-of-the-art 33 percent solar cells and in the development of 35 percent and 37 percent solar cells. It is forecast that Ge substrates will be used for solar cells on most NSS missions for the next 10-15 years. Major accomplishments in 2012 include a 25 percent yield improvement and installation of two significant pieces of equipment (crystal growth furnace, wafer saw) to support capacity expansion.

Total government funding for this project is $8.55M, augmented by $8.8M of contractor cost sharing. Government funding is provided by members of the Space Industrial Base Council's Critical Technologies Working Group, under the terms of a MOA with the Title III office. This was a sole source solicitation, as a determination was made that only a single space-qualified domestic source existed.

Vacuum Induction Melting, Vacuum Arc Remelting Furnace Capacity

Low alloy Vacuum Induction Melting, Vacuum Arc Remelting (VIM VAR) steel is high purity corrosion resistant steel that is processed through multiple melts under vacuum to reduce excess gases and other impurities. VIM VAR steel is essential for many military applications including engine bearings, helicopter rotor shafts, transmission gears and engine mounts. The focus of this Title III initiative is to address production constraints and single points of failure in order to reduce lead times and ensure the domestic supply of low alloy VIM VAR steels for critical military components.

Major accomplishments in 2012 include the continued adherence to the military requirement of maintaining lead times below 20 weeks. Two major achievements that have been accomplished to maintain competitive lead times in the past year include the installation of a new ultrasonic tester and three new VAR furnaces.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $25.6M, augmented by $33.5M of contractor cost sharing. This was a competitive solicitation.

C.2 DoD ManTech Component Program Summaries

Defense-wide Manufacturing Science and Technology (DMS&T) Program

The Defense-wide Manufacturing Science and Technology (DMS&T) Program responds to a recommendation from the 2006 Defense Science Board ManTech study. The DMS&T Program concurrently develops manufacturing processes with emerging technologies and transitions advanced manufacturing processes and technologies for achieving significant productivity and efficiency gains in the defense manufacturing base. The program addresses cross-cutting, game changing initiatives

that are beyond the scope of any one Military Department or Agency. It complements the component ManTech programs by focusing on early, emerging technologies, cross-cutting DoD priorities, and enterprise-wide, above-the-factory-floor manufacturing issues. These DMS&T initiatives are identified and ranked through road mapping and data call activities conducted in collaboration with DoD and industry manufacturing representatives and are intended to benefit multiple defense systems and platforms. The primary transition target may be a single Military Department or Defense Agency application, but there will be secondary transition targets in alternate components or applications, which may require additional assistance from those component ManTech or acquisition programs.

Investment Strategy

DMS&T has three areas of investment: Advanced Electronics Manufacturing, Advanced Materials Manufacturing, and Enterprise and Emerging Manufacturing. Advanced Electronics Manufacturing addresses efforts in a wide range of advanced manufacturing technologies including but not limited to sensors, radars, power generation, switches, and optics. Advanced Materials Manufacturing addresses efforts in a wide range of advanced manufacturing technologies including but not limited to composites, metals, ceramics, nanomaterials, metamaterials, and low observables. Enterprise and Emerging Manufacturing addresses efforts in a wide range of advanced manufacturing technologies including, but not limited to, direct digital (or additive) manufacturing, machining, robotics, assembly, joining, and advanced manufacturing enterprise.

Highlighted Projects

The Chip Scale Atomic Clock project enables continued operation of C4ISR systems in a GPS- denied environment and allows rapid re-acquisition of GPS military code in a hostile EMI environment. However, the high cost ($2,500/unit) and low production rate (100/year) precludes large-scale fielding. Through the ManTech investment in improving the manufacturing capability through automating the micro-assembly of the physics package, the production rate will increase to over 20,000 units/year and reduce the cost per unit to $100.

Out of Autoclave (OoA) composites enable large bismaleimides (BMI) composite parts and eliminate the need for an autoclave, thus increasing the supplier base. BMI composites have improved structural performance compared to current epoxy based OoA composites. The OoA project looks to develop a BMI composites formulation that prevents void formation during cure under vacuum pressure only and demonstrate comparable properties to autoclave-cured composites. This enables part fabrication larger than current autoclave capabilities desired for future mobility aircraft concepts, future long-range strike concepts, and future launch vehicles. In addition, it increases the supplier base to fabricate large parts.

The Silicon Carbide High Efficiency Power Switches project looks to enable a new class of power electronics that allows flexible new architectures at higher voltages, higher frequencies, less volume/weight, higher temperatures, higher efficiency (reduced fuel consumption), and better power quality. Benefits include:

- Power: 70 percent more efficient than Si circuits and, hence, 2-8 percent fuel savings for mechanical-drive platforms (operated at ≤ 3 MPH). For 2 percent efficiency increase in combat vehicles alone, savings could be $648M/year during wartime OPTEMPO.
- Cooling: Greater operating temperature (>100°C coolant) and high efficiency; cooling system SWAP is significantly reduced.
- Reliability: Si power electronics (80°C coolant) have no thermal margin. SiC power electronics have >60°C margin and can provide 'Limp Home' functionality.
- Endurance: Ability to sustain operations for an extended time without support or replenishment.

The National Additive Manufacturing Innovation Institute (NAMII) is a whole new government approach to enable and facilitate an open innovation ecosystem for additive manufacturing through the active engagement and unique commercialization of tools of innovation and seed funding partners: regional economic development groups and Manufacturing Extension Partnerships (MEPs). U.S.-based original equipment manufacturers (OEMs) will benefit from the research and development projects conducted through NAMII. The growth of additive manufacturing products and technologies will depend on the ability to grow a strong base of small and medium enterprises (SMEs) to support the additive manufacturing supply chain. To achieve this, the NAMII will engage nationwide OEMs with SMEs in next-generation "open innovation supply chains" to bring forward commercially viable innovations. This expanded NAMII innovation community will include non-traditional sources such as the "Maker" movement, a new category of builders who are using open-source methods and the latest technology to bring manufacturing out of its traditional factory context and into the realm of the personal desktop computer.

Army

The Army Manufacturing Technology (ManTech) Program's mission is to provide affordable and timely manufacturing solutions that address the highest priority needs of the Army. The Army ManTech Program supports the transition of manufacturing technologies and affordable technical capabilities to the Warfighter. The program accomplishes this through demonstration of effective, efficient and adaptable processes and encourages strong internal and external partnerships.

The U.S. Army Research, Development and Engineering Command (RDECOM), a subordinate command of the Army Materiel Command (AMC), has been further designated as the Army's ManTech Program Manager. The Programs and Engineering (P&E) office within RDECOM performs this function and provides direction

to the Army's Research, Development and Engineering Centers (RDECs) and the Army Research Laboratory (ARL). ManTech managers in these organizations are responsible for coordination with project managers for the execution of individual projects. This structure allows the Army to take advantage of system level technical expertise by maintaining close contact with both the acquisition managers and the corresponding technology managers. This approach ensures a balanced portfolio aligned with RDECOM's Strategic Plan and application of systems engineering during projects to promote effective project planning and execution.

Investment Strategy

Army ManTech's strategy focuses on: (1) Affordable manufacturing processes to reduce the risk of transitioning and implementing mature technologies to currently fielded systems; (2) Enabling the maturation and transition of critical S&T products through manufacturing process improvements for emerging technologies in areas where the Army is the primary consumer; and (3) Advanced Manufacturing Technology Initiatives to enable Model-Based Enterprise (MBE) solutions that underpin the design and, more specifically, manufacturing processes necessary for more efficiently developing and maintaining Army systems. The Army ManTech Program is currently funded at approximately $60M per year, displaying a relatively stable level of investment. Investments result in cost avoidance and reduced risk of transitioning military-unique manufacturing processes into production.

The Army ManTech process is structured to fund projects that are deemed high priority for the Army. Proposals are submitted through the laboratories and RDECs to RDECOM. ManTech efforts are vetted and prioritized, coordinated through the Joint Defense ManTech Panel (JDMTP), and approved by the RDECOM Board of Directors.

The Program supports process prototyping and pilot demonstration to develop or modify manufacturing technologies for the Army's use. The Army ManTech Program does not acquire off-the-shelf capital equipment unless it is a minor portion of the investment and is required to establish the first-case application integral to the ManTech project. Prior to receiving Army ManTech funds, the Program Manager (PM) or organization responsible for transition and implementation must demonstrate a robust Acquisition Strategy that includes a realistic plan to transition and implement the technology in the industrial base. In support of this requirement, the PM must provide a Metrics Confirmation Memo (MCM) to validate project deliverables and demonstrate alignment with acquisition milestones. The MCM provides the three key elements for transition planning (project deliverables, associated metrics that determine the success of those deliverables, and a schedule that shows the planned transition point). The MCM assists with transition planning, feeds into Technology Transition Agreements (TTA's), and facilitates implementation planning. Specific initiatives are organized by the following portfolios:

AIR SYSTEMS – To include investing in rotary wing and unmanned air vehicle ManTech efforts and embedded sensors for composite structures

GROUND SYSTEMS – To include affordable lightweight structural armor, transparent armor solutions, multi-purpose warheads, seeker domes for missiles, and insensitive munitions processes

COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS –To include infrared (IR) sensors and focal plane array (FPA) systems, low cost laser designator modules, chip scale atomic clocks, flexible electronics, and micro-displays

SOLDIER SYSTEMS – To include improved chemical heating, energy efficient shelters, chemical and biological resistant fabric, and body armor

ADVANCED MANUFACTURING INITIATIVES – To address "above the shop floor" technologies, including network centric model based enterprise data to support integrated weapons system life-cycle.

The Army conducts semi-annual Internal Program Reviews (IPRs) for cost, schedule, program metrics and implementation planning. Each project's transition plan is routinely evaluated to see if projected metrics and transition milestones have been met. These IPRs and other supporting program documentation feed directly into the Army ManTech budget item justifications and success stories.

Highlighted Projects

One of the highest priorities for the Army is lightening the Soldier's load. An example of Army ManTech's strategy in support of this priority is enabling hybridized manufacturing processes for lightweight body armor. The objective is to develop an integrated suite of manufacturing technologies based on recent material and process advances that can deliver the same level of protection with at least a 10 percent reduction in total system weight. The strategy for ManTech investments brings a three-fold approach to bear on the problem: enabling processes for improved ceramic compositions; new processes for enhancing performance and reducing assembly costs of polymer-based composite backings; and new integration and consolidation methods to maximize the ballistic efficiency of all constituent materials. This program is continuously coordinated with PM SPIE (Soldier Protection and Individual Equipment) under PEO Soldier to ensure relevance to specific weight reduction requirements and to identify and enable body armor solutions. Direct coordination with the industrial base ensures that a manufacturing capability is mature, stable, and significant enough to warrant PM SPIE investment in issuing a new specification for improved body armor.

The energy efficient shelter liners project has provided an expedient insulation solution for soft-wall shelters. Results included significant energy savings, lighter weight materials, easier to install shelters, and smaller packaging for shipment. These insulation materials will save over 50 percent in energy costs associated with shelters, with an effective R-value (or system R-value) of 6. Implementation is through PM Force Sustainment Systems (PM-FSS), which has purchased over 2600 liners for

59 600-man Force Provider equipped base camps. NASA, USAMMDA, and the Sustainment Basing technical demonstrations are evaluating liners.

An Army ManTech- Army SBIR funded project improved MRE Chemical Heaters through a robust, cost effective manufacturing process for producing and assembling components of a water-less ration heater. This chemical-based MRE heater will be available at the same cost as the water-based heater. The product has transitioned to the DoD Combat Rations group for scale up to full production. DLA will begin to procure over 40 million units per year to satisfy MRE requirements. Due to technical advances as a result of ManTech investments, the commercial market has shown significant interest, and expected market volume industry-wide could approach more than 500 million units annually.

Army ManTech investments in transparent spinel armor increased production capacity for large transparent ceramic-based armor plates by addressing base material processing, scale up tooling sizes for larger batch processing, improvements to secondary processes such as grinding and polishing, and development of new non-destructive evaluation processes for inspection. This program led to a 50 percent reduction in cost for producing hot-pressed spinel plates, an increase in plate sizes from 170 in2 to 400 in2, and the maturation of production capabilities to the point where industry invested over $20M in a new domestic production facility dedicated to manufacturing of large spinel plates. Based on Army ManTech investments and achievements, the Navy is now investing in even larger sized windows for use on their ships. Additional details on these efforts and others can be found at www.armymantech.com.

Navy

The Navy ManTech Program provides for the development of enabling manufacturing technology and the transition of this technology for the production and sustainment of Navy weapon systems. Customers range from the acquisition Program Managers (PMs) and industry responsible for transitioning major Navy weapon systems from development into production, to the logistics managers at the naval depots and shipyards responsible for repair, overhaul, and remanufacture of major weapon systems.

The Office of Transition within the Office of Naval Research (ONR) manages the Navy ManTech Program, with oversight from the Chief of Naval Research. ONR's Office of Transition is composed of transition-centric programs including ManTech, Future Naval Capabilities (FNCs), the Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR), and other transition initiatives. The Navy ManTech Program executes its projects through its Centers of Excellence (COEs) that have expertise in specific technology areas. ManTech's seven COEs are: Center for Naval Shipbuilding Technology (CNST) (Charleston, SC); Composites Manufacturing Technology Center (CMTC) (Anderson, SC); the Electro-Optics Center (EOC)

(Freeport, PA); Electronics Manufacturing Productivity Facility (EMPF) (Philadelphia, PA); Energetics Manufacturing Technology Center (EMTC) (Indian Head, MD); Institute for Manufacturing and Sustainment Technologies (iMAST) (State College, PA); and Navy Metalworking Center (NMC) (Johnstown, PA).

Investment Strategy

Reducing the acquisition cost of current and future platforms is a critical goal of the Navy. As a result, in 2006, ManTech adopted an affordability investment strategy to help key naval programs achieve their respective affordability goals by transitioning needed manufacturing technology which, when implemented, results in a cost reduction or cost avoidance for these programs. Current investments are focused on both acquisition and life-cycle affordability for the following key Navy platforms: VIRGINIA Class submarine (VCS), DDG 51 Class destroyer, Littoral Combat Ship (LCS), CVN 78 Class carrier, and Joint Strike Fighter (JSF). A recent change to the investment strategy is the addition of the OHIO Replacement Program (ORP) to the existing VIRGINIA Class submarine initiative for a coordinated PEO (Subs) affordability initiative, starting in FY2014.

Strategic planning is an ongoing effort. Navy ManTech annually analyzes acquisition plans to determine major ship and aircraft acquisition programs that might benefit from a close partnership with Navy ManTech. Platforms for investment are determined by total acquisition funding, stage in acquisition cycle, platform cost reduction goals, and cost reduction potential for manufacturing, all of which determine platforms for investment. As the platforms currently supported mature through their respective acquisition cycles, ManTech's investment targets will change.

Although different in focus, scope, and size, the five affordability initiatives (DDG Family, CVN 78 Class Carrier, LCS, VCS, and JSF) function similarly. For each, ManTech has established an IPT with representatives from Navy ManTech, the platform Program Office, and representative industry. The IPT meets regularly to coordinate and review the portfolio and ensure that projects are completed in time to meet the platform's window of opportunity for implementation.

The Navy ManTech Program schedules periodic program reviews for each of the affordability portfolios. In these reviews, the platform's IPT assesses the overall portfolio as well as individual projects with respect to technical progress, cost and schedule progress, and probability of implementation to meet the platform's window of opportunity.

Affordability Assessments. To review progress towards meeting both platform and ManTech affordability goals, affordability assessments are conducted semi-annually. In these assessments, cost avoidance/savings per project as well as estimated total savings per platform are identified and have the concurrence of both the Program Office and the industry implementing the technology.

Technology Transition Plans. For each project, a Technology Transition Plan (TTP), which highlights the path from the technology development that ManTech performs to implementation on the factory floor, is developed. Implementation actions, roles and responsibilities, and required resources are identified. TTPs are signed by Navy ManTech, the relevant COE Director, a management representative of the industrial facility where implementation will occur, the Program Office, and, if appropriate, the Technical Warrant Holder.

Since switching to its affordability focus in 2006, Navy ManTech has impacted and is continuing to impact both ship and submarine affordability and, more recently, has begun to impact aircraft affordability as well. ManTech has established good working relationships with relevant Program Offices and industry and has established a detailed internal planning effort. Affordability assessments on a per-platform basis, agreed upon by both the relevant Program Offices and industry, show good cost reduction potential, and ManTech's transition rate for projects is increasing. Affordability projects have transitioned and have been implemented on factory floors, and cost reduction values are being 'booked' by industry for these programs.

Highlighted Projects

Since switching to its affordability focus in 2006, Navy ManTech has impacted and is continuing to impact both ship and submarine affordability and, more recently, has begun to i:rppact aircraft affordability as well. ManTech has established good working relationships with relevant Program Offices and industry and has established a detailed internal planning effort. Affordability assessments on a per-platform basis, bought off by both the relevant Program Offices and industry, show good cost reduction potential, and ManTech's transition rate for projects is increasing. Affordability projects have transitioned and have been implemented on factory floors, and cost reduction values are being 'booked' by industry for these programs.

For the VIRGINIA Class submarine (VCS) initiative, extensive interaction and cooperation between Navy ManTech, Navy ManTech Centers of Excellence (COEs), General Dynamics Electric Boat, Northrop Grumman Shipbuilding- Newport News, PEO (Subs), and the PMS 450 Program Office has resulted in a focused ManTech initiative. This project is successfully transitioning and implementing technology to aid in the Navy's and industry's common goal to reduce the cost of VCS from $2.4B to $2.0B (FY05 $)to allow for the construction of two submarines per year in 2012. The current ManTech portfolio contains approximately 70 completed, active, or pending projects and has a potential acquisition cost savings of over $35M per hull for a return on investment in less than two hulls (from ManTech's Feb 2012 Affordability Assessment which was vetted through PMS 450). To date, 28 of the Man Tech affordability projects have been implemented or are in the process of implementation. Realized· cost savings/hull of approximately $25.2M have been recognized by the VIRGINIA Class Program Office and General Dynamics Electric Boat (Oct 2012 update). Navy ManTech, in its partnership with PMS 450 and the VCS primes, is now expanding its focus to Block IV and reduction of Total Ownership Cost (TOC), to include acquisition cost savings;

maintenance cost savings; and reducing total time in dry dock to improve operational availability.

A major success in the VCS Affordability Initiative this past year was the continuing implementation of the results of the VCS Supply Chain Improvement project. Contractor furnished components (CFE) make up nearly 30 percent (or approximately $600M) of overall VCS cost, with about $146M of that attributable to 40 very costly components. Through this ManTech effort, the General Dynamics Electric Boat (GDEB) and Huntington Ingalls Industries – Newport News Shipbuilding (NNS) teams conducted a structured review of these 40 most costly contractor-furnished components to determine how best to lower costs and improve on-time availability while maintaining technical and quality requirements. Overall, nearly 60 cost savings opportunities were identified between the VCS co-build shipyards. Implementation began in January 2011 using a phased approach, and initial savings of $1.04MNCS hull were accomplished with no implementation costs. Implementation is continuing and, once fully implemented, shipyards and vendors expect cost savings to increase by over $7M per hull to support the Block IV reduction of total ownership cost initiative. The total estimated cost savings is $8.5M per VCS hull.

After the implementation in FY2011 of automated fiber placement (AFP) for carbon fiber bismaleimide (BMI) material for the Joint Strike Fighter (JSF) expected to result in a $100M savings overall for the program, Navy ManTech had another major success for the JSF program with the implementation of controlled volume molding for the JSF horizontal tail seals and bullnose parts. A recent design change to these carbon fiber/BMI parts, fabricated using hand lay-up and autoclave cure, had resulted in problems during cure causing the scrapping of a substantial percentage of parts and significant rework and a doubling of cost for those parts not scrapped. Navy ManTech developed a process that produces a net shaped profile by controlling volume during the cure process resulting in parts of better quality than the autoclave-cured parts while meeting JSF requirements at an affordable cost. Benefits from the implementation of this process include significantly reduced lay-up time, reduced number of debulks, elimination of part bagging, reduction in machining and reduction in finishing time. The total cost savings is estimated to exceed $36M from a project cost of less than $200K, a significant return on investment.

With affordability as its focus, Navy ManTech is committed to working with acquisition programs and industry to provide the technology needed to reduce production costs. The continued collaboration of ManTech, Program Offices, and industry on cost-reduction opportunities can and will help platforms achieve their affordability goals.

Air Force

The AF ManTech program plans, manages and advocates advanced manufacturing processes, techniques, and technologies for timely, high quality,

economical production and sustainment of Air Force systems. A deliberate planning process based on strategic requirements, industrial base assessments, and high priority Air Force and DoD requirements is followed to pursue projects that will benefit the Warfighter the most within all Air Force mission areas: air, space, and cyber.

Investment Strategy

Integral to the AF ManTech investment process is an active, long-term vision and strategy of attaining next generation agile manufacturing for affordable, high quality weapon systems. This expansive vision contains several components, each of which is critical to the future manufacturing enterprise. An agile manufacturing base emphasizes speed of delivery, but also the capability within the manufacturing community to quickly react to changing conditions or requirements. Flexibility in system alternatives and lower technology transition risk is aided through constant monitoring of new emerging technologies and innovative procedures. Next generation agile manufacturing is as much about the discovery of advanced technologies, such as virtual manufacturing, as innovative approaches to overcome defense-unique production challenges, such as low-volume, high-mix fabrication or modeling surge responses for supplier networks. The AF ManTech vision is predicated upon a set of four strategic thrusts that are considered critical to achieving the future state of an agile U.S. manufacturing base. Each of these thrusts is described below.

1. **Moving Manufacturing Left** is a disruptive philosophy and methodology to foster greater awareness of manufacturing readiness issues earlier in S&T development and during the design and acquisition process (towards the “left”). Various studies have indicated that many cost and schedule overruns in DoD acquisition programs are due to the lack of manufacturing readiness. Many emerging materials and systems that could benefit the AF often do not bridge the “valley of death” due to manufacturing immaturity, among other issues. AF ManTech is well positioned to impact these issues and has thus defined a strategic vision for Moving Manufacturing Left to foster changes across both the fundamental and applied phases of S&T development, as well as the early phases of the acquisition cycle.

2. **Cradle to Cradle Digital Thread** of the next generation will be defined by technologies that enable all parties within a weapon system's enterprise to access the same computer-based technical description of the product at any point of the life-cycle. This digital thread is a fundamental shift away from static, nominal product/process models towards dynamic, real-time representations that describe the current and future states of weapon systems and the enterprises that support them. The Digital Thread concept is broad and reaches well outside the manufacturing community (e.g. designers, sustainers), making collaboration and coordination critical to achieving success. Tool development will provide new capabilities, but the true benefit of creating a digital thread lies in the integration of actionable information.

3. **Factory of the Future** denotes the capability of continuously adapting to and rapidly responding to a Warfighter demand that requires accelerated change and heightened system complexity. The Factory of the Future is envisioned to be one where small lot sizes and custom configurations are the norm, but where costs and cycle times are insensitive to this environment. The Factory of the Future incorporates new and innovative processes to maximize responsiveness, such as advanced robotics and flexible/reconfigurable tooling, and is fueled by information from the Digital Thread.

4. **Responsive, Integrated Supply Base** addresses the need to actively manage supply chain risk and performance as part of an agile enterprise. Responsiveness implies a capacity for timely reaction – that capability is available and that there is a willingness to address new opportunities. Integration within the supply base implies a capacity exists that is composable and configurable, with transparent and complete information flow and well aligned objectives. Whether the basis is a distinct supply chain or the industrial base as a whole, the analysis questions are the same…only the scale is different. The capability for rapid response to changing Warfighter needs is contingent upon the flexibility of the supply base. A quickly assembled product realization enterprise requires visibility to information, methods to enable rapid collaboration, and tools for risk management across the DoD industrial base, as well as specific supply chains. Tomorrow's supply base – an increasingly complex and dynamic management environment for the AF and its prime contractors – is globally distributed, and networking capabilities must account for the complexities of integrating and operating across differing infrastructures, languages, and cultures. Classic management issues such as supplier discovery, capability matching, and information exchange are far more effective through the use of web-based tools, methods, and advanced modeling techniques. Status of specific issues – or of entire sectors – is provided real-time.

Highlighted Projects

Following are two project summaries that demonstrate the types of agile manufacturing technologies needed for affordable, high quality weapon systems.

Fastener Insertion Live Link System (FILLS):

Dependence on paper documentation and outlying computer resources is a large cost contributor to airframe assembly. By using optical projection techniques, pertinent assembly data can be projected directly on airframe components and assemblies. The data (structural, electrical, coating data, specs, procedural text, photos, etc) projected can be calibrated so that physical features are illuminated and annotated, with information targeted to that specific structural or electrical location, thus eliminating the challenging and often confusing process of interpreting blueprint drawings as they relate to work in progress.

In the case of fasteners, structural assemblies use a large mix of fastener types that require diligence on the part of the mechanic during installation to avoid mistakes. Optical projection guides the mechanic through the fastener installation process, as well as other tasks such as structural assembly, hole drilling, fastener grip length measurement, temporary assembling, surface coating, and mate surface sealing, resulting in significant savings in labor hours and improved quality.

The Fastener Insertion Live Link System (FILLS) is an optical projection system that has been adopted amongst multiple airframe OEMs. One attribute that makes FILLS particularly useful is its ability to project a variety of images onto contoured surfaces. The F-35 Center Wing program uses this capability by integrating a seven-projector FILLS system for engine nacelle inner skin assembly. Four of the seven projectors are dedicated to displaying information directly under overhanging bulkheads. This system provides the assembly mechanic with full vertical and circumferential fastener insertion instructions. These instructions are coupled with improved procedures that sequence the work for maximum efficiency. The use of a calibrated, ergonomically designed wireless grip gage guided by the FILLS system has cut in half the time it takes to manually acquire fastener grip lengths. FILLS uses the grip data to provide mechanics with time-saving fastener kit lists. The measured results of FILLS implementation on F-35 nacelle assembly include reduced span times and assembly hours (hours per unit, HPU), and an increase in quality. As a first application, benefits have been estimated for the F-35 program at over $111M. Applications to other systems include the C-5 troop door, the C-130, the P-3 re-wing, the E-2, Gulfstream, Spirit AeroSystems, and Raytheon's satellite assembly operations.

Customer/Supplier Interoperability during Collaborative Design (CSI):

All major programs are highly collaborative, involving many different partners who must exchange technical data packages (TDPs) frequently throughout the program. As many as 4000 TDP exchanges per month may occur between any set of partners. Considering the number of partners and the length of major programs, more than 4 million exchanges may occur over the life of a program. With current technology and processes, these exchanges require significant manual effort, which results in significant costs and longer delivery schedules.

The CSI program developed software solutions to address the massive engineering inefficiencies associated with data exchanges in defense supply chains. Through the automation of manual tasks and by creating a toolset to advance current technical data exchanges from 2D to 3D, the CSI program has paved the path toward Model-Based Definition (MBD) for the defense industrial base. Through CSI, the following types of activities have been automated:

- Automated preparation of TDPs for delivery: This preparation ensures compliance with specific contract requirements in order to provide ready to use data with no or limited additional manual intervention.

- Automated translation of CAD models: Data is translated into neutral STEP or directly into partner native CAD formats, including Model Based Definition (MBD) with manufacturing information (PMI), thus helping to resolve common translation issues.
- Automated validation of translated models: This ensures derivative models (neutral standards, visualization, etc), including MBD models, match the content of the original models.
- Automated simplification of models: This helps to reduce the size and remove unnecessary/proprietary information.
- Automated solutions to migrate from legacy to MBD based models: Merging associative 2D GD&T into the model and producing associative 3D PMI; thereby providing the translation of associative 3D models between dissimilar CAD environments for PMI.
- Automated solutions to identify manufacturing issues early in design: This allows for the detection and resolution of model issues through producibility rule sets; which are completed for machining operations.
- Automated documentation for Engineering Change Orders (ECOs): Document model changes in a 3D format greatly improves communication between customer and supplier.

Through side-by side comparisons with current best practices, the CSI technologies generated projected cost savings of ~$22M per year for the three CSI manufacturers, and ~$50M per year when fully adopted by all supply chain members in a large, defense acquisition program.

Defense Logistics Agency (DLA)

The Defense Logistics Agency (DLA) is America's Combat Support Agency. DLA provides our military forces the food, clothing, fuel, medical supplies, and spare parts essential to conducting worldwide military and humanitarian operations. DLA maintains a Research & Development (R&D) program to address strategic logistics requirements and processes (PE-0603712S), and to address select industrial and technology capabilities in accordance with DoD Directive 4200.15, Manufacturing Technology Programs (PE-0708011S). DLA's Small Business Innovation Research (SBIR) program also contributes to improving industrial capabilities for defense weapon system parts (PE-0605502S).

Investment Strategy

DLA's investment strategy aligns with our global supply chain needs. Specific areas of technological capability concern exist in microcircuits, military batteries, castings and forgings, operational rations, and military clothing. DLA's program also engages with the Joint Defense Manufacturing Technology Panel (JDMTP) and Defense-wide manufacturing technology efforts, including: castings & forgings projects

within the metals subpanel; advanced microcircuit emulation and battery network projects within the electronics and power sources subpanel; and logistics information projects coordinated with the advanced manufacturing enterprise subpanel.

Highlighted Projects

DLA's recent accomplishments to improve Industrial Base Capabilities include the following programs and respective projects:

DLA's Advanced Castings Technology Program

DLA's Advanced Castings Technology Program has:

- Developed a computer prediction model and standards to improve inspection accuracy of casting discontinuities to 95 percent.
- Developed and transitioned 13 new die cast technologies through the North American Die Casting Association's Productivity Enhancement Toolkit, resulting in five to ten percent cost reductions and 20 percent shorter lead-times.
- Created a 'Procurement Solutions Network' to identify supply chain gaps and streamline unfulfilled orders, resulting in a cost savings of $2M and reduction of production lead time of 12 weeks. This network includes valuable resources such as: the Defense Tooling Locator, Defense Casting Supplier Database, and Bid Solicitation Review, which identify, qualify, and leverage metal-casting parts and facilities.

DLA's Advanced Microcircuit Emulation (AME) Program

DLA's Advanced Microcircuit Emulation (AME) program continues to successfully emulate discontinued product lines with modern production techniques. Overall, AME has sustained over 100,000 microcircuits for 350 weapon systems, with an estimated cost avoidance for equipment redesign in excess of $700M. This year, the program transitioned to new production capabilities for 0.8 micron digital complementary metal oxide semiconductors. During proof-of-concept, sourcing was reestablished for 11 items and DLA will use this capability to source dozens of items in the future.

DLA's Weapon System Sustainment Program

DLA's Weapon System Sustainment program demonstrated an inexpensive capability, known as custom botanical deoxyribonucleic acid (DNA) marking, in order to assure the source of microcircuits and defeat counterfeiters. In August 2012, DLA announced its intent to require the use of DNA marking by suppliers of microcircuits to DLA.

DLA's Battery Network Program

DLA's Battery Network program has:

- Developed standard module designs for military lithium-ion batteries in order to reduce future acquisition costs.
- Developed a low cost, non-hazardous battery electrode production process.
- Developed initial production capability for a new generation, high energy soldier battery.

DLA's Combat Rations Network Program

DLA's Combat Rations Network program optimized the packaging of Meals Ready to Eat (MRE), resulting in a combined cost savings of $1M/year.

C.3 Science & Technology Investments

DoD's warfighting capabilities are critically enabled by software and communications. Accordingly, we need our industrial partners to produce both of these elements of our warfighting systems rapidly, with a high degree of effective complexity, and at cost effective rates. To enable improvements in industrial capacity, DoD has made investments in S&T to provide improved tools and methods to deliver software and waveforms faster and with better performance.

Software Engineering

The Software Engineering Institute (SEI) and the Software Producibility Initiative (SwPri) are sponsored by the Office of the Assistant Secretary of Defense for Research and Engineering. The SEI is a R&D Federally Funded Research and Development Center (FFRDC) that focuses on software engineering. The SEI establishes collaborations that leverage work in industry, academia, and government laboratories. SwPri directly funds R&D efforts in industry and academia that improve the efficiency and quality of software production. DoD invested approximately $20M in FY2012 on technologies targeted to improve our industrial capabilities in software.

There are two examples being pursued by SEI and SwPri that improve industrial capabilities: Improved Value Visibility & Improved Composability of Software Modules.

Improved Value Visibility

Software is a primary reason why DoD programs are unaffordable. The DoD process favors infrequent exchanges with decision-makers and reported measures of progress are loosely tied to actual program progress. In the private sector, modern agile development methods are characterized by frequent technical exchanges between customer and developer. In the DoD, a significant amount of senior-level oversight on large programs will persist because of the required stewardship of the taxpayer's investment. This oversight model makes the successful use of agile development methods that are proven to be efficient for smaller projects more difficult.

One reason software-intensive projects are hard to manage is because common measures of progress are arbitrary or subjective. Tools that make objective technical information about software projects more accessible to decision-makers at all levels will help alleviate this problem. The goal of R&D in this area is to make objective, repeatable measurements of project progress at low levels (e.g., software code) that can be synthesized and consistently summarized at high (system architecture) levels. This must be done in an environment where the requirement for senior-level oversight persists.

Some examples of success include GrammaTech's Code Sonar application It is a successful static analysis and code visualization tool that received funding under SwPri. Another example is the Architecture Analysis & Design Language. It is a model-based engineering method that has become an SAE standard. The Software Engineering Institute played a significant role in its development and continues to improve AADL and the tools that use it.

There are also promising avenues of new research. The Software Engineering Institute is working with DoD to make historical cost databases more accessible and accurate. This will allow decision-makers to choose development methods that are proven to be efficient in the DoD environment. The SEI is also exploring other promising approaches that use automated data collection on development activities and seek new measures of progress and value based on the vast amount of data collected.

Improved Composability of Software Modules

Formally proving that software will behave correctly is very hard because of there are so many permutations of inputs and decisions based on those inputs. On small modules, the mathematics exists to assure software was written correctly. However, when these modules are connected ("composed'") the composition does not share the same behavior guarantees as the separate modules. The R&D goal in this area is to increase the size and complexity of assured software systems by better understanding the risks and limitations associated with combining two modules that have been separately assured to be correct.

Some examples of success include the Open Component Portability Infrastructure (OpenCPI) and the Physically-Asynchronous Logically-Synchronous (PALS) method. OpenCPI addresses the different behavior and incompatibilities of software when it runs on different types of processors. Open CPI was development was done under SwPri. PALS addresses different assumptions about timing in separate software modules. Timing is a significant obstacle to assuring the correct behavior of composed software modules. The Software Engineering Institute contributed to the development and improvement of PALS. SwPri is sponsoring several other R&D efforts that address timing.

<u>Communications Examples</u>

Rapid Waveform Development

The Advanced Tactical High-performance Network Architecture (ATHENA) program objective is to develop a suite of advanced algorithms, protocols, and communication designs that will advance the state of the art in capabilities and performance for airborne tactical communications and networking. In FY2012,

breakthrough improvements in communication efficiency and resiliency were achieved, while establishing a theoretical foundation for the component design elements of the communication architecture. The prototype systems developed and implemented under this program are being successfully transitioned to the Defense industrial base in fully developed software systems, emphasizing the use on existing Defense industrial base radio and networking products, thus leveraging existing industrial capabilities in hardware and software for Defense systems. The technology development has been extensively documented in peer-review technical journals, conferences and international standards bodies, allowing the Defense industrial base to incorporate the technologies in their future product development plans and in corporate research and development programs. The ATHENA program was funded at $1.8M in FY2012.

Emulation of Communications Environments

The OSD Network Communication Capability program is developing enhanced tactical, mobile network modeling capabilities to support advancement of resilient, autonomous networking technology for DoD. This includes an open design for high fidelity wireless network emulation of tactical communication environments using existing, emerging and experimental network protocol, application, and system software implementations. The Common Open Research Emulator (CORE) and Extensible Mobile Ad-hoc Emulator (EMANE) software being developed under this effort provides a sustainable, open source capability presently being adopted by a range of relevant efforts and is openly available to the DoD industrial base with related documentation. Additionally, supporting components and software are being developed to enable rapid generation of operationally relevant scenarios and provide analytics and visualization to gain a greater scientific understanding earlier in the design and development process. This includes the Network Modeling Framework (NMF) initiative that provides software tools to enable sharing of common scenarios and results among the different testbed and modeling environments of DoD, academia, and industry. The comprehensive modeling capabilities and experimentation framework allows for evaluation of the complex tiered software and distributed network systems with an emphasis on mobile tactical communication environments. The overall impact of this work to the industrial base is to accelerate the development of mobile tactical network and information system technology with a reduction in cost and technical risk earlier in the software and system development and engineering process. The Mobile Wireless Network Modeling and Analytics program was funded at $2.0M in FY2012.

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Preface

This report of the Defense Production Act Committee (DPAC) has been prepared for submission to the Committee on Banking, Housing, and Urban Affairs of the United States Senate and the Committee on Financial Services of the United States House of Representatives, in accordance with subsection 722(d) of the Defense Production Act of 1950, as amended 50 U.S.C. App. § 2061 et seq. (DPA). This report provides an overview of DPA authorities and activities of Federal departments and agencies during Calendar Years 2011 and 2012 and describes ongoing DPAC activities to assess the use of DPA authorities in support of the national defense, including military, space, and energy programs, disaster preparedness and response activities, critical infrastructure protection and restoration, and counterterrorism programs.

Department of State

Department of the Treasury

Department of Defense

Department of Justice

Department of the Interior

Department of Agriculture

Department of Commerce

Department of Labor

Department of Health and Human Services

Department of Transportation

Department of Energy

Department of the Homeland Security

Office of the Director of National Intelligence

Central Intelligence Agency

Council of Economic Advisors

National Aeronautics & Space Administration

General Services Administration

Executive Summary

The Defense Production Act Committee ("DPAC" or "Committee") is an interagency body established to identify whole-of-government approaches to strengthen domestic industrial base capabilities to meet national defense supply requirements under normal and emergency conditions.[14] The Committee advises the President on the effective use of the Defense Production Act (DPA) and develops recommendations for changes to the law and the use of its authorities. To achieve these objectives, the Committee engages in assessment activities and enables information sharing related to the industrial base and DPA authorities.

This report provides a review of the DPAC operations and describes activities within the Executive Branch related to the use of DPA authorities. The report does not include any recommendations for legislative action involving DPA authorities.

Pursuant to subsection 722(b)(2) of the DPA, the President has designated the Secretary of Homeland Security and the Secretary of Defense as rotating chairpersons of the DPAC. The DPAC Chairperson rotates annually on April 1. Within the Department of Homeland Security, the DPAC responsibilities of the Secretary have been delegated to the Administrator of the Federal Emergency Management Agency. The Administrator was the DPAC Chairperson until March 31, 2013. The Committee's membership includes the heads of Federal departments and agencies to which the President has delegated DPA authorities and responsibilities.

The Committee is currently conducting several assessments focused on:

- Providing recommendations on the use of DPA Title III authorities;
- Use of DPA priorities and allocations authority to support disaster preparedness and response activities, as well as critical infrastructure protection and restoration; and
- Use of the DPA voluntary agreements authority.

[14] As defined in the Defense Production Act, "national defense" means programs for military and energy production or construction, military or critical infrastructure assistance to any foreign nation, homeland security, stockpiling, space, and any directly related activity. "National defense" also includes emergency preparedness activities conducted pursuant to title VI of The Robert T. Stafford Disaster Relief and Emergency Assistance Act 42 U.S.C. § 5195 et seq. and critical infrastructure protection and restoration.

1. Introduction

1.1. Defense Production Act

The Defense Production Act of 1950, as amended (50 U.S.C. App., §2061 et seq.) (DPA), is the primary source of Presidential authorities to expedite supply and expand productive capacity of materials and services needed to promote the national defense. For the purposes of the DPA, "national defense" means programs for military and energy production or construction, military or critical infrastructure[15] assistance to any foreign nation, homeland security,[16] stockpiling, space, and any directly related activity. "National defense" also includes emergency preparedness[17] activities conducted pursuant to Title VI of The Robert T. Stafford Disaster Relief and Emergency Assistance Act [42 U.S.C. § 5195 et seq.] (Stafford Act)[18] and critical infrastructure protection and restoration.

Major DPA provisions include:

- The authority to require acceptance and priority performance of contracts and orders to promote the national defense [DPA section 101];

- The authority to allocate materials, services, and facilities in such manner, upon such conditions, and to such extent as deemed necessary or appropriate to promote the national defense [DPA section 101];

- Various forms of financial incentives and assistance for industry to create, maintain, protect, expand, or restore domestic industrial base capabilities in order to reduce current or projected shortfalls of resources essential for the national defense [DPA Title III];

- Antitrust protection for voluntary agreements and action plans among business competitors to enable cooperation to plan and coordinate measures to increase the supply of materials and services needed for the national defense [DPA section 708];

[15] The DPA defines "critical infrastructure" to mean "any systems and assets, whether physical or cyber-based, so vital to the United States that the degradation or destruction of such systems and assets would have a debilitating impact on national security, including, but not limited to, national economic security and national public health or safety."

[16] The DPA defines "homeland security" to include efforts: (A) to prevent terrorist attacks within the United States; (B) to reduce the vulnerability of the United States to terrorism; (C) to minimize damage from a terrorist attack in the United States; and (D) to recover from a terrorist attack in the United States.

[17] "Emergency preparedness" includes all those activities and measures designed or undertaken to prepare for or minimize the effects of a hazard upon the civilian population, to deal with the immediate emergency conditions which would be created by the hazard, and to effectuate emergency repairs to, or the emergency restoration of, vital utilities and facilities destroyed or damaged by the hazard.

[18] The purpose of title VI of the Stafford Act is to provide a system of emergency preparedness for the protection of life and property in the United States from hazards and to vest responsibility for emergency preparedness jointly in the Federal Government and the States and their political subdivisions. This title is carried out by the Administrator of the Federal Emergency Management Agency.

- The authority to establish a cadre of persons with recognized expertise for employment in executive positions in the Federal Government in the event of an emergency [DPA section 710(e)]; and

- The authority to review certain mergers, acquisitions, and takeovers by or with any foreign person that could result in foreign control of any person engaged in interstate commerce in the United States [DPA section 721[19]].

1.2. Defense Production Act Committee

The Defense Production Act Committee (DPAC), established by section 722 of the DPA and further defined by Executive Order (EO) 13603 (March 16, 2012), is an interagency forum to discuss and share information about the domestic industrial base and DPA authorities and to advise the President on the effective use of these authorities in support of the national defense. The DPAC:

- Identifies whole-of-government approaches to strengthen domestic industrial base capabilities to meet national defense supply requirements under normal and emergency conditions, using DPA authorities;

- Develops recommendations for the effective use of DPA authorities;

- Develops recommendations for changes to the DPA and Executive Branch DPA guidance and procedures to support effective use of DPA authorities;

- Develops recommendations to improve information sharing among Federal agencies on the use of DPA authority, including dissemination of "best practices" and "lessons learned"; and

- Prepares an annual report to Congress, in accordance with section 722 of the DPA.

The position of DPAC Chairperson rotates between the Secretaries of Defense and Homeland Security annually on April 1. On April 1, 2012, the Chair rotated from Defense to Homeland Security. The DPAC is comprised of the Secretary of State, the Secretary of the Treasury, the Secretary of Defense, the Attorney General, the Secretary of the Interior, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Labor, the Secretary of Health and Human Services, the Secretary of Transportation, the Secretary of Energy, the Secretary of Homeland Security, the Director of National Intelligence, the Director of the Central Intelligence Agency, the Chair of the Council of Economic Advisers, the Administrator of the National Aeronautics and Space Administration, and the Administrator of General Services. The Director of the Office of Management and Budget and the Director of the Office of Science and Technology Policy are invited to participate in all Committee meetings and activities in an

[19] The Committee on Foreign Investment in the United States (CFIUS), established by DPA section 721, has a separate annual reporting requirement to Congress. CFIUS issues are not addressed in this report.

advisory role. The DPAC Chairperson may also invite the heads of other departments and agencies to participate in DPAC meetings, as appropriate.

1.3. Organization of the Report

This report addresses the subjects listed in subsection 722(d) of the DPA. Chapter 2 describes programs in place to make effective use of the DPA authorities to support national defense programs. Chapter 3 includes information about ongoing DPAC assessment activities. Chapter 4 describes procedures and actions to share information among Federal agencies regarding DPA issues. Annex A provides a summary of EO 13603 and a review of the DPA authorities of Federal departments and agencies. Annex B contains the full text of EO 13603.

2. Use of DPA Authorities

This chapter describes activities of federal departments and agencies to make effective use of DPA authorities to promote the national defense. These activities include: (1) development of consistent priorities and allocations regulations by Departments to whom the President has delegated these authorities; (2) coordinated implementation of a Federal Priorities and Allocations System; and (3) implementation of the Title III authorities, including actions to increase collaboration between the Department of Defense (DOD) Title III Program Office and other Federal agencies in conducting Title III projects that support energy, space, critical infrastructure, and homeland security programs, in addition to military programs.

2.1. *Use of Title I Authorities: Priority Ratings*

Title I of the DPA provides the President the authority to require preferential performance on contracts and orders, as necessary or appropriate, to meet national defense requirements. EO 13603 delegates these authorities to various federal departments.

EO 13603 directs the Secretary of each department that is delegated priorities and allocations authority by the President ("resource department") to plan for and issue regulations to establish standards and procedures by which the authority shall be used to promote the national defense under both emergency and non-emergency conditions and to authorize the heads of other agencies, as appropriate, to place priority ratings on contracts and orders for materials, services, and facilities needed in support of programs approved under section 202 of the EO. The Department of Commerce (DOC) is currently in the process of updating its rule for the Defense Priorities and Allocations System (DPAS). New priorities and allocations rules have been published by the Department of Energy (DOE) and the Department of Transportation (DOT), and new rules are being prepared by the Department of Agriculture and the Department of Health and Human Services. At this time, however, only the priorities system established under the DOC regulation is actively used.

To implement its authority, DOC administers DPAS (*See* 15 C.F.R. 700), which has been a cornerstone of DOD procurement activity since 1950. DOC has delegated authority to DOD, DOE, the General Services Administration, and the Department of Homeland Security (DHS) to place rated orders for industrial resources in support of programs determined eligible for priorities and allocations support, in accordance with the provisions of section 202 of EO 13603. DOC also authorizes other government agencies, foreign governments, owners and operators of critical infrastructure, or companies to place DPAS-rated orders on a case-by-case basis. Such requests must first be determined "necessary or appropriate to promote the national defense" by DOD, DOE, or DHS, depending on the purpose of the program targeted for support (i.e., military, energy, or civilian respectively). As the primary user of the authority, DOD places priority ratings on DOD-approved national defense program contracts and subcontracts for industrial resources, including construction and Foreign Military Sales contracts.

Use of priority authorities by Government organizations to support non-military programs has been relatively limited. In the past, DHS has used DPAS-rated orders to obtain industrial

resources in support of such activities as: hurricane and flood preparedness and response; Homeland Security Technology Programs; the Customs and Border Protection Air and Marine P-3 Aviation Program; and the Federal Emergency Management Agency (FEMA) National Radio System Program. Other Federal departments and agencies have also used DPAS priority ratings in support of DHS-approved programs, including the U.S. Army Corps of Engineers (for example, during its response to the 2011 Missouri River flooding).

2.1.1. ***Consistent and Unified Federal Priorities and Allocations System***

During the past two years, the six federal departments that are delegated priorities and allocations authority with respect to certain resources continued their collaborative efforts to implement a consistent and unified Federal priorities and allocations system to the extent practicable, with DHS providing coordination for this interagency effort. New rules for this system are based, primarily, on DPAS guidance and procedures and address the potential use of the priorities and allocations authority for all types of resources that may be needed to support the national defense. These rules incorporate several key elements of the DPAS, including: mandatory acceptance of rated orders; preferential scheduling of rated orders to meet delivery requirements; and extension of priority ratings by contractors to lower-level suppliers and subcontractors.

2.2. ***Use of Title VII Authorities: Voluntary Agreements and Plans of Action***

The purpose of a voluntary agreement is to allow cooperation among business competitors to expedite or expand the supply of critical materials or services to meet national defense needs, particularly under emergency conditions. Participants in a voluntary agreement, established in accordance with section 708 of the DPA, are granted relief from antitrust laws. Before a voluntary agreement may take effect, the Attorney General is required to make a written finding that the purpose of helping provide for the national defense cannot reasonably be achieved without the voluntary agreement or with a voluntary agreement having fewer anti-competitive effects. Guidance and procedures for use of the section 708 authority are provided in 44 CFR 332, "Voluntary Agreements Under Section 708 of the Defense Production Act of 1950, as Amended."

Currently, there are two active voluntary agreements, both sponsored by the Maritime Administration in DOT: (1) the Voluntary Intermodal Sealift Agreement (VISA); and (2) the Voluntary Tanker Agreement (VTA). The purpose of the VISA is to provide DOD with assured access to commercial, dry cargo sealift capacity and intermodal equipment and systems to support emergency deployment and sustainment of U.S. military forces. The purpose of the VTA is to provide DOD with assured access to commercial tanker capacity in support of DOD contingency requirements.

2.3. ***Use of Title III Authorities***

Title III of the DPA authorizes various actions by the President to create, expand, maintain, or modernize domestic production capabilities for industrial resources and critical technology items needed for national defense purposes. Title III is focused on ensuring that the industrial base can

meet national defense needs, at any subcontractor tier. Such a focus necessitates that selected projects follow sound business models and meet the requirements for long-term economic viability after such Title III assistance has ended.

DOD is the only department with Title III funding and a program office dedicated to the use of Title III authorities. As a result, the DOD DPA Title III Program Office coordinates and executes government-wide use of Title III authorities to address industrial base shortfalls on behalf of all Federal departments and agencies engaged in procurement related to the national defense.[20] Since the 1980s, most Title III projects have been funded entirely by DOD, but other agencies have also occasionally participated. Given the interagency commitment to the industrial base assessment study groups established by the DPAC, additional federal department and agency involvement in Title III actions is expected.

The DPA requires that the President make several determinations before a Title III project is initiated. Among other things, he must determine that: (1) the project is essential for national defense; and (2) industry cannot or will not provide needed capacity in a timely manner without Title III assistance. Under EO 13603, determination authority is delegated to the head of each federal department or agency engaged in procurement for the national defense. Within DOD, this authority is further delegated to the Under Secretary of Defense for Acquisition, Technology & Logistics. Once a determination is made, the House Committee on Financial Services and the Senate Committee on Banking, Housing and Urban Affairs must be notified of such action.

Title III projects may address industrial base shortfalls in several ways. First, government purchases and purchase commitments reduce the financial risks that discourage potential producers from creating new capacity. Second, the new production capabilities stimulated by Title III incentives are generally more efficient and result in lower production costs and product prices. Third, Title III projects commonly generate information about the performance characteristics of new materials and support testing and qualification to promote the use of these materials in defense systems. It is important to note that, in the case of any DOD Title III Program expenditure, cost-sharing on the part of the private sector is required.

The Title III Program executes projects ranging from process improvement to production plant construction. Some project objectives include: expanding and sustaining production capacity; ensuring government access to technology and resources; and ensuring long-term commercial viability. While Title III projects target national defense needs, they generally result in more broad-based benefits to the U.S. economy, such as reducing foreign dependencies, increasing greater economic and technological competitiveness, and advancing American work skills. Additionally, improvements in production capabilities result in decreased production costs, lowered prices, and improved product quality.

At the end of calendar year 2012, the DPA Title III Program had 34 domestic firms under agreement/contract. No projects reached completion during the year, while four new projects were awarded; an additional project is expected to be awarded in early 2013.

[20] DOD Directive 4400.01E (October 12, 2001) delegates authority and responsibilities within DOD regarding use of the DPA authorities and designates the Secretary of the Air Force as the DOD Executive Agent for the Defense DPA III Program.

The following projects were initiated in 2012:

- Bio-Synthetic Paraffinic Kerosene (BSPK), (Sept 2012)
- SIBC CMOS FPA, (May 2012)
- SIBC Solar Cell Germanium, (Mar 2012)
- Terahertz Spectrometer (THz), (Sept 2012)
- Advanced Drop-In Biofuels Production Project (award date TBD)

Previously awarded DPA Title III projects that are ongoing involve the following:

- Advanced Carbon Nanotubes
- (Domestic) Armstrong Titanium Production
- Atomic Layer Deposition Hermetic Coatings
- ALON & Spinel Optical Ceramics
- Beryllium Supply Industrial Base
- Coal-Based Carbon Foam
- Conductive Composites
- Extremely Large Domestic Expendable and Reusable Structures (ELDERS)
- Gallium Nitride (GaN) Radar and Electronic Warfare (EW) Monolithic Microwave Integrated Circuit (MMIC) Producibility
- Gallium Nitride (GaN) X-Band Monolithic Microwave Integrated Circuits (MMICs)
- Heavy Forging Production Capacity
- High Homogeneity Optical Glass
- Integrated Advanced Composite Fiber Placement (IACFP)
- Light-Weight Ammunition & Armor
- Lithium Ion Batteries for Space (LISA)
- Low Cost Military Global Positioning Receivers (GPS) for Space
- Military Lens System Fabrication & Assembly
- Mini-Refrigerant Compressors for Man-Portable Cooling
- Non-Aerospace Titanium (NATASTP)
- Polyhedral Oligomeric Silsesquioxane (POSS) Nanotechnology
- Radiation Hardened Microprocessors
- Radiation Hardened Cryogenic Readout Integrated Circuits (ROICs)
- Small Secure Satellite Communication (SATCOM) Transceiver
- SIBC ROICs ON Semi
- SIBC Traveling Wave Tube Amplifiers (TWTAs) for Space
- Silicon Carbide Powder Production and Ceramic Armor Manufacturing
- Thermal Battery Production
- Titanium Metal Matrix Composites (TiMMCs)
- Reactive Plastic CO2 Absorbent
- Vacuum Induction Melting, Vacuum Arc Remelting (VIM-VAR) Furnace Capacity

3. DPAC Assessment Activities

To inform and support any potential recommendations to the President and Congress for the effective use of DPA authorities or amendments to improve these authorities, the DPAC has initiated a number of assessment activities.

3.1. *DPAC Industrial Capability Assessment Activities*

In accordance with a Memorandum of Agreement between DHS and DOD, the DPAC has established DOD as coordinator of Industrial Capability Study Groups to conduct assessments and develop long-term strategies for addressing the supply chain problems of various industrial sectors. Each of these study groups is chaired by a senior subject-matter expert from a civilian agency who directs the group's work, while DOD provides operational staff and funding for assessment activities. During 2011, three study groups were established to examine supply chain issues related to metal fabrication, led by the DOC; power and energy, led by the DOE; and telecommunications, led by the White House Office of Science & Technology Policy.

At a September 2011 meeting, the DPAC tasked each study group with identifying for analysis annually three to five sub-tiers that agencies consider essential to national defense. The goal of these study groups is to identify industrial base shortfalls related to unmet or potentially unmet Government needs essential to multiple Federal departments and agencies to inform recommendations for mitigation (e.g., use of DPA Title III authorities). To facilitate their work, the study groups have engaged in a number of data-gathering and analytical activities, including holding broad and specialized interagency meetings of subject matter experts and acquisition specialists, discussions with industry, market analysis, and site visits. Additionally, elements of the DOD Sector-by-Sector, Tier-by-Tier (S2T2)[21] activity are contributing to study group analyses.

The number and scope of potential DPA Title III activities is limited by current Title III funding to the highest-priority supply chain risks (e.g., in Fiscal Year 2012, funds made available through a $150 million increase for activities of DOD over the account's anticipated budget may be applied as seed monies for specific mitigation efforts). Consequently, a premium is placed on developing a ranked order of merit for identified supply chain risks. Requirements are prioritized based on interagency supported analysis of factors, such as (1) how cross-cutting is an issue within the interagency, (2) how critical are the capabilities affected, (3) how difficult is it to replace the supply chain component if it is disrupted, and (4) how fragile is the supply chain component to deviations in Government procurement. Any study group recommendations involving Title III authority are focused on short-term activities that will ensure long-term economic viability for a particular sector.

[21] S2T2 collects and analyzes industrial base data to create a DOD-wide repository held in a consistent format that gives the DOD the opportunity to systematically identify critical and fragile niches of the industrial base, to consider interdependencies between seemingly unrelated acquisition programs because their supply chains intersect at the lower tiers, and to otherwise improve decision-making as it relates to the industrial base.

3.1.1. *Metal Fabrication Study Group*

The Metal Fabrication Study Group surveyed senior acquisition officials from across the Federal Government regarding unmet agency mission-critical component needs that are limited by current domestic metal fabrication capabilities. Based on this interagency discourse and subsequent industry engagement, the Study Group identified three primary cross-cutting risk areas that are essential to the national defense: forgings, castings, and machining:

1. Much of the foundation of domestic forging was established through investments made several decades ago. Yet, the critical need for this capability has not diminished. The Study Group found that risks in the supply chain for domestically produced forged-quality parts, especially those produced by heavy forging presses, have the potential to impair capabilities of the industrial base to meet the needs of various federal agencies, including DOD, DOE, the National Aeronautics and Space Administration, and DOT. Some affected components include: aircraft wheels and landing gear, vehicle armor, steam generators, railcar components, large rotor disks for power turbines, and rocket engine parts.

2. The domestic castings industry lacks the ability to efficiently adapt processes and create tools for the low-volume demand items the U.S. Government frequently requires. Some essential systems affected include: aircraft fuselages, aircraft wing skins, gas turbine casings, submarine propellers, nuclear power components, and railroad truck frames.

3. In examining the machining industry, the Study Group found no lack of domestic machining capacity or capability. However, the cost impact of the material waste and tooling development can be significant, and virtually every critical defense system relies on machined components. Advances in machining process efficiency and the promise of near-net-shape processing prior to machining could reduce the extent of machining processes, with likely economic advantages. Additionally, advances in additive manufacturing capabilities could complement traditional machining, especially for small lot sizes, when processing expensive materials is involved or complex advanced designs challenge the inherent capability of machining.

Based on its findings, the Study Group determined that: (1) forged-quality metal components represent the highest-priority industrial base shortfall within metal fabrication due to the current risks and the pervasiveness of the capability gap; (2) it is unlikely that the private sector will be able or willing to address the issue unilaterally; and (3) economically viable solutions are lacking. The Study Group is recommending that the national defense needs in the areas of castings adaptability and machining be addressed in the near future.

3.1.2. *Telecommunications Study Group*

In support of the telecommunications infrastructure supply chain policy objective of "enhancing the viability of United States (U.S.) science, technology, and advanced manufacturing capabilities to achieve national security objectives," the National Security Staff tasked the DPAC with assessing the market viability and emerging trends of pertinent U.S. supply chains. In

response to this tasking, the DPAC established a Telecommunications Study Group, co-chaired and staffed by DOD and the White House Office of Science and Technology Policy personnel.

The DPAC Telecommunications Study Group created an analytical process to assess the capability gaps and Government needs of the sector and develop recommendations addressing U.S. Government and critical infrastructure needs and supporting U.S. competitiveness. It identified six essential equipment subsectors for assessment: (1) routing and switching equipment; (2) optical transport equipment; (3) professional services; (4) sub-components; (5) Operating System Software with a focus on Network Management Software; and (6) wireless networking equipment.

The Telecommunications Study Group's comprehensive assessment of the U.S. position in the global telecommunications equipment market found diminishing capabilities of the U.S. industrial base in key sectors of the market. The Study Group's work included a detailed analysis of extensive market data, discussions with domestic telecommunications companies and trade associations, and consideration of responses received from an official Request for Information (RFI) that closed in June 2012. Specifically, the Study Group has concluded that several factors have combined to reduce the relative position of U.S. equipment vendors. These factors include: the rapid consolidation of the global carrier market; market-impacting foreign-government policies; and low labor costs in foreign markets. As a consequence, U.S. manufacturers face increased competition from overseas vendors and reduced profit margins. While the U.S. still has internationally competitive capabilities in many of the key telecommunications equipment market sectors, a global shift in the market has left the U.S. with only one domestic firm in the top tier, a few medium-size manufacturers (annual sales exceeding $500 million), and several smaller vendors. The U.S. no longer has a wireless equipment vendor capable of producing at scale. Three primary consequences of the market's transformation include:

1. The U.S. is losing its capabilities in key equipment sectors;

2. There are fewer leading U.S. vendors for agencies and universities to partner with for research and development (R&D); and

3. The options to successfully translate domestic innovation into U.S. telecommunications equipment are increasingly limited.

The Study Group is in the process of developing recommendations for public-private partnerships and co-investment in key wireless and optical subsectors. These partnerships will likely involve coordinated activities related to applied R&D, technology demonstrations, scale-up, and facilitating government as an early adopter. Production scale-up could be implemented using DPA Title III authorities to ensure that essential Government needs can be met.

3.1.3. *Power and Energy Study Group*

For its initial assessment cycle, the Power and Energy Study Group surveyed pertinent senior acquisition officials and subject matter experts from across the Federal Government to identify cross-cutting shortfalls, risks, and concerns related to fulfillment of current and future

government requirements. Based on this survey, preliminary analysis, and follow-up interagency conversations, it was determined that the Study Group should focus on shortfalls related to (1) fuel cells; (2) lightweight materials; and (3) gallium nitride (GaN) substrates.

Fuel Cells

The U.S. Government has an essential need for adaptable and highly-efficient energy production and conversion devices. In particular, DOD has emphasized this need. The 2011 DOD Operational Energy Strategy emphasized the requirement for enhanced combat energy effectiveness that reduces the risk and cost of military missions. Specific U.S. Government systems in need of these energy advancements include auxiliary power units (APUs), silent watch tactical vehicles (limited noise and thermal signature), APUs for Class 8 trucks, unmanned ground and aerial capabilities (increased loiter time), decreased logistics fuel trains, wearable power, and stationary tactical capabilities (e.g., counter rocket/mortar systems on the edge of operating bases).

Fuel cell systems are highly efficient energy conversion devices that can extend the range of batteries, reduce the number of inefficient combustion generators, and be powered with universally available logistics fuel (such as propane or methanol) to provide effective support to many of the operational energy requirements of the U.S. Government. Widespread implementation of these devices, however, has been hindered by manufacturing inefficiencies and industrial base shortfalls. These include a lack of manufacturing automation, wasted materials, real-time quality control, and inadequate component standardization due to limited production lines.

The Power & Energy Study Group has determined that there are productized and commercialized fuel cell systems available that could help meet some of the Government's requirements listed above. Yet, uncertain demand has resulted in an inadequate incentive for the private sector to invest in scaling-up production to the levels necessary to achieve efficiencies and price points enabling commercial viability. Mitigating the technical and financial risks by addressing manufacturing shortfalls in these areas would likely increase efficiencies, reduce prices, and stabilize demand.

Based on its analysis, the Study Group issued a formal RFI on fuel cell systems (closed May 2012) to confirm its preliminary conclusions and fill identified gaps in knowledge. The Study Group is currently in the process of prioritizing potential approaches to mitigating these fuel cell manufacturing shortfalls.

Lightweight Materials

Availability of advanced lightweight materials (e.g., carbon fiber) is a cross-cutting requirement crucial to improving energy efficiency. Critical government systems affected range from vehicles and aircraft to alternative energy sources such as wind power. The Study Group's analytical team has determined, however, that development of advanced lightweight materials and expansion of their availability has been hindered by the difficulty of predicting demand. The supply uncertainty and price volatility of these materials has prevented their adoption for commercial

applications. Consequently, technical breakthroughs – such as, alternative precursors, composite forming, or material joining – may be slow to develop and insufficient to spur the level of commercialization necessary to expand the availability and affordability of advanced lightweight materials to meet government needs.

Gallium Nitride (GaN) on Silicon Carbide (SiC) Substrates

Unique government mission requirements lead to a low-demand need for power electronic systems related to transmit-and-receive modules (e.g., electronic warfare capabilities such as counter-IED (improvised explosive device) devices and active radar systems and frequency jamming) that require specialized GaN on SiC substrates. The significant capital investments necessary to develop advanced integrated circuit fabrication capabilities using GaN on SiC, however, have prevented private industry from expanding or upgrading their facilities to meet U.S. Government demand. Unless addressed, the need for these components is expected to increase at a pace greater than the industrial base's ability to produce them, and the high cost of GaN on SiC devices will limit their implementation and deployment. DOE's Office of Energy Efficiency and Renewable Energy's efforts with electric drive vehicles, solar, wind, geothermal should produce additional pressures on GaN on SiC manufacturers since the chargers, dc-dc converters, and inverters required by these systems are expected to increasingly rely on wide bandgap-based semiconductors (e.g., GaN and SiC). To address this industrial base shortfall, the Study Group is recommending that the DPA Title III Program expand its current efforts related to GaN to include GaN on SiC in order to improve industry's ability to meet government needs.

3.2. *DPAC DPA Authorities Assessment Activities*

The Study Group on Defense Production Act Issues was established by the DPAC in March 2011 to address a number of questions involving use of DPA authorities. These questions focused on:

1. Use of the DPA priorities authority: (a) by State and local governments in support of disaster preparedness and response activities; (b) by the private sector for protection or restoration of critical infrastructure operations; and (c) for critical infrastructure assistance to foreign nations;

2. Use of the DPA Title III authorities by other Federal agencies (in addition to DOD); and

3. Use of voluntary agreements (under DPA section 708) to respond to emergency requirements for critical supplies and services and barriers to such use.

The Study Group is still assessing both the adequacy of current statutory language and Executive Branch guidance with respect to these possible uses.

4. Information Sharing on DPA Issues

There are a wide variety of guidance, procedures, and activities that promote information sharing on industrial base capabilities and DPA issues among federal departments and agencies. Guidance and procedures are provided in a number of orders, directives, regulations, interagency agreements, and other guidance documents. Information is also shared on a continuing basis via government websites and meetings between representatives of the federal departments and agencies engaged in industrial base assessment activities, and DPA plans and programs.

4.1. *DPA-Related Guidance and Procedures Involving Information Sharing*

Executive Orders, beginning with EO 10161 (September 9, 1950) and continuing with EO 13603 (March 16, 2012) have provided for information sharing among federal departments and agencies for more than 60 years. EO 13603, alone, contains more than 20 separate provisions for coordination, consultation, assistance, and information sharing among federal departments and agencies on the use of DPA authorities. Both EO 13618 and EO 12656 contain numerous similar provisions, relating to emergency preparedness plans and guidance; EO 12656 in particular specifically addresses DPA authorities.

4.2. *Interagency Working Groups and Agreements*

DHS is directed by a number of Presidential orders and directives to provide coordination and guidance for DPA and other emergency preparedness plans and programs. DHS fulfills the coordination by convening periodic interagency working groups and meetings with representatives of individual agencies. For example, DHS has been coordinating an interagency working group with membership consisting of the agencies that are developing the priorities and allocations regulations discussed in section 2.1.1 of this report. DHS also convenes an interagency working group each year to share information and prepare a report to Congress on the use of DPA section 101 authority to ensure the preparedness of industry to reduce interruptions in critical infrastructure and key resource operations during emergencies.

4.3. *DOC Defense Industrial Capability and Technology Assessments*

DOC's Bureau of Industry and Security (BIS) conducts industry analyses to assess the capabilities of the U.S. industrial base to support the national defense pursuant to section 705 of the DPA and EO 12656. These studies are conducted in cooperation with experts from other Government agencies (including DOD and DHS) and the private sector. The goal is to enable Government agencies to monitor trends, benchmark industry performance, raise awareness of diminishing manufacturing capabilities, and support national resource preparedness, as appropriate.

4.4. *Offsets in Defense Trade*

DOC's BIS, in consultation with DOD, the Department of State, the Department of Labor, and the United States Trade Representative, prepares an annual report to Congress on the impact of

offsets in defense trade pursuant to Section 723 of the DPA.[22] The United States Government has established an interagency team to consult with foreign nations on limiting the adverse effects of offsets in defense procurement. The data collected by DOC's BIS are utilized in the multilateral and bilateral consultations of the team and its working group.

4.5. *DPA Websites*

Federal departments and agencies maintain a number of websites and web pages focused on DPA issues:

4.5.1. *DOD Websites*

Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy (DASD)(MIBP) – http://www.acq.osd.mil/mibp/

Under Secretary of Defense for Acquisition, Technology, & Logistics: "Defense Priorities & Allocations System (DPAS)" – http://www.acq.osd.mil/mibp/dpas.shtml

Naval Supply Systems Command: "Defense Priorities & Allocations System (DPAS)" – https://www.navsup.navy.mil/navsup/ourteam/navsup/dpas

Defense Contract Management Agency (DCMA): "Defense Priorities and Allocations System (DPAS)" – http://guidebook.dcma.mil/38/dpas.htm

Defense Acquisition University: "Defense Priorities and Allocations System Continuous Learning Module (CLC 043)" – https://learn.dau.mil

DOD/OSD: "Defense Production Act Committee" – http://www.dpacommittee.com

DOD/OSD: "Defense Production Act Title III Homepage" – http://www.dpatitle3.com

4.5.2. *DHS Websites*

FEMA, Office of Policy and Program Analysis, The Defense Production Act Program Division – http://www.fema.gov/defense-production-act-program-division

Emergency Management Institute Courses:

- IS-245.a - Introduction to the Defense Priorities and Allocations System (DPAS) – http://training.fema.gov/EMIWeb/IS/IS245a.asp
- IS-245.a - IS-246.11 - Implementing the Defense Priorities and Allocations System (DPAS) – http://training.fema.gov/EMIWeb/IS/is246.11.asp

[22] Offsets in defense trade encompass a range of industrial compensation arrangements required by foreign governments as a condition of the purchase of defense articles and services from a non-domestic source.

4.5.3. *DOC Websites*

DOC/BIS: "Defense Priorities and Allocations System (DPAS) Program" – http://www.bis.doc.gov/dpas/default.htm

DOC/BIS: "Offsets in Defense Trade" – http://www.bis.doc.gov/defenseindustrialbaseprograms/osies/offsets/default.htm

DOC/BIS: "Defense Industrial Capability and Technology Assessments" – http://www.bis.doc.gov/defenseindustrialbaseprograms/osies/defmarketresearchrpts/default.htm

Annex A

Delegation of DPA Authorities

A.1. *Summary of Executive Order 13603*

Executive Order (EO) 13603 of March 16, 2012, National Defense Resources Preparedness, supersedes EO 12919 of June 3, 1994 and sections 401(3) and (4) of EO 12656 of November 18, 1988. While largely containing the same text as these two prior EOs, the new EO updates delegations of Presidential Defense Production Act (DPA) authorities and functions to reflect amendments to the DPA since 1994. The EO is attached in Annex B.

A.2. *Delegation of DPA Authorities*

This annex provides a review of the delegations of DPA authority by the President to the heads of Federal departments and agencies. Presidential documents that delegate DPA or other emergency preparedness authority include:

- EO 13618 (July 6, 2012), “Assignment of National Security and Emergency Preparedness Communications Functions,” establishes a requirement for survivable, resilient, enduring, and effective communications, both domestic and international.

- EO 13603 (Mar. 16, 2012), "National Defense Industrial Resources Preparedness," delegates DPA authorities and addresses national defense industrial resource policies and programs under the DPA.

- Presidential Memorandum, "Designating the Chairperson of the Defense Production Act Committee," June 19, 2010.

- EO 12742 (Jan. 8, 1991), "National Security Industrial Responsiveness," as amended by EO 13286, delegates authorities with respect to the placing of orders for prompt delivery of articles or materials.

- EO 12656 (Nov. 18, 1988), "Assignment of Emergency Preparedness Responsibilities," as amended by EOs 13074, 13224, and 13286, delegates emergency preparedness responsibilities, based, in part, on DPA authorities.

A.3. *Title I Priorities and Allocations Authorities*

The President's priorities and allocations authority under section 101 of the DPA and Section 18 of the Selective Service Act of 1948 are delegated to:

(1) The Secretary of Agriculture (USDA) with respect to food resources (including potable water packaged in commercially marketable containers), food resource facilities, livestock resources, veterinary resources, plant health resources, and the domestic

distribution of farm equipment and commercial fertilizer (EO 13603); and all food resources (EO 12742, as amended);

(2) The Secretary of Energy (DOE) with respect to all forms of energy (both EO 13603 and EO 12742, as amended);

(3) The Secretary of Health and Human Services (HHS) with respect to health resources (EO 13603 only);

(4) The Secretary of Transportation (DOT) with respect to all forms of civil transportation (both EO 13603 and EO 12742, as amended);

(5) The Secretary of Defense (DOD) with respect to water resources, except potable water packaged in commercially marketable containers (EO 13603); and

(6) The Secretary of Commerce (DOC) for all other materials, services, and facilities, including construction materials (EO 13603); and all other articles and materials including construction materials (EO 12742, as amended).

The authority delegated under EO 12742, as amended, is limited to use for articles or materials for the exclusive use of the Armed Forces of the United States or for DOE atomic energy programs.

EO 13603 directs the Secretary of each agency delegated priorities and allocations authority to plan for and issue regulations to prioritize and allocate resources and establish standards and procedures by which the authority shall be used to promote the national defense, under both emergency and non-emergency conditions. Each Secretary is also directed to authorize the heads of other agencies, as appropriate, to place priority ratings on contracts and orders for materials, services, and facilities needed in support of approved programs.

EO 13603 also provides that the priorities and allocations authorities may be used only to support programs that have been determined in writing as necessary or appropriate to promote the national defense:

(1) By DOD with respect to military production and construction, military assistance to foreign nations, military use of civil transportation, stockpiles managed by DOD, space, and directly related activities;

(2) By DOE with respect to energy production and construction, distribution and use, and directly related activities; and

(3) By DHS with respect to all other national defense programs, including civil defense and continuity of government.

EO 12742 requires similar determinations (but applying a "national security" standard) by DOD regarding prompt delivery of the articles or materials for the exclusive use of the Armed Forces of the United States and DOE regarding prompt delivery of the articles or materials for DOE's atomic energy programs.

A.4. *Title III Authorities*

EO 13603 delegates authorities of the President under Sections 301, 302, and 303 of the DPA. The head of each Federal department or agency engaged in procurement for the national defense[23] is authorized to:

- Make loan guarantees (DPA section 301), direct loans (DPA section 302), purchase commitments and purchases (DPA section 303(a)), and subsidy payments (DPA section 303(c));
-
- Make provision for the development of production capabilities;
- Make provision for the increased use of emerging technologies in security program applications and to enable the rapid transition of emerging technologies;
- Procure and install equipment in industrial facilities (DPA section 303(e));
- Transfer materials acquired under section 303 of the DPA to the National Defense Stockpile, if such transfer is determined by the Secretary of Defense as the National Defense Stockpile Manager to be in the public interest (DPA section 303(f));
- Make provision for the development of substitutes for strategic and critical materials, critical components, critical technology items, and other industrial resources (DPA section 303(g));
- Make the required determinations, judgments, certifications, findings, and notifications required by the DPA with respect to use of these authorities [after appropriate consultation], with the exception of determinations made by the President under DPA section 303(a)(7)(B);
- Utilize Title III authority or any other provision of law to provide appropriate incentives to develop, maintain, modernize, restore, and expand the productive capacities of domestic sources for critical components, critical technology items, materials, and

[23] This includes the Departments of Agriculture, Commerce, Defense, Energy, Health and Human Services, Homeland Security, the Interior, Justice, State, and Transportation; the Office of the Director of National Intelligence; the Central Intelligence Agency; the General Services Administration; and the National Aeronautics and Space Administration.

industrial resources essential for the execution of the national security strategy of the United States (DPA section 107(a)); and

- Utilize the authority of Title III of the Act to guarantee the purchase or lease of advance manufacturing equipment and any related services for purposes of the DPA section 108(b).

In addition, the Secretaries of Defense and the Interior are authorized to make provision to encourage the exploration, development, and mining of critical and strategic materials and other materials (DPA section 303(a)(l)(B).

EO 13603 directs the heads of Federal departments or agencies engaged in procurement for the national defense to take appropriate action to ensure that critical components, critical technology items, essential materials, and industrial resources are available from reliable sources when needed to meet defense requirements during peacetime, graduated mobilization, and national emergency (DPA section 107(b)).

EO 13603 designates the Secretary of Defense as the Defense Production Act Fund Manager and directs the Secretary to carry out the duties specified in DPA section 304(f), in consultation with the agency heads having approved Title III projects and appropriated Title III funds.

A.5. *Title VII Authorities*

Generally, EO 13603 delegates the authorities of the President provided in Title VII of the DPA to the heads of each Federal department and agency. These authorities involve:

- Voluntary agreements and plans of action (DPA section 708);

- Employment of personnel for the purposes of the DPA, including establishment of units of the National Defense Executive Reserve (DPA sections 703 and 710);

- and

- The power of subpoena with respect to priorities and allocations, Title III authorities, and the offsets provisions.

A.6. *Preparedness Measures*

Based, in part, on DPA authorities, EO 12656, as amended, directs the head of each federal department and agency, as appropriate, to design preparedness measures to permit a rapid and effective transition from routine to emergency operations and to make effective use of the period following initial indication of a probable national security emergency. This EO assigns lead responsibilities to various departments and agencies to develop plans, procedures, and programs for national security emergencies with respect to resources within their jurisdictions. .

A.7. *Coordination and Guidance for Use of DPA Authorities*

EO 13603 provides that DHS shall: (1) serve as an advisor to the President on issues of national defense resource preparedness and the use of DPA authorities by federal departments and agencies; (2) provide for the central coordination of DPA plans and programs; (3) provide guidance to agencies assigned functions under the order, developed in consultation with such agencies, for use of DPA authorities; and (4) report to the President periodically concerning all program activities conducted pursuant to the order.

EO 12656, as amended, directs DHS to serve as an advisor to the NSC on issues of national security emergency preparedness and to assist in the implementation of national security emergency preparedness policy, by coordinating with the other federal departments and agencies and with State and local governments and by providing periodic reports to the NSC on implementation of national security emergency preparedness policy. It also directs DHS to: (1) coordinate and support the initiation, development, and implementation of national security emergency preparedness programs and plans among Federal departments and agencies; (2) coordinate the implementation of policies and programs for efficient mobilization of Federal, State, local, and private sector resources in response to national security emergencies; and (3) provide guidance to the heads of Federal departments and agencies on the appropriate use of defense production authorities, including resource claimancy, in order to improve the capability of industry and infrastructure systems to meet national security emergency needs.

Annex B

Executive Order 13603

The White House

Office of the Press Secretary

For Immediate Release March 16, 2012

Executive Order -- National Defense Resources Preparedness

EXECUTIVE ORDER

NATIONAL DEFENSE RESOURCES PREPAREDNESS

By the authority vested in me as President by the Constitution and the laws of the United States of America, including the Defense Production Act of 1950, as amended (50 U.S.C. App. 2061 *et seq*.), and section 301 of title 3, United States Code, and as Commander in Chief of the Armed Forces of the United States, it is hereby ordered as follows:

PART I - PURPOSE, POLICY, AND IMPLEMENTATION

Section 101. Purpose. This order delegates authorities and addresses national defense resource policies and programs under the Defense Production Act of 1950, as amended (the "Act").

Sec. 102. Policy. The United States must have an industrial and technological base capable of meeting national defense requirements and capable of contributing to the technological superiority of its national defense equipment in peacetime and in times of national emergency. The domestic industrial and technological base is the foundation for national defense preparedness. The authorities provided in the Act shall be used to strengthen this base and to ensure it is capable of responding to the national defense needs of the United States.

Sec. 103. General Functions. Executive departments and agencies (agencies) responsible for plans and programs relating to national defense (as defined in section 801(j) of this order), or for resources and services needed to support such plans and programs, shall:

(a) identify requirements for the full spectrum of emergencies, including essential military and civilian demand;

(b) assess on an ongoing basis the capability of the domestic industrial and technological base to satisfy requirements in peacetime and times of national emergency, specifically evaluating the

availability of the most critical resource and production sources, including subcontractors and suppliers, materials, skilled labor, and professional and technical personnel;

(c) be prepared, in the event of a potential threat to the security of the United States, to take actions necessary to ensure the availability of adequate resources and production capability, including services and critical technology, for national defense requirements;

(d) improve the efficiency and responsiveness of the domestic industrial base to support national defense requirements; and

(e) foster cooperation between the defense and commercial sectors for research and development and for acquisition of materials, services, components, and equipment to enhance industrial base efficiency and responsiveness.

Sec. 104. Implementation. (a) The National Security Council and Homeland Security Council, in conjunction with the National Economic Council, shall serve as the integrated policymaking forum for consideration and formulation of national defense resource preparedness policy and shall make recommendations to the President on the use of authorities under the Act.

(b) The Secretary of Homeland Security shall:

(1) advise the President on issues of national defense resource preparedness and on the use of the authorities and functions delegated by this order;

(2) provide for the central coordination of the plans and programs incident to authorities and functions delegated under this order, and provide guidance to agencies assigned functions under this order, developed in consultation with such agencies; and

(3) report to the President periodically concerning all program activities conducted pursuant to this order.

(c) The Defense Production Act Committee, described in section 701 of this order, shall:

(1) in a manner consistent with section 2(b) of the Act, 50 U.S.C. App. 2062(b), advise the President through the Assistant to the President and National Security Advisor, the Assistant to the President for Homeland Security and Counterterrorism, and the Assistant to the President for Economic Policy on the effective use of the authorities under the Act; and

(2) prepare and coordinate an annual report to the Congress pursuant to section 722(d) of the Act, 50 U.S.C. App. 2171(d).

(d) The Secretary of Commerce, in cooperation with the Secretary of Defense, the Secretary of Homeland Security, and other agencies, shall:

(1) analyze potential effects of national emergencies on actual production capability, taking into account the entire production system, including shortages of resources, and develop recommended preparedness measures to strengthen capabilities for production increases in national emergencies; and

(2) perform industry analyses to assess capabilities of the industrial base to support the national defense, and develop policy recommendations to improve the international competitiveness of specific domestic industries and their abilities to meet national defense program needs.

PART II - PRIORITIES AND ALLOCATIONS

Sec. 201. Priorities and Allocations Authorities. (a) The authority of the President conferred by section 101 of the Act, 50 U.S.C. App. 2071, to require acceptance and priority performance of contracts or orders (other than contracts of employment) to promote the national defense over performance of any other contracts or orders, and to allocate materials, services, and facilities as deemed necessary or appropriate to promote the national defense, is delegated to the following agency heads:

(1) the Secretary of Agriculture with respect to food resources, food resource facilities, livestock resources, veterinary resources, plant health resources, and the domestic distribution of farm equipment and commercial fertilizer;

(2) the Secretary of Energy with respect to all forms of energy;

(3) the Secretary of Health and Human Services with respect to health resources;

(4) the Secretary of Transportation with respect to all forms of civil transportation;

(5) the Secretary of Defense with respect to water resources; and

(6) the Secretary of Commerce with respect to all other materials, services, and facilities, including construction materials.

(b) The Secretary of each agency delegated authority under subsection (a) of this section (resource departments) shall plan for and issue regulations to prioritize and allocate resources and establish standards and procedures by which the authority shall be used to promote the national defense, under both emergency and non-emergency conditions. Each Secretary shall authorize the heads of other agencies, as appropriate, to place priority ratings on contracts and orders for materials, services, and facilities needed in support of programs approved under section 202 of this order.

(c) Each resource department shall act, as necessary and appropriate, upon requests for special priorities assistance, as defined by section 801(l) of this order, in a time frame consistent with the urgency of the need at hand. In situations where there are competing program requirements for limited resources, the resource department shall consult with the Secretary who made the

required determination under section 202 of this order. Such Secretary shall coordinate with and identify for the resource department which program requirements to prioritize on the basis of operational urgency. In situations involving more than one Secretary making such a required determination under section 202 of this order, the Secretaries shall coordinate with and identify for the resource department which program requirements should receive priority on the basis of operational urgency.

(d) If agreement cannot be reached between two such Secretaries, then the issue shall be referred to the President through the Assistant to the President and National Security Advisor and the Assistant to the President for Homeland Security and Counterterrorism.

(e) The Secretary of each resource department, when necessary, shall make the finding required under section 101(b) of the Act, 50 U.S.C. App. 2071(b). This finding shall be submitted for the President's approval through the Assistant to the President and National Security Advisor and the Assistant to the President for Homeland Security and Counterterrorism. Upon such approval, the Secretary of the resource department that made the finding may use the authority of section 101(a) of the Act, 50 U.S.C. App. 2071(a), to control the general distribution of any material (including applicable services) in the civilian market.

Sec. 202. Determinations. Except as provided in section 201(e) of this order, the authority delegated by section 201 of this order may be used only to support programs that have been determined in writing as necessary or appropriate to promote the national defense:

(a) by the Secretary of Defense with respect to military production and construction, military assistance to foreign nations, military use of civil transportation, stockpiles managed by the Department of Defense, space, and directly related activities;

(b) by the Secretary of Energy with respect to energy production and construction, distribution and use, and directly related activities; and

(c) by the Secretary of Homeland Security with respect to all other national defense programs, including civil defense and continuity of government.

Sec. 203. Maximizing Domestic Energy Supplies. The authorities of the President under section 101(c)(1) (2) of the Act, 50 U.S.C. App. 2071(c)(1) (2), are delegated to the Secretary of Commerce, with the exception that the authority to make findings that materials (including equipment), services, and facilities are critical and essential, as described in section 101(c)(2)(A) of the Act, 50 U.S.C. App. 2071(c)(2)(A), is delegated to the Secretary of Energy.

Sec. 204. Chemical and Biological Warfare. The authority of the President conferred by section 104(b) of the Act, 50 U.S.C. App. 2074(b), is delegated to the Secretary of Defense. This authority may not be further delegated by the Secretary.

PART III - EXPANSION OF PRODUCTIVE CAPACITY AND SUPPLY

Sec. 301. Loan Guarantees. (a) To reduce current or projected shortfalls of resources, critical technology items, or materials essential for the national defense, the head of each agency engaged in procurement for the national defense, as defined in section 801(h) of this order, is authorized pursuant to section 301 of the Act, 50 U.S.C. App. 2091, to guarantee loans by private institutions.

(b) Each guaranteeing agency is designated and authorized to: (1) act as fiscal agent in the making of its own guarantee contracts and in otherwise carrying out the purposes of section 301 of the Act; and (2) contract with any Federal Reserve Bank to assist the agency in serving as fiscal agent.

(c) Terms and conditions of guarantees under this authority shall be determined in consultation with the Secretary of the Treasury and the Director of the Office of Management and Budget (OMB). The guaranteeing agency is authorized, following such consultation, to prescribe: (1) either specifically or by maximum limits or otherwise, rates of interest, guarantee and commitment fees, and other charges which may be made in connection with such guarantee contracts; and (2) regulations governing the forms and procedures (which shall be uniform to the extent practicable) to be utilized in connection therewith.

Sec. 302. Loans. To reduce current or projected shortfalls of resources, critical technology items, or materials essential for the national defense, the head of each agency engaged in procurement for the national defense is delegated the authority of the President under section 302 of the Act, 50 U.S.C. App. 2092, to make loans thereunder. Terms and conditions of loans under this authority shall be determined in consultation with the Secretary of the Treasury and the Director of OMB.

Sec. 303. Additional Authorities. (a) To create, maintain, protect, expand, or restore domestic industrial base capabilities essential for the national defense, the head of each agency engaged in procurement for the national defense is delegated the authority of the President under section 303 of the Act, 50 U.S.C. App. 2093, to make provision for purchases of, or commitments to purchase, an industrial resource or a critical technology item for Government use or resale, and to make provision for the development of production capabilities, and for the increased use of emerging technologies in security program applications, and to enable rapid transition of emerging technologies.

(b) Materials acquired under section 303 of the Act, 50 U.S.C. App. 2093, that exceed the needs of the programs under the Act may be transferred to the National Defense Stockpile, if, in the judgment of the Secretary of Defense as the National Defense Stockpile Manager, such transfers are in the public interest.

Sec. 304. Subsidy Payments. To ensure the supply of raw or nonprocessed materials from high cost sources, or to ensure maximum production or supply in any area at stable prices of any materials in light of a temporary increase in transportation cost, the head of each agency engaged in procurement for the national defense is delegated the authority of the President under section

303(c) of the Act, 50 U.S.C. App. 2093(c), to make subsidy payments, after consultation with the Secretary of the Treasury and the Director of OMB.

Sec. 305. Determinations and Findings. (a) Pursuant to budget authority provided by an appropriations act in advance for credit assistance under section 301 or 302 of the Act, 50 U.S.C. App. 2091, 2092, and consistent with the Federal Credit Reform Act of 1990, as amended (FCRA), 2 U.S.C. 661 *et seq*., the head of each agency engaged in procurement for the national defense is delegated the authority to make the determinations set forth in sections 301(a)(2) and 302(b)(2) of the Act, in consultation with the Secretary making the required determination under section 202 of this order; provided, that such determinations shall be made after due consideration of the provisions of OMB Circular A 129 and the credit subsidy score for the relevant loan or loan guarantee as approved by OMB pursuant to FCRA.

(b) Other than any determination by the President under section 303(a)(7)(b) of the Act, the head of each agency engaged in procurement for the national defense is delegated the authority to make the required determinations, judgments, certifications, findings, and notifications defined under section 303 of the Act, 50 U.S.C. App. 2093, in consultation with the Secretary making the required determination under section 202 of this order.

Sec. 306. Strategic and Critical Materials. The Secretary of Defense, and the Secretary of the Interior in consultation with the Secretary of Defense as the National Defense Stockpile Manager, are each delegated the authority of the President under section 303(a)(1)(B) of the Act, 50 U.S.C. App. 2093(a)(1)(B), to encourage the exploration, development, and mining of strategic and critical materials and other materials.

Sec. 307. Substitutes. The head of each agency engaged in procurement for the national defense is delegated the authority of the President under section 303(g) of the Act, 50 U.S.C. App. 2093(g), to make provision for the development of substitutes for strategic and critical materials, critical components, critical technology items, and other resources to aid the national defense.

Sec. 308. Government-Owned Equipment. The head of each agency engaged in procurement for the national defense is delegated the authority of the President under section 303(e) of the Act, 50 U.S.C. App. 2093(e), to:

(a) procure and install additional equipment, facilities, processes, or improvements to plants, factories, and other industrial facilities owned by the Federal Government and to procure and install government-owned equipment in plants, factories, or other industrial facilities owned by private persons;

(b) provide for the modification or expansion of privately owned facilities, including the modification or improvement of production processes, when taking actions under sections 301, 302, or 303 of the Act, 50 U.S.C. App. 2091, 2092, 2093; and

(c) sell or otherwise transfer equipment owned by the Federal Government and installed under section 303(e) of the Act, 50 U.S.C. App. 2093(e), to the owners of such plants, factories, or other industrial facilities.

Sec. 309. Defense Production Act Fund. The Secretary of Defense is designated the Defense Production Act Fund Manager, in accordance with section 304(f) of the Act, 50 U.S.C. App. 2094(f), and shall carry out the duties specified in section 304 of the Act, in consultation with the agency heads having approved, and appropriated funds for, projects under title III of the Act.

Sec. 310. Critical Items. The head of each agency engaged in procurement for the national defense is delegated the authority of the President under section 107(b)(1) of the Act, 50 U.S.C. App. 2077(b)(1), to take appropriate action to ensure that critical components, critical technology items, essential materials, and industrial resources are available from reliable sources when needed to meet defense requirements during peacetime, graduated mobilization, and national emergency. Appropriate action may include restricting contract solicitations to reliable sources, restricting contract solicitations to domestic sources (pursuant to statutory authority), stockpiling critical components, and developing substitutes for critical components or critical technology items.

Sec. 311. Strengthening Domestic Capability. The head of each agency engaged in procurement for the national defense is delegated the authority of the President under section 107(a) of the Act, 50 U.S.C. App. 2077(a), to utilize the authority of title III of the Act or any other provision of law to provide appropriate incentives to develop, maintain, modernize, restore, and expand the productive capacities of domestic sources for critical components, critical technology items, materials, and industrial resources essential for the execution of the national security strategy of the United States.

Sec. 312. Modernization of Equipment. The head of each agency engaged in procurement for the national defense, in accordance with section 108(b) of the Act, 50 U.S.C. App. 2078(b), may utilize the authority of title III of the Act to guarantee the purchase or lease of advance manufacturing equipment, and any related services with respect to any such equipment for purposes of the Act. In considering title III projects, the head of each agency engaged in procurement for the national defense shall provide a strong preference for proposals submitted by a small business supplier or subcontractor in accordance with section 108(b)(2) of the Act, 50 U.S.C. App. 2078(b)(2).

PART IV - VOLUNTARY AGREEMENTS AND ADVISORY COMMITTEES

Sec. 401. Delegations. The authority of the President under sections 708(c) and (d) of the Act, 50 U.S.C. App. 2158(c), (d), is delegated to the heads of agencies otherwise delegated authority under this order. The status of the use of such delegations shall be furnished to the Secretary of Homeland Security.

Sec. 402. Advisory Committees. The authority of the President under section 708(d) of the Act, 50 U.S.C. App. 2158(d), and delegated in section 401 of this order (relating to establishment of advisory committees) shall be exercised only after consultation with, and in accordance with, guidelines and procedures established by the Administrator of General Services.

Sec. 403. Regulations. The Secretary of Homeland Security, after approval of the Attorney General, and after consultation by the Attorney General with the Chairman of the Federal Trade

Commission, shall promulgate rules pursuant to section 708(e) of the Act, 50 U.S.C. App. 2158(e), incorporating standards and procedures by which voluntary agreements and plans of action may be developed and carried out. Such rules may be adopted by other agencies to fulfill the rulemaking requirement of section 708(e) of the Act, 50 U.S.C. App. 2158(e).

PART V - EMPLOYMENT OF PERSONNEL

Sec. 501. National Defense Executive Reserve. (a) In accordance with section 710(e) of the Act, 50 U.S.C. App. 2160(e), there is established in the executive branch a National Defense Executive Reserve (NDER) composed of persons of recognized expertise from various segments of the private sector and from government (except full time federal employees) for training for employment in executive positions in the Federal Government in the event of a national defense emergency.

(b) The Secretary of Homeland Security shall issue necessary guidance for the NDER program, including appropriate guidance for establishment, recruitment, training, monitoring, and activation of NDER units and shall be responsible for the overall coordination of the NDER program. The authority of the President under section 710(e) of the Act, 50 U.S.C. App. 2160(e), to determine periods of national defense emergency is delegated to the Secretary of Homeland Security.

(c) The head of any agency may implement section 501(a) of this order with respect to NDER operations in such agency.

(d) The head of each agency with an NDER unit may exercise the authority under section 703 of the Act, 50 U.S.C. App. 2153, to employ civilian personnel when activating all or a part of its NDER unit. The exercise of this authority shall be subject to the provisions of sections 501(e) and (f) of this order and shall not be redelegated.

(e) The head of an agency may activate an NDER unit, in whole or in part, upon the written determination of the Secretary of Homeland Security that an emergency affecting the national defense exists and that the activation of the unit is necessary to carry out the emergency program functions of the agency.

(f) Prior to activating the NDER unit, the head of the agency shall notify, in writing, the Assistant to the President for Homeland Security and Counterterrorism of the impending activation.

Sec. 502. Consultants. The head of each agency otherwise delegated functions under this order is delegated the authority of the President under sections 710(b) and (c) of the Act, 50 U.S.C. App. 2160(b), (c), to employ persons of outstanding experience and ability without compensation and to employ experts, consultants, or organizations. The authority delegated by this section may not be redelegated.

PART VI - LABOR REQUIREMENTS

Sec. 601. Secretary of Labor. (a) The Secretary of Labor, in coordination with the Secretary of Defense and the heads of other agencies, as deemed appropriate by the Secretary of Labor, shall:

(1) collect and maintain data necessary to make a continuing appraisal of the Nation's workforce needs for purposes of national defense;

(2) upon request by the Director of Selective Service, and in coordination with the Secretary of Defense, assist the Director of Selective Service in development of policies regulating the induction and deferment of persons for duty in the armed services;

(3) upon request from the head of an agency with authority under this order, consult with that agency with respect to: (i) the effect of contemplated actions on labor demand and utilization; (ii) the relation of labor demand to materials and facilities requirements; and (iii) such other matters as will assist in making the exercise of priority and allocations functions consistent with effective utilization and distribution of labor;

(4) upon request from the head of an agency with authority under this order: (i) formulate plans, programs, and policies for meeting the labor requirements of actions to be taken for national defense purposes; and (ii) estimate training needs to help address national defense requirements and promote necessary and appropriate training programs; and

(5) develop and implement an effective labor management relations policy to support the activities and programs under this order, with the cooperation of other agencies as deemed appropriate by the Secretary of Labor, including the National Labor Relations Board, the Federal Labor Relations Authority, the National Mediation Board, and the Federal Mediation and Conciliation Service.

(b) All agencies shall cooperate with the Secretary of Labor, upon request, for the purposes of this section, to the extent permitted by law.

PART VII - DEFENSE PRODUCTION ACT COMMITTEE

Sec. 701. The Defense Production Act Committee. (a) The Defense Production Act Committee (Committee) shall be composed of the following members, in accordance with section 722(b) of the Act, 50 U.S.C. App. 2171(b):

(1) The Secretary of State;

(2) The Secretary of the Treasury;

(3) The Secretary of Defense;

(4) The Attorney General;

(5) The Secretary of the Interior;

(6) The Secretary of Agriculture;

(7) The Secretary of Commerce;

(8) The Secretary of Labor;

(9) The Secretary of Health and Human Services;

(10) The Secretary of Transportation;

(11) The Secretary of Energy;

(12) The Secretary of Homeland Security;

(13) The Director of National Intelligence;

(14) The Director of the Central Intelligence Agency;

(15) The Chair of the Council of Economic Advisers;

(16) The Administrator of the National Aeronautics and Space Administration; and

(17) The Administrator of General Services.

(b) The Director of OMB and the Director of the Office of Science and Technology Policy shall be invited to participate in all Committee meetings and activities in an advisory role. The Chairperson, as designated by the President pursuant to section 722 of the Act, 50 U.S.C. App. 2171, may invite the heads of other agencies or offices to participate in Committee meetings and activities in an advisory role, as appropriate.

Sec. 702. Offsets. The Secretary of Commerce shall prepare and submit to the Congress the annual report required by section 723 of the Act, 50 U.S.C. App. 2172, in consultation with the Secretaries of State, the Treasury, Defense, and Labor, the United States Trade Representative, the Director of National Intelligence, and the heads of other agencies as appropriate. The heads of agencies shall provide the Secretary of Commerce with such information as may be necessary for the effective performance of this function.

PART VIII - GENERAL PROVISIONS

Sec. 801. Definitions. In addition to the definitions in section 702 of the Act, 50 U.S.C. App. 2152, the following definitions apply throughout this order:

(a) "Civil transportation" includes movement of persons and property by all modes of transportation in interstate, intrastate, or foreign commerce within the United States, its

territories and possessions, and the District of Columbia, and related public storage and warehousing, ports, services, equipment and facilities, such as transportation carrier shop and repair facilities. "Civil transportation" also shall include direction, control, and coordination of civil transportation capacity regardless of ownership. "Civil transportation" shall not include transportation owned or controlled by the Department of Defense, use of petroleum and gas pipelines, and coal slurry pipelines used only to supply energy production facilities directly.

(b) "Energy" means all forms of energy including petroleum, gas (both natural and manufactured), electricity, solid fuels (including all forms of coal, coke, coal chemicals, coal liquification, and coal gasification), solar, wind, other types of renewable energy, atomic energy, and the production, conservation, use, control, and distribution (including pipelines) of all of these forms of energy.

(c) "Farm equipment" means equipment, machinery, and repair parts manufactured for use on farms in connection with the production or preparation for market use of food resources.

(d) "Fertilizer" means any product or combination of products that contain one or more of the elements nitrogen, phosphorus, and potassium for use as a plant nutrient.

(e) "Food resources" means all commodities and products, (simple, mixed, or compound), or complements to such commodities or products, that are capable of being ingested by either human beings or animals, irrespective of other uses to which such commodities or products may be put, at all stages of processing from the raw commodity to the products thereof in vendible form for human or animal consumption. "Food resources" also means potable water packaged in commercially marketable containers, all starches, sugars, vegetable and animal or marine fats and oils, seed, cotton, hemp, and flax fiber, but does not mean any such material after it loses its identity as an agricultural commodity or agricultural product.

(f) "Food resource facilities" means plants, machinery, vehicles (including on farm), and other facilities required for the production, processing, distribution, and storage (including cold storage) of food resources, and for the domestic distribution of farm equipment and fertilizer (excluding transportation thereof).

(g) "Functions" include powers, duties, authority, responsibilities, and discretion.

(h) "Head of each agency engaged in procurement for the national defense" means the heads of the Departments of State, Justice, the Interior, and Homeland Security, the Office of the Director of National Intelligence, the Central Intelligence Agency, the National Aeronautics and Space Administration, the General Services Administration, and all other agencies with authority delegated under section 201 of this order.

(i) "Health resources" means drugs, biological products, medical devices, materials, facilities, health supplies, services and equipment required to diagnose, mitigate or prevent the impairment of, improve, treat, cure, or restore the physical or mental health conditions of the population.

(j) "National defense" means programs for military and energy production or construction, military or critical infrastructure assistance to any foreign nation, homeland security, stockpiling, space, and any directly related activity. Such term includes emergency preparedness activities conducted pursuant to title VI of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5195 *et seq*., and critical infrastructure protection and restoration.

(k) "Offsets" means compensation practices required as a condition of purchase in either government to government or commercial sales of defense articles and/or defense services as defined by the Arms Export Control Act, 22 U.S.C. 2751 *et seq*., and the International Traffic in Arms Regulations, 22 C.F.R. 120.1 130.17.

(l) "Special priorities assistance" means action by resource departments to assist with expediting deliveries, placing rated orders, locating suppliers, resolving production or delivery conflicts between various rated orders, addressing problems that arise in the fulfillment of a rated order or other action authorized by a delegated agency, and determining the validity of rated orders.

(m) "Strategic and critical materials" means materials (including energy) that (1) would be needed to supply the military, industrial, and essential civilian needs of the United States during a national emergency, and (2) are not found or produced in the United States in sufficient quantities to meet such need and are vulnerable to the termination or reduction of the availability of the material.

(n) "Water resources" means all usable water, from all sources, within the jurisdiction of the United States, that can be managed, controlled, and allocated to meet emergency requirements, except "water resources" does not include usable water that qualifies as "food resources."

Sec. 802. General. (a) Except as otherwise provided in section 802(c) of this order, the authorities vested in the President by title VII of the Act, 50 U.S.C. App. 2151 *et seq*., are delegated to the head of each agency in carrying out the delegated authorities under the Act and this order, by the Secretary of Labor in carrying out part VI of this order, and by the Secretary of the Treasury in exercising the functions assigned in Executive Order 11858, as amended.

(b) The authorities that may be exercised and performed pursuant to section 802(a) of this order shall include:

> (1) the power to redelegate authorities, and to authorize the successive redelegation of authorities to agencies, officers, and employees of the Government; and
>
> (2) the power of subpoena under section 705 of the Act, 50 U.S.C. App. 2155, with respect to (i) authorities delegated in parts II, III, and section 702 of this order, and (ii) the functions assigned to the Secretary of the Treasury in Executive Order 11858, as amended, provided that the subpoena power referenced in subsections (i) and (ii) shall be utilized only after the scope and purpose of the investigation, inspection, or inquiry to which the subpoena relates have been defined either by the appropriate officer identified in section 802(a) of this order or by such other person or persons as the officer shall designate.

(c) Excluded from the authorities delegated by section 802(a) of this order are authorities delegated by parts IV and V of this order, authorities in section 721 and 722 of the Act, 50 U.S.C. App. 2170-2171, and the authority with respect to fixing compensation under section 703 of the Act, 50 U.S.C. App. 2153.

Sec. 803. Authority. (a) Executive Order 12919 of June 3, 1994, and sections 401(3)-(4) of Executive Order 12656 of November 18, 1988, are revoked. All other previously issued orders, regulations, rulings, certificates, directives, and other actions relating to any function affected by this order shall remain in effect except as they are inconsistent with this order or are subsequently amended or revoked under proper authority. Nothing in this order shall affect the validity or force of anything done under previous delegations or other assignment of authority under the Act.

(b) Nothing in this order shall affect the authorities assigned under Executive Order 11858 of May 7, 1975, as amended, except as provided in section 802 of this order.

(c) Nothing in this order shall affect the authorities assigned under Executive Order 12472 of April 3, 1984, as amended.

Sec. 804. General Provisions. (a) Nothing in this order shall be construed to impair or otherwise affect functions of the Director of OMB relating to budgetary, administrative, or legislative proposals.

(b) This order shall be implemented consistent with applicable law and subject to the availability of appropriations.

(c) This order is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person.

BARACK OBAMA

THE WHITE HOUSE,
March 16, 2012.