Annual Industrial Capabilities

Report to Congress

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1. Executive Summary

The defense industrial base is comprised of an extremely diverse set of companies that provide both products and services, directly and indirectly, to national security agencies,[1] including the military. References to "the" defense industrial base that imply a monolithic entity are not analytically useful. The defense industrial base includes companies of all shapes and sizes resourced from around the globe, from some of the world's largest public companies to sole proprietorships to garage start-ups. Some companies deal directly with the federal government, while the vast majority act as suppliers, subcontractors, and service-providers in a value chain that leads to those prime contractors.

Companies at any tier,[2] and of any size, may offer critical[3] or hard-to-make products that ultimately lead to the critical systems, or components of systems, used by our Warfighters. Likewise, companies not traditionally suppliers to the Department of Defense at various tiers may have the ability to offer highly competitive products or services that could be substituted if the specific production art used by a legacy provider were lost, thus offering the Department vital technology and process refreshment over time.

Some products and services sold by companies in the defense industrial base are unique to defense applications, while most have substantial levels of non-defense demand or are sold exclusively on commercial terms such that the supplier may not even know that the product is used in military systems. Likewise, the military may not know it depends upon a primarily commercial component. Finally, while the pace of innovation is extremely rapid in some segments across the defense industrial base, other segments are based on very mature technologies where dynamic innovation is less important to the Department.

In short, there is not a single defense industrial base. There is a defense market serviced by a diverse selection of companies that span, and often reflect, the greater global economy for goods and services.

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[1] National security agencies include the Departments of Defense (DoD), Homeland Security, Justice, and Energy, and, on occasion, select others.

[2] Subcontractors work at a variety of levels known as tiers. The prime contractor works directly with the DoD customer. The prime contractor hires first-tier subcontractors to perform work on the DoD program. The second-tier subcontractor is hired by the first-tier subcontractor to perform specific tasks. A third-tier subcontractor works with the second-tier subcontractor and so on until the part or component reaches the lowest tier (typically the raw material provider).

[3] Critical industrial capabilities are products, services, or materials in the industrial base upon which DoD programs/weapon systems depend, which are not easily replaced, and for which foreign sources may be unfavorable.

The reality of this market is that the U.S. military's superior operational capabilities are enabled by this diverse and deep base. For decades, the United States has commanded a decisive lead in the quality of defense-related research and engineering conducted globally and in the military capabilities of the products that flow from this work. However, the advantages that have enabled American preeminence in defense technology are not a birthright, and the key elements of that base that are necessary to ensure U.S. dominance on future battlefields must be sustained and nurtured. The U.S. defense industrial base – the entire industrial base, down to the fourth and fifth tiers – is critical to equipping our military with superior capabilities; and a strong, technologically vibrant, and financially successful defense industry is therefore in the national interest.

The complexity of the defense industrial base is largely a result of three overarching trends. Simply put, the base upon which the Department relies is more global, commercial, and financially complex than at any time in our Nation's history. Any industrial base policy must consider these facts in developing a much more sophisticated and nuanced view of our base than has traditionally been the case.

Overall, the goods and services the Department of Defense (DoD) relies upon reach far deeper into the overall U.S. economy than most appreciate. While there are unique items produced solely for the Department, these items themselves often rely upon a complex and integrated supply chain of product providers, which if restricted at the second, third, and even fourth tiers would jeopardize even the largest industrial players ability to support the Warfighter on an ongoing basis.

Given these overarching trends, the assessment of industrial base capabilities this year includes several cross-sector, multi-tier issues that were identified particularly at the sub-tiers, in addition to traditional sector-specific industrial base analysis. Focusing on a myopic view of the industrial base makes little sense when our supply chains are increasingly interdependent and inter-connected.

By identifying, analyzing, and understanding crosscutting, multi-sector, and multi-tier issues, the Department is able to better assess the complexities of the industrial base, as well as develop enhanced insights to better inform strategic investment decisions to benefit the Warfighters, the taxpayers, and the Nation as a whole. To complement the cross-sector, multi-tier assessments, the Department first examined each individual sector of the defense industrial base to identify potential at-risk areas that might require the Department's attention and potential mitigation. The Department also examined each sector's overall health, potential impacts from program cancellations, and any critical issues that require further monitoring. What the Department found in its analysis is that the health of the industrial base varies across sectors.

The Department has therefore begun pursuing an aggressive analytic effort to map and assess the industrial base sector-by-sector, tier-by-tier. The ongoing Sector-by-Sector, Tier-by-Tier repository of industrial base data, known as "S2T2," will

serve as a jumping-off point for future assessments by all Defense Components, ensuring data collection and analysis cumulates, thereby increasing the value of all industrial base assessment efforts. Sustaining and strengthening the data over time will contribute required insight to the Department's merger, acquisition, and divestiture reviews and other industrial base policies. The information collected will also be used to manage the Department's[4] investments more effectively to ensure a healthy industrial base for those key sectors critical to future capabilities.

As the budget environment changes, the Department expects some niche firms to face difficulty due to decreased demand. In such cases, the Department will identify early warning signs through a variety of means, to isolate and, if necessary, mitigate these issues, particularly if a firm offers truly critical, unique, and necessary capabilities. While to date, these cases have been isolated, the Department must nevertheless be prepared on occasion to tailor our investment policies to preserve essential capabilities; and we will do so when appropriate.

The Department will generally rely on normal market forces to make the most efficient adjustments to the defense industrial base. The Department will examine transactions to ensure that the Department's long term interests in a robust and competitive industrial base dominate any near term or one-time proposed savings; that potential organization conflicts of interest are avoided or carefully mitigated; and that we have full visibility into restructuring costs and the potential for continuing capital investment and R&D.

When market forces are insufficient to meet essential national defense requirements, the Department uses the tools and authorities established by the Defense Production Act (DPA) and those in the Federal Acquisition Regulations (FAR) to focus industry attention on critical technology development, accelerate technology insertion into manufacturing processes, create or expand critical production facilities, and direct production capacity towards meeting the most urgent Warfighter needs.

Assessing the defense industrial base is a monumental task. Defense acquisition investment is never evenly spread across sectors and systems, and the levels of investment required to sustain and enhance industrial base capabilities vary from niche to niche. Moreover, defense systems are extremely complex, incorporating many different components produced by lower-tier suppliers that actually connect the supply chains of seemingly unrelated programs – for example, ground vehicles and unmanned aerial systems (UASs) may rely on the same parts producers for motors or electronics. The lower-tier suppliers also connect the defense products to the commercial industrial base, helping the Department take advantage of the innovative strength of the American economy and helping the Department share the resource burden of supporting the defense industrial base with highly productive commercial markets. Recognizing the important linkages at the lower tiers better prepares the Department to invest efficiently in the critical industrial capabilities that contribute so

[4] Throughout this document, the terms "Department" or "DoD" are used in the broadest sense to include the Military Services and DoD Components and Agencies at all levels.

much to the U.S. Warfighters' edge. The Department has already identified some critical and fragile niches that require intensive monitoring, even on the heels of a decade of robust defense spending. Implementing a systematic process to identify such critical and fragile niches and to integrate that information into budgetary and programmatic decision-making is one of the Department's priority initiatives in the current era of constrained budgets.

2. Strategic Guidance

2.1 Department Recognition of the Importance of the Industrial Base

The Quadrennial Defense Review issued in February 2010 for the first time identified and discussed the critical importance of the industrial base in achieving the Nation's strategic objectives.

> In order for the Department of Defense to develop, field, and maintain high-quality equipment, it must rely on a robust and capable defense industry. Indeed, America's industrial capacity and capability made victory in World War II possible, maintained the technological edge against the Soviet Union, and today helps ensure that our military personnel in harm's way have the world's best equipment and are supported by modern logistics and information systems; thus our technological advantage must be closely monitored and nurtured.
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> Quadrennial Defense Review Report – February 2010

Understanding the growing complexity of the base upon which the Department relies, the Deputy Secretary of Defense issued guidance in March 2011 that directed the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)) to undertake a comprehensive review, now commonly referred to as the Sector-by-Sector, Tier-by-Tier (S2T2) review.

In October 2011, then Acting USD(AT&L), Mr. Frank Kendall, issued as one of his top priorities in his Memorandum to the AT&L Workforce the strengthening of the industrial base. In that directive, Mr. Kendall stated, "Industry is our partner in the defense acquisition enterprise; without the industrial base, we could not equip and support our Warfighters. A healthy industrial base means a profitable industrial base, but it also means a lean and efficient base that provides good value for the taxpayers' defense investments and that increases in productivity over time. We will execute contracts with industry that include appropriate incentives and drive fair business deals that protect the taxpayers' interest, while providing industry with reasonable profit opportunities and without putting industry at unacceptable risk. We will ensure critical skills and capabilities in the industrial base are identified and preserved."

In January 2012, President Barack Obama and Secretary of Defense Leon Panetta issued a comprehensive new strategic guidance, "Sustaining U.S. Global Leadership: Priorities for 21st Century Defense," to articulate the Department's strategic direction for the future. As part of that vision, a robust and vibrant industrial base was again singled out as a critical element of future national defense policy.

Throughout 2011, the Department's leadership has given the highest priority to elevating the role of the industrial base in its deliberative processes, which are described below. The Secretary of Defense, Deputy Secretary of Defense, and

USD(AT&L) routinely address both general and specific industrial base concerns through regular dialogue and interaction with the base.

2.2 Industrial Base Impacts in the Department's Budget Deliberations

For the past decade, the defense budget has provided a healthy infusion of resources into the defense industry. However, even at the funding peak, some critical niches in the industry, especially at tiers below the prime contractors, faced low levels of demand for their products. As the defense budget top line contracts, additional capabilities and the firms that provide them will likely become more fragile. Recognizing that risk, the Department explicitly considered the effects of program adjustments on the industrial base in the FY 2013 budget cycle. The Department created an industrial base issue team as part of the Deputy's Management Action Group (DMAG). That team identified a short list of critical and fragile niches in the industrial base and used that information, for example, to make some adjustments to smooth workflow, especially by considering the impact of spending across different programs that had a common sub-tier supplier considered at risk.

The Department will expand the effort to incorporate industrial base concerns into the budget process for the FY 2014 budget build. For the FY 2014 budget, the USD(AT&L) is creating a process to work with the Services to comprehensively identify critical and fragile industrial base niches involved in the supply chains for major defense acquisition programs. This effort will draw from data in the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy's (DASD(MIBP)) S2T2 repository, as well as from detailed knowledge in the program offices. DASD(MIBP) will analyze the portfolio of critical and fragile niches across the defense enterprise, and the results will inform DoD budget discussions.

The industry must be allowed to continue to evolve as new technologies and threats emerge, so adjustments in the proposed budget to intervene will be rare, very selective, and based on solid data. This effort will not substantially increase the amount of intervention in the industrial base or dramatically alter the budget proposals. 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

In June 2010, the Secretary of Defense launched an Efficiencies Initiative that required the Department to reduce funding devoted to unnecessary or low-priority overhead, and to transfer these funds to force structure and modernization.

As part of the Efficiencies Initiative, the USD(AT&L) directed greater efficiency and productivity in defense spending by pursuing initiatives in the following five areas:

(1) Target Affordability and Control Cost Growth
(2) Incentivize Productivity and Innovation in Industry
(3) Promote Real Competition
(4) Improve Tradecraft in Services Acquisition
(5) Reduce Non-Productive Processes and Bureaucracy

The Department remains committed to the Better Buying Power (BBP) initiative and seeks to increase greater efficiency in the acquisition process and lower the burden of non-value-added requirements on the defense industry. The Department also recognizes the importance of profit as the goal of industry and as 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.

As part of this process, the USD(AT&L) directed DASD(MIBP) to reach out to industry. Early in the BBP process, in the summer of 2010, DASD(MIBP) solicited industry comments on the efficiency of the acquisition process which fed into the 23 BBP initiatives formalized in then-Under Secretary Ashton Carter's September 14, 2010, memorandum. As a specific implementation step, Dr. Carter directed DASD(MIBP) to solicit finer-grained comments from industry on DoD regulations and procedures that encourage actions that increase non-value-added costs to industry. DASD(MIBP) executed the task by requesting data through a February 2011 posting in the *Federal Register* that attracted 75 suggestions from 27 organizations ranging from individuals and small businesses to prime contractors and industry associations. In reaction to the data provided by industry, DASD(MIBP) has worked with the appropriate agencies and components to follow up, gathering additional data as needed from the Department's sources and striving to reduce non-value-added rules and procedures that burden industry and reduce efficiency.

2.4 Realignment of Industrial Base Programs to Improve Outcomes

2.4.1 Creation of the DASD for MIBP, and transfer of Title III and MANTECH

Section 896 of the Ike Skelton National Defense Authorization Act (NDAA) for Fiscal Year 2011 directed the establishment of a Deputy Assistant Secretary of Defense (DASD) for MIBP, to be appointed by the USD(AT&L), and transferred the Department's 10 U.S.C 2521 ManTech and 50 U.S.C. DPA Title III oversight responsibilities from the Assistant Secretary of Defense for Research and Engineering (ASD(R&E)) to DASD(MIBP). In response to this congressional direction in section 896, the Department transformed OSD's longstanding Industrial Policy (IP) office into the new,

Office of the DASD(MIBP), merging on March 9, 2011, the ManTech, Title III, and Independent Research and Development (IR&D) policy functions and enabling a more holistic focus on defense manufacturing, production, and industrial base issues. This legislation directly supported MIBP's core mission to broadly assess and address the health and resiliency of the defense industrial base.

2.4.2 Transfer of DoD Lead for National Security Reviews of Foreign Acquisitions

In January 2011, then Secretary of Defense Robert M. Gates signed guidance, as part of the DoD Fiscal Year Defense Program (FYDP) budget document Resource Management Directive (RMD) 700A3, moving the DoD lead for national security reviews of foreign acquisitions of U.S. firms under the Committee on Foreign Investment in the United States (CFIUS) to USD(AT&L) from the USD for Policy (USD(P)). USD(AT&L) in turn gave the CFIUS operational lead to the DASD(MIBP). The operational lead had previously resided with the Defense Technology Security Administration (DTSA).

The increase in the complexity and sustained volume of covered transactions (see section 5.2 below) led to a reorganization of the CFIUS DoD organization now under DASD(MIBP) leadership.

The transfer of responsibilities also allows for greater interaction and cooperation of industry expertise resident throughout DASD(MIBP), including data collected as part of the S2T2 effort to better inform DoD decision making regarding mergers and acquisitions.

2.4.3 Transfer of North American Technology and Industrial Base Organization (NATIBO)

The United States and Canada have a long and positive history of cooperation on industrial issues as evidenced by Congress' inclusion of Canada in its definition of the "national technology and industrial base." The North American Technology and Industrial Base Organization (NATIBO) is one of the mechanisms for advancing this goal of an integrated defense industrial base. NATIBO provides for the formation of technology working groups, conduct of industry studies, and implementation of project arrangements to support the common goals of the United States and Canada. Oversight of activities undertaken through NATIBO was transitioned and elevated to the DASD(MIBP) by the USD(AT&L) in September 2011. This transfer will ensure greater emphasis on identifying and analyzing key industrial sectors that are critical to defense, and developing strategies to enhance and sustain the shared defense industrial base. The Department's goal, working through NATIBO, is to strengthen the integration of North American defense industrial base, increasing the organizations visibility within the Department and enhancing high-level industry and Government interaction.

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

In 2011, at the direction of the Deputy Secretary of Defense, the Department launched a new initiative focused on the defense industrial base with the objective of providing insights so as to improve the Department's acquisition strategies. The USD(AT&L), ultimately the DASD(MIBP), was tasked with its implementation. This initiative is the Sector-by-Sector, Tier-by-Tier (S2T2) assessment. This effort is not a study, but rather a comprehensive process to categorize, identify, and monitor the vast and complex base upon which our Warfighters rely, from the shoestrings on their boots to the ships they sail. This effort seeks to better understand and quantify the complexity of the defense industrial base, which encompasses tremendous variation: some defense-unique parts of the base develop brand-new, emerging technologies, while others manufacture and update very mature products; some products and services incorporated into the defense supply chain are widely available in commercial markets, while others are uniquely useful to the military; some niches have significant backlogs of work and reservoirs of capital earned in a recent production surge, while others currently operate at or below their minimum sustaining rate and are financially fragile. In some parts of the defense industry, all of the intellectual capital resides in a few key companies that interact directly with the Department and rely on build-to-print subcontractors, while in other areas the key design capability and production skills are diffused through the extensive layers of the supply chain. As described previously, there is little value in treating the defense industrial base as a monolithic entity. The S2T2 project collects data, prepares analyses, and guides the DoD investments and policy choices to recognize the complexity of the industrial base. The project will assist the Department in indentifying current and emerging sectors of the defense industrial base critical to the Nation's security.

As part of the S2T2 approach, the Deputy Secretary of Defense also directed DASD(MIBP) to serve as the Department's repository for industrial base data to encourage reuse, make it easier to see connections, reduce the cost of collection, and enhance inter-service cooperation. This designation means that in the future Military Departments and Defense Agencies and Components can begin their industrial base efforts by asking what relevant data already exists, preventing expensive, redundant collection efforts that would otherwise unnecessarily repeat the time required by industry and program offices to provide duplicate information and use the repository as a baseline for their future industrial base assessments. This role for the repository is being phased in as the Department creates the necessary institutions for sharing and protecting data and will be informed by extensive collaboration among DASD(MIBP), the Defense Contract Management Agency's Industrial Analysis Center, the Military Departments, and other Components with industrial base concerns. Even after the S2T2 repository is fully established, specific industrial base efforts across the Department will still collect supplemental data to respond to specific requirements not covered in the baseline data. Where appropriate, the supplemental data from the Military Departments and Components will then flow into the repository, expanding the breadth and depth of the baseline information available for future efforts across the

Department. This characteristic of the Department-wide repository for industrial base data (as well as the rapid changes occurring throughout the supply chain) reinforces the need to make S2T2 a continuing activity rather than a specific, time-bound study.

S2T2 data will also systematically inform DoD decision-making about industrial base investments, identifying critical and fragile niches where limited resources can be best applied for maximum impact to preserve, enhance, or modernize defense industrial capabilities. Where appropriate, investments critical to the readiness of our forces may be executed by program offices or through Department-wide authorities and accounts such as ManTech, DPA Title III, and the Industrial Base Innovation Fund (IBIF) or by using the authorities provided in the FAR. S2T2 data also supports the Department's program review and budget process and contributes required insight into potential industry transactions, which provide a systematic way for Department leadership to consider the industrial base impact of program adjustments on both prime contractors and key subcontractors. These reviews will also increase the Department's ability to maintain awareness of the changing competitive landscape of the industrial base and leverage that knowledge to drive improvements in affordability.

To efficiently influence the Department's decision-making, DASD(MIBP), in coordination with other Department components, developed a template to systematically assess key characteristics and prioritize industrial base niches. The characteristics of a critical and fragile niche are in the table below.

CHARACTERISTICS OF AN INDUSTRIALLY CRITICAL AND FRAGILE NICHE

Defense unique	No alternatives available at reasonable cost, schedule, and performance
Relevant to many platforms	Certain future demand
Uses highly skilled labor	Socio-political reliability limits non-U.S. sources
Design-intensive activity	High reconstitution cost
Suppliers' finances weak	Long lead item
Few firms in niche	Production near minimum sustaining rate
Variation in output imposes high costs	Suppliers' earnings depend on few program elements

Source: DASD(MIBP)

This is an initial screening and decisions are not rated in perpetuity. In fact, one of the strongest advantages to the S2T2 approach is the ability to evaluate critical sub-component elements of a given industrial base over time to better access the trends, which can alert for the need for early interventions.

Niches that do not rate highly on the industrial base assessment template may still be extremely important to national security. The Department's programming and budget processes consider the intersection of critical requirements and critical industrial base needs. Many systems that Warfighters identify as critical to their ability to conduct

operations and to maintain U.S. technological superiority relative to potential future adversaries are developed and produced by parts of the industrial base that are relatively easy to generate or are currently financially stable. On the other hand, some industrially critical and fragile niches are no longer important for meeting Warfighter requirements, and the Department should not be expected to support or sustain unneeded niches at the expense of those critical niches needed for the Warfighter. Simply put, the Department cannot afford to protect the entire industrial base, especially in a time of budget austerity, and the Department recognizes that an effort to protect too much would also stand in the way of innovation, which over time replaces the industrial base that supplies old technologies with dynamic, new industrial capabilities.

The initial phase of the S2T2 project, executed primarily in the latter half of 2011, developed a baseline of data across a wide swath of industry including facilities at all tiers of the supply chains for aircraft; information technology and command, control, communications, and computers, (IT/C4); contract services; ground vehicles; munitions and missiles; missile defense; shipbuilding; and space. By focusing on the industrial capabilities of specific facilities, S2T2 seeks to find the cross-program and cross-Service interdependencies in the supply chain – niches where multiple programs come together in a particular lower-tier supplier. Finding the linkages among the various sectors of the industrial base will improve the Department's ability to manage its investments on an enterprise-wide basis, reducing the disruption that program adjustments in one area might impose on seemingly unrelated programs elsewhere in the Department's portfolio.

The S2T2 initiative works through five tracks:

- Traditional industrial base analysis involving site visits and intensive interaction with industry in key niches;
- Use of recognized experts on the industrial base, who provide targeted and expert insight on specific aspects of the base by responding to a set of systematic questions developed by DASD(MIBP) leadership;
- Factory-floor perspective from the DASD(MIBP)-led Joint Defense Manufacturing Technology (ManTech) Panel, emphasizing cross-cutting manufacturing technologies in metals, composites, electronics, and the advanced manufacturing enterprise;
- Interaction with the Military Departments and DoD Components that use industrial base data to share data with the repository while preserving appropriate controls and protection on company proprietary information and the ways in which the Department should use industrial base data provided by companies; and
- An extensive survey in partnership with the Department of Commerce, using the authority granted by the DPA, to gather data on industrial capabilities across thousands of facilities, resulting in a much wider, but less interactive sample than can be developed through other tracks.

By integrating information across the five tracks, the overall S2T2 initiative gains the benefits of both broad sweep and focused, in-depth assessments. The Department does not expect to make decisions based on S2T2 data without incorporating both the due diligence of interactive research and the heightened understanding of linkages across the breadth of the industrial base that can only be achieved through wide-aperture efforts like survey research and interaction with the program office affected.

DASD(MIBP)'s sustained efforts, in close cooperation with the Military Departments, will maintain and strengthen the data over time, continuing to work through all five tracks and perhaps incorporating additional mechanisms, as appropriate. In addition to integrating data collected across the Department, DASD(MIBP) will collect more data to update the repository and to add information about additional suppliers. S2T2's periodic data collections using the same basic template (but adapted to the particular circumstances of each task, as appropriate) will offer regularly refreshed data and the possibility for trend analysis as additional data is collected over time. Moreover, both to meet the mandate of creating a central repository for industry data and to reduce the burden imposed to industry, DASD(MIBP) strives to ensure duplicative or redundant data calls to industry will be an exception as opposed to the rule. In all surveys asked of industry, DASD(MIBP) will query to see if the set of questions has been asked before, by any Department organization, to ensure we limit the time and effort required by industry to the maximum extent possible. The Department will continue to follow its Information Collection framework which fully complies with Federal guidelines to ensure these requests are designed to meet essential needs and are as infrequent as feasible. By collecting and retaining this information, in full collaboration with the Military Departments and other Components that collected it, the S2T2 effort will be further expanded and populated to the benefit of the entire Department and the taxpayer.

The S2T2 effort in CY 2012 will continue to pursue all five tracks, incorporating data from a major inter-agency project on the space industrial base and collecting additional data, especially in the area of defense electronics and the supply chain for command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems. In 2012, the Department will also develop a secure relational database to store S2T2 data that will facilitate improved mapping, visualization, and mathematical network analysis of the defense supply chain, a step beyond the informal supply chain mapping available in the first phase of S2T2. This improved capability to assess supply chain risks will eventually inform the acquisition and sustainment decisions of the Services and other Components.

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 FY 2011, as required by section 2505(b) of title 10, United States Code. Several of the crosscutting issues identified and examined as part of the Department's S2T2 assessments of the defense industrial base are highlighted separately in the blue text boxes.

4.1 Aircraft Sector Industrial Summary

The Department sits on the cusp of important decisions regarding the future of key tactical aircraft design and development capabilities. The Department's tactical aircraft Research and Development (R&D) budget is projected to decline with the end of F-35 development and an absence of new fighter requirements in the FYDP. This challenge is compounded by an aging aerospace workforce and dwindling interest from younger engineers in the aerospace domain. Consequently, critical design capabilities unique, but not limited to, tactical aircraft such as transonic/supersonic/hypersonic aerodynamics, high angle of attack, high-g structures, thrust vectoring, carrier operations, high altitude, low observables, ballistic-tolerant structures, fire detection/suppression, canopy/cockpit design and integration, egress systems, target acquisition, stores management, and weapons separation – which affect combat maneuverability, survivability, and weapons integration – face current shortages and risk atrophy or erosion. The existing capabilities are the direct result of the Department's steadfast investment in and development of unique technologies and capabilities over the past 60 years. The Department is pursuing some early design efforts to mitigate risks in this area.

While declines in manned tactical aircraft may be expected, a key area of growth is in UASs. UASs continue 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 and have resulted in demand exceeding the supply.

The UAS industrial base is large, robust, and continues to grow driven by the ever-expanding UAS demand – including not only traditional fixed-wing and vertical-lift primes, but also companies such as General Atomics, Aerovironment, Textron (acquired AAI Corporation), Raytheon (acquired Swift's UAS business via Northrop Grumman), IAI, and Elbit Systems. Greater computing power, combined with

developments in miniaturization, sensors, and artificial intelligence, will dramatically boost UAS capabilities, their ability to operate with each other, and how they interact with humans. This evolution in UASs has the potential to provide alternative solutions to meeting operational requirements in the future.

Similarly, over the past decade, the Department has relied heavily upon the vertical lift sector for critical support to ongoing conflicts with 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 is resulting in R&D engineering skill shortages in nearly all disciplines, and an inability to make needed capital investments. The Future Vertical Lift Executive Steering Group was formed to help steer the Department through this potential recapitalization problem and to allow the Department to work closer with industry (via the Vertical Lift Consortium) for the expressed purpose of enhancing communication and targeting long-term advancements in vertical lift technologies.

In terms of financial health, defense aircraft sales and profits showed a modest increase in 2011. According to the Aerospace Industries Association's 2011 Year-End Review and Forecast, sales of DoD aerospace products and services also showed modest growth in both 2010 (3.7 percent increase over 2009) and 2011 (preliminary data indicates an additional 4.2 percent increase over 2010). Additionally, companies have for the most part maintained their financial health with relatively low debt and large free cash flow.

The Department also continues to progress in its recapitalization effort with the demand for new or upgraded aircraft remaining strong. In some cases, as new aircraft programs slip or encounter problems, proven legacy aircraft production lines are being extended beyond the Department's original acquisition plans. Sustaining legacy aircraft has become progressively more expensive and time consuming for maintainers with many aircraft types operating beyond their original design life.

The Department's initial S2T2 assessment of the sub-tiers that support the aircraft sector validated a few areas of concern that the Department will continue to monitor and address as necessary. These include heavy forgings and castings, which are also discussed in the Shipbuilding (4.8) and Defense Product Act Committee (DPAC) (6.1.1) sections of this report, and high-precision bearings.

Forgings and castings are used extensively in aircraft manufacture. The limited numbers of suppliers for castings and forgings, which typically require significant lead times (often measured in years, not months) contribute to the potential for supply disruption and make them a pacing item in the manufacture of new aircraft. Castings and forgings are also highly sensitive to demand cycles and price changes in energy and raw materials.

Materials used in the aerospace industry must be durable, making forged metals common across the sub-tiers of the supply chain. Since forgings have high strength-to-

weight ratios and offer immense structural reinforcement, their properties improve the performance, range, and payload capacity of aircraft. Advances in hot-die (isothermic) forging of titanium alloys closer to the net size as discussed in section 6.1.1, have wide application for jet engine components and have shown positive results in improved quality and reduced machining and material costs. However, isothermic forge dies are more expensive and production rates are typically very low due to the need to maintain a controlled environment to permit proper die filling and avoid die corrosion. Because of the larger size and asymmetrical shapes required for airframe parts, isothermic forging has not been extensively used, so conventional forgings will continue to be a mainstay of structural product form for next-generation aircraft. As a result, suppliers of both isothermic and conventional forgings are, and will continue to be, critical to the aircraft sector.

Similarly, high-precision bearings have long been a challenge for the aerospace sector. Aging aircraft fleets, increased aftermarket/maintenance support, and additional modernization programs have all contributed toward a demand growth in this market – especially for replacement bearings. There is a limited supply base and many platforms are dependent not only upon the same product, but upon a single supplier for that product.

For instance, bearings for the AH-64, H-60, and MH-53E/K programs are all currently provided by a single source supplier. These products have long lead times that compound the potential for supply disruption. Additionally, the requirement for increasingly superior quality products due to extended lifecycles and increased load fatigue necessitates capital-intensive machinery investments and strict process controls.

HIGH PRECISION BEARINGS

The Department uses high-precision bearing products in multiple applications including fighter jets, troop transports, naval vessels, helicopters, gas turbine engines, armored vehicles, guided weaponry, and satellites. The Department requires technically-sophisticated flight- and safety-critical bearing products that will endure harsh environments (withstand extremely low or high temperatures, weightlessness, and high acceleration forces) and meet extreme performance and reliability criteria. Precision bearings must be highly accurate in terms of material quality, consistency of finish and diameter, and repeatability of tolerance levels. These strict requirements require very hard, high-alloy steel that provides the mechanical properties and resistance to corrosion that results in an extremely durable bearing. However, their hardness is also what makes them difficult to produce – the material hardness causes rapid machine wear and makes it very difficult to maintain tight tolerances. This problem is further compounded by the demand for high production volumes. Consequently, these bearings must go through rigorous tests that check internal structure for failure tendencies and measure diameters to within one-millionth of an inch.

The issues facing the high-precision bearing industry are both numerous and complex. There is a limited supply base and many platforms are dependent upon a single supplier. In addition, these products have long lead times that can impede production surge during increased operational tempos and compound the potential for supply disruption. Suppliers sometimes experience financial challenges because margins in this industry are highly sensitive to demand cycles and price changes in energy and raw materials. Additionally, the requirement for increasingly superior quality products due to extended lifecycles and increased load fatigue necessitates capital-intensive machinery investments to maintain tight tolerances and manage machine wear in a high volume industry.

These and other issues require continuous monitoring and will be achieved through the Department's S2T2 assessments and analyses.

4.2 Information Technology, Radar and Electronic Warfare, and Command, Control, Communications, and Computers, (IT/C4) Sector Summary

4.2.1 Information Technology Industrial Summary

The Information Technology (IT) sector remains generally robust with a wide variety of alternative suppliers. While DoD purchases a significant quantity of IT equipment and services from traditional defense suppliers rather than commercial suppliers, traditional commercial firms are increasingly being relied upon, especially at the lower tiers of the base. In fact, in many respects the technology and technical skills necessary for success are not substantially different from those found in the commercial world. The demands of operational environments and the heightened need for reliability when lives are at risk are two examples of design and operating considerations that may differentiate the defense market. There are also some exceptions in small, highly specialized niches of the software market that are generally being watched by individual acquisition programs.

Modeling and simulation (M&S) frequently emerges as a topic of interest and DASD(MIBP)'s assessment finds the industry to be robust and capable of meeting current and foreseeable future demands. More information concerning this subject can be found in the USD(AT&L) Report to Congress on Defense M&S Technological and Industrial Base that was submitted in response to section 1059 of the FY2010 NDAA, Public Law 111-84.

4.2.2 Radar and Electronic Warfare Sector Industrial Summary

An S2T2 in-depth, focused study on the radar industrial base finds that overall the health of the Radar and Electronic Warfare (EW) sector to be sustainable, but shallow. Some critical technologies are not easily adaptable to the commercial world. Two examples include high-power radio-frequency technology found in Active Electronically Scanned Array (AESA) devices and high power infrared technology found in some electronic countermeasure devices. While these technologies are readily demonstrated in bench-scale, low power, non-operational tests, the ability to package them on a sufficiently small scale at high power while integrating them onto operational platforms presents critical capabilities that may warrant further monitoring for potential industrial base effects.

Gallium Nitride (GaN) Monolithic Microwave Integrated Circuits (MMICs) are critical components and efforts to ensure multiple domestic sources of supply are addressed in both the DPAC (6.1.1) and Title III (6.2) sections of this report. Other

critical components such as high-temperature and low-temperature co-fired ceramics (HTCC and LTCC) also have a very limited number of qualified suppliers. Changes in both defense and commercial markets could result in some suppliers voluntarily or involuntarily exiting the market for such discrete components. At present, it appears that these markets have sufficient depth so that new HTCC and LTCC suppliers could be qualified. Qualifying new suppliers (or even buying out existing suppliers) usually results in additional costs and/or schedule delays.

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

A wide variety of vendors are 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 final end use in defense products. In essence, the C4 industrial base upon which the Department typically relies is largely global below the prime.

The largely 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 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. The Department continues to implement numerous actions identified in the Report to Congress on Trusted Defense Systems in response to section 254 of the FY 2009 NDAA, Public Law 110-417.

Because a great deal of DoD communications resides on commercial networks, commercial telecommunications network security is a military as well as a civil issue. Shifts in the telecommunications equipment market have left the United States with only one domestic firm in the top-tier and fewer tier-two vendors; the United States no longer has a wireless equipment vendor capable of producing at scale. While there are mid-tier U.S. wireless equipment vendors capable of production on a small scale for defense-specific needs, commercial wireless networks in the United States (widely used by DoD) rely on equipment from Swedish, Finnish, French, and Chinese vendors. This topic is addressed further in section 6.1.1 of this report.

4.3 Contract Services Sector Industrial Summary

The contract services sector is simply organized, comprising principally of two tiers: primes and subcontractors. Both tiers draw from a sizable professional labor pool. Prime companies that have a requirement to obtain a specialized skill set often

satisfy the requirement through one or more subcontractor arrangements. In this two-tier construct, there are usually no additional demands for a third or lower-tier provider unless they are highly specialized. Since almost every requirement has multiple, highly competitive, experienced sources of supply, the contract services sector remains generally healthy.

Improving tradecraft in services acquisition is a significant component of the Department's Better Buying Power Initiative and includes measures for additional effective management and enhanced competition. Highlights include creation of a senior manager for acquisition of services in each component and a focus on competed contracts receiving only a single bid.

In company interviews conducted as part of the S2T2 assessment, the Department found that recent Government in-sourcing has to date not presented a significant challenge to industry's ability to recruit and retain talented personnel. Additionally, the fluidity and mobility of the contract services workforce appear to contribute to healthy competition within the sector and ensure optimal cost for Department service contracts. However, this issue warrants close attention as this particular market remains quite fluid.

There are some exceptions, such as areas with an insufficient labor pool or very large endeavors such as design teams for complex weapons systems, which are discussed in greater detail in the Design Team section of this report.

4.4 Cyber Sector Industrial Summary

Because of its essential nature unique to national security, the cyber industry assessed as a separate sector from traditional IT/C4 in both this report and in the Department's continuing S2T2 assessments. The cyber sector can loosely be described as a subset of the Information and Communications Technology (ICT) industry that is specifically focused on products and services for security operations in the cyber domain. Products and services offered are for both commercial and Government use. Within the Government, the Intelligence Community (IC), DoD, and the Department of Homeland Security (DHS) typically contract cyber products and services. Excess commercial and Government demand for individuals with cyber security expertise has resulted in a barely adequate domestic cyber industry.

Adversaries in cyberspace, including individuals, criminal organizations, and both state and non-state actors, rely upon the same global commercial supply chain that U.S. Government agencies use. More specifically, end products developed and used by both the "white-hats" and the "black-hats" all leverage the same global ICT supply chain and industrial base. In interviews with cyber industry leaders, a unique U.S. "culture of innovation" was the almost universal, unsolicited response to questions about how the U.S. commercial ICT industry enables the growth of a U.S. cyber industry that is capable of ensuring a strategic advantage in cyberspace. Multiple important elements

of this "culture of innovation" were cited, such as: entrepreneurial freedom and profit opportunity, personal creativity with a willingness to leap away from the status quo, access to venture capital, and a strong legal framework including intellectual property rights.

One positive finding in DASD(MIBP)'s assessment of the cyber industry is that it is not completely necessary for the U.S. commercial ICT sector to remain *the* world's leader in size or annual revenues to maintain the Department's ability to create high-speed sensors, advanced analytics, and automated systems to ensure a strategic advantage over competitors and potential adversaries. It appears only necessary that the commercial ICT sector remain *a* world leader in this area. The reason is that most of the ICT industry is globally based, with much of the product development and manufacturing work globally performed. The global nature of the industry ensures that multiple countries are dependent on the same pool of available talent and resources, and does not give any one country a decisive advantage over another.

CYBER SECURITY

The security of defense industrial base networks (the private corporate networks of DoD contractors) is a major concern in the Department. An area of particular interest is development of a Defense Federal Acquisition Regulation Supplement (DFARS) rule mandating the adoption of particular safeguards by industry. While the rule is essential for protecting DoD information, there is some potential for costs to exceed the benefits. The number of variables and a lack of solid data make a precision cost estimate challenging. Overall, DoD contractors currently spend roughly 0.1-0.2 percent of their total DoD contract value on IT security for protection of their information systems. A new DFARS rule is estimated to add an additional 0.01-0.1 percent to that total or $40M-$400M. If businesses outsource their IT operations in order to meet the requirements of the proposed rule, the potential economies of outsourcing could actually result in an overall cost savings to the Department. The potential market for a cost transfer to external IT service suppliers from internal IT operations by the defense industrial base is estimated to be as high as $1B annually.

4.5 Ground Vehicles Sector Industrial Summary

During the last decade, the majority of vehicle suppliers have responded extremely well to increased demand in support of the wars in Iraq and Afghanistan. The U.S. Army, U.S. Marine Corps, and Joint Service ground vehicle R&D and procurement budgets for tactical and combat vehicles were $15B in FY 2009, $17B in FY 2010, and $11B in the FY 2011 President's Budget.[5] Supplemental appropriations represented almost 40 percent of this funding. The largest vehicle programs over the 3 fiscal years were Mine Resistant Ambush Protected All Terrain Vehicles (M-ATV) at $13.3B; High Mobility Multipurpose Wheeled Vehicles (HMMWV) at $6.3B; and Family of Heavy Tactical Vehicles (FHTV) at $4.2B.

[5] These figures included programmed and supplemental funding and are in then-year dollars.

In addition to new vehicle acquisitions, the Department increased its overhaul and repair of the ground vehicles fleet due to the high operating tempo and extreme operating environment in Iraq and Afghanistan. The cost was $17B to $19B annually over the past few years compared to $2.5B to $3B per year prior to the wars. Repair and overhaul are extremely important for preserving the tracked vehicle industrial capability, particularly in light of the 2009 cancellation of the Manned Ground Vehicle (MGV) portion of the Future Combat System (FCS). The forthcoming Ground Combat Vehicle (GCV) replacement program began with initial technology development contracts awarded in FY2011. The 2012 new strategic guidance anticipates reduced defense spending and a smaller, leaner, and agile military force. These considerations could alter conventional thinking of the industrial base capabilities necessary for both maintaining the legacy fleet and for developing the GCV replacement and future generations of combat vehicles.

More than one half of all military vehicle manufacturers are concentrated in the Upper Midwest[6] and the Great Lakes Region,[7] as evidenced in DASD(MIBP)'s S2T2 assessment of the ground vehicles sector. Up to 80 percent of their sub-tier suppliers are also located in this region. Most sub-tier automotive vehicle suppliers that manufacture common stock and build-to-print products serve both military and commercial vehicle customers. Based on the latest available Department of Commerce data (using the North American Industry Classification System), Motor Vehicle Parts manufacturing was a $206B industry and Heavy Duty Truck manufacturing was a $19B industry. In comparison, Military Armored Vehicles was only $11B. Given the regionalized location of the supplier base, DASD(MIBP) concluded that the economic state of the automotive industry within the Great Lakes Region might serve as a useful bellwether of the overall health of the military vehicle sector.

While declines in the military ground vehicles sector are anticipated, companies that service both the commercial and military markets are expected to fare better than military-unique companies. For example, suppliers that service the heavy truck, off-road equipment, and construction vehicles industries are better able to weather market declines because of their dual-use in the commercial market. While the military has traditionally had minimal interactions with the passenger and light truck segment of the motor vehicle industry, the supply chains for on-road commercial trucks and off-road equipment are nevertheless important to the Department, because they provide reliable, responsive, and cost-effective commercial capabilities to the military market.

Another example can be seen in power train components, engines, and transmissions used in tactical wheeled vehicles. Large commercial companies primarily manufacture these products and all of the product models used are essentially commercial products. This level of interdependence is the result of similarities in weight

[6] The Upper Midwest is a region in the northern portion of the Midwestern United States. Although there are no uniformly agreed-upon boundaries, the region is most commonly used to refer to the states of Minnesota, Wisconsin, and Michigan's Upper Peninsula. By most definitions, it extends into Iowa, North and South Dakota, northern Illinois, and eastern Nebraska.

[7] The Great Lakes region of North America includes the eight U.S. states of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin as well as the Canadian province of Ontario.

class between military wheeled vehicles and heavy truck and off-highway construction vehicles. Moreover, both commercial trucking and military tactical wheeled vehicles serve similar missions, the movement of people and materials. So, despite anticipated declines in the military procurement budget for ground vehicles, the power train industry and its associated supply chain are expected to continue to meet the Department's changing demands for tactical wheeled vehicles.

In contrast, companies whose portfolios have no commercial applicability or whose niche markets have not yet rebounded from a shrinking market will likely have to close or consolidate facilities and/or face a complete shutdown of operations. Maintaining the supplier base for combat tracked vehicles will be particularly challenging as the requirements for engines and transmissions to satisfy speed and maneuverability of these types of vehicles are much more demanding than for commercial tracked off-road equipment. In addition, combat tracked vehicles' weight and space limitations for integration inside the crew compartment are significantly different than the power train demands for commercial heavy truck and off-road equipment vehicles. S2T2 data and analysis will help to target acquisitions at critical and fragile sub-tier niches to mitigate the risks of single-points of failure that would otherwise be too costly to reconstitute later.

Almost 60 percent of the suppliers for military tracked transmissions are small businesses that are frequently single- or sole-sources. Some of these companies are build-to-print suppliers with general capabilities; others have workers with specific, rare skills, specialized capital equipment, or key roles in design and development for the next generation of technology. Sustaining the important capabilities may be challenging. Large or prime companies that possess extensive product portfolios may be able to help these smaller companies weather contractions for military unique products. The U.S. Army and DASD(MIBP) continue to monitor and engage this segment of the ground vehicle industrial base to identify at-risk capabilities, especially at lower tiers, and to mitigate the risks of losing critical industrial capabilities.

The table on the following page depicts the dramatic changes in ground vehicle funding profiles from 2009-2012. The majority of the ground vehicles budget has been for tactical vehicles and support equipment vice combat vehicles.

DoD Ground Vehicles Annual Budget

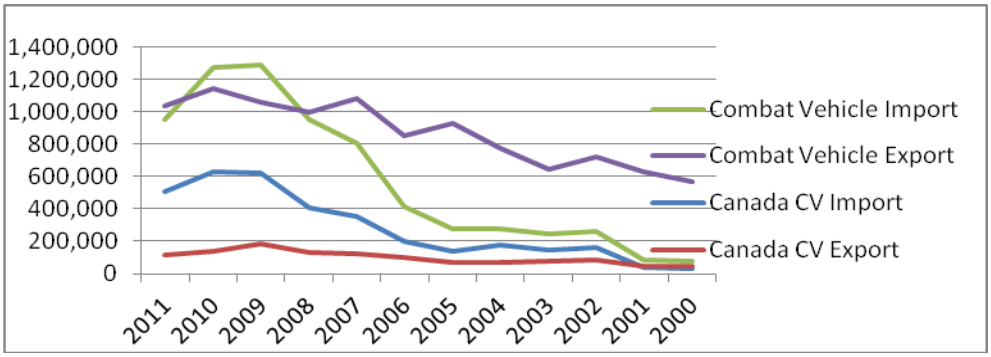
FY (Then-Year $M)	2009	2010	2011	2012
Support Equipment	900	9,400	12,100	7,859
Medium Tactical Vehicles	1,000	1,800	1,600	865
Light Tactical Vehicles	1,200	2,200	1,500	323
Heavy Tactical Vehicles	1,200	1,600	4,400	1,088
Combat Vehicles	4,900	8,800	2,600	5,218
Total Ground Vehicles	**9,200**	**23,800**	**22,200**	**15,353**

Source: OSD Comptroller

Although overall demand for military vehicles is expected to decline over the next few years, production of heavy-duty trucks in North America is expected to increase by 30 percent to approximately 330,000 vehicles.[8] This growth represents a doubling of the previous year's production of 154,200 trucks. The growth in heavy-duty trucks may offset any potential losses in military vehicle demand for companies that serve both the commercial and defense markets.

Additionally, increasing globalization of the ground vehicles supply chain may partially offset reduced domestic military demand and promote competition. The following chart is compiled from U.S. International Trade Statistics data for Military Armored Vehicles, Tanks, and Tank Components for the past 12 years. It reflects a growing trend by U.S. combat vehicle manufacturers to engage in global trade, with a pronounced increased dependency on imports, almost one half of which is attributable to imports from Canada.

U.S. and Canadian Combat Vehicle Export and Import



Source: U.S. International Trade Statistics

The globalization of the commercial truck power train industry is a principal reason why the Department was able to acquire over 1,000 MRAP vehicles per month;

[8] Projection provided by ACT Research Company.

a rate not experienced for a family of military vehicles since World War II. As of December 31, 2011, the MRAP vehicle family totaled 27,740 – of which 8,011 are MRAP M-ATVs developed for Afghanistan.

In contrast, the military-unique segments of the ground vehicles industrial base tend to be more regionally dependent, limited in sources and competition, and are therefore at risk of falling behind technologically. However, the Department can access commercial sources for tactical wheeled power trains, and other important technologies, through the global supply chain. Moreover, the Department will need to depend on globalization in order to preserve competition and access to the best technologies such as ballistic protection, high-pressure fuel rail systems, integrated power train electronic controls, and precision-machined parts like crankshafts and pistons.

The wars in Iraq and Afghanistan created a significant, albeit temporary, surge in the development and production of wheeled military vehicles and related modification programs to add advanced armor and electronic defense systems to both tactical and combat vehicles. The overhaul and reset of tracked vehicles contributed as well to the sustainment of unique manufacturing capabilities. Increased operational tempo also helped to preserve unique capabilities and develop new engineering design and manufacturing capabilities that are important for the development of next generation military vehicles.

The current environment of shrinking budgets and the relatively good state of readiness of the ground vehicle fleet necessitate a contraction of the wheeled and tracked vehicle sectors over the next few years and the probable consolidation of suppliers and unavoidable loss of some military-unique industrial capabilities. The Department will continue to monitor these potential at-risk areas through S2T2 assessments and will consider steps necessary to preserve single or sole source suppliers that may be adversely affected by declining demands in the ground vehicles sector.

4.6 Materials Sector Industrial Summary

Access to the basic materials required as inputs for producing intermediate products and components as well as finished products, including robust and diverse materials supply chains, is integral to the Nation's manufacturing base and thus to the Nation's overall economic and national security. Typically, materials supply chains rely on considerable international trade, including basic raw material inputs through intermediate and fabricated materials products. However, there are a range of actions worldwide, that serve to distort supply chains. These may include export controls that 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, such that 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.

A group of materials with numerous commercial as well as defense applications is the rare earth elements. In general, the domestic supply chain for all end-uses for these materials exists, but is thin. In particular, there is one niche for which there is no domestic production, neodymium-iron-boron magnets (neo magnets). International trade augments the domestic supply chain, but currently, China and Japan are the principal sources for these magnets, and presently, China is the ultimate source of most of the rare earth material required to manufacture the magnets in Japan. With a recent announcement by a major Japanese neo magnet producer who holds the required intellectual property rights, capabilities are increasing within the domestic supply chain for rare earth materials, including the future domestic production of neo magnets. The producer plans to construct a neo magnet facility in the U.S. with a startup planned in mid-2013. In addition, a U.S. company, in a joint venture with two Japanese companies, will produce neo magnets by early next year in Japan using non-Hitachi technology.

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 materials 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, Critical Material Criteria and Prioritization, will assess the materials 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. The Department's Strategic Materials Protection Board (SMPB) met in October 2011, at which time the Chair of the SMPB indicated the Department needed to isolate those materials for which the Department has a specific equity, and that a means of sharing this information with the NSTC Committee's working group would be beneficial.

4.7 Munitions and Missiles Sector Industrial Summary

The munitions and missile industrial sector is primarily a defense unique sector with some elements of the small diameter munitions base also serving commercial and civilian markets. The Department typically acquires munitions systems on an as-needed basis. Over several cycles, the sector has provided necessary resources to ramp up production for munitions and missile systems to support Warfighter needs when the country is engaged in conflict, and reduces production 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 critical sub-tier munitions and missile suppliers.

Within the missile sector, two prime contractors account for approximately 85 percent of the Department's munitions and missile procurement funding. Competition at the sub-tier level exists in some instances, depending on the specific missile system in development. However, many of the sub-tier suppliers service both companies, so competition at the lower tiers is limited. The two prime contractors serve on the majority of defense programs comprised of strategic, tactical, and ballistic missile defense. They are also generally able to meet defense unique technical performance requirements.

As budgets in the future are increasingly constrained, investments in munitions and missile R&D and procurement may be reduced. The munitions and missiles industrial sector faces a number of industrial capability challenges that fall into two broad categories: (1) sustaining design and engineering teams, and (2) sustaining critical suppliers in the sub-tier industrial base.

Most of the R&D funding in the munitions and missile sector is associated with legacy program upgrades or modifications that limit competitive opportunities. The Joint Air-to-Ground Missile (JAGM) is currently the only new missile development program in competition. The newest DoD strategic missile in the U.S. inventory is the Trident D5 missile that was developed in the 1980s with the Minuteman III developed even earlier in the 1960s. Both the Air Force and Navy are developing requirements for next generation missiles: Navy Offensive Anti-Surface Weapon (OASuW) and Air Force next generation Air-Launched Cruise Missile (ALCM). However, the Department remains concerned that the industrial design engineering capabilities needed for these systems may not be readily available should the sector atrophy in the absence of demand.

The shortage of new missile program development limits the Department's ability to fully exercise the industrial capabilities necessary in the missile industrial base – from design concept, system development, and production – to meet current and future national security needs. Additionally, declining munitions and missiles R&D funding, coupled with limited competitive opportunities projected in the near-term for new munitions and missile systems, will challenge the munitions industry's ability to attract and retain a qualified and experienced workforce.

The Department is also concerned with the ability of munitions and missile prime contractors to sustain critical sub-tier suppliers. Many sub-tier suppliers are single or sole source providers and some are foreign-based. The munitions and missile industrial sector is routinely affected by shifts in DoD demand because of various factors; most commonly, by the initiation of new conflicts or the cessation of conflicts. Two examples of at-risk sub-tier suppliers include:

- *Long-range Cruise Missile Propulsion*: The long-range cruise missile propulsion sector is at risk of losing its design and engineering team. The Department relies on the viability of a sole U.S. source for its long-range cruise missile propulsion technology and production. 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, coupled with the lack of future R&D technology investments, have threatened the viability of the sole U.S. source for long-range cruise missile propulsion technology. Loss of the U.S. cruise missile propulsion industrial base would adversely affect current procurement of the Department's long-range cruise missiles and its ability to support existing long-range cruise missile weapon systems. The risk is not limited to only current capability. 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 consider material solution options including cruise missiles with enhanced standoff, survivability, and responsiveness. Without sustainment of the existing cruise missile propulsion industrial base, future development of long-range strike (OASuW and ALCM) capabilities could be delayed by 5-10 years or possibly even longer. Preserving the existing national cruise 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 maintenance of 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, munitions and missile prime contractors primarily support them, because they consider this capability a core competency.

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 has identified several examples of defense unique at-risk areas: solid rocket motors, small turbine engine, thermal batteries, and fuzes, some of which 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 for 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 cancellation of Constellation have resulted in significant under-utilization of existing capacity.

- *Thermal Batteries*: All DoD Precision Guided Munitions (PGMs) use thermal batteries. Thermal batteries are predominantly defense-unique items and the

domestic thermal battery industry has historically been dominated by one supplier with little participation by other firms. Two other domestic companies that produce thermal batteries constitute less than 20 percent of the DoD thermal battery market. The dependency on a dominant supplier of thermal batteries 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 reduced the quantity of fuzes required for 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 . Site visits conducted as part of the Department's S2T2 assessments revealed that 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.

Additionally, the Department has previously identified several sub-tier supplier issues that require mitigation. Examples 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, and Javelin missile systems. The previous U.S.-based 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 of 2006 prohibits the acquisition of items listed on the USML from companies such as this producer. The Secretary of the Army signed waivers 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 first quarter 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 closed 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 SRM primes, 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. 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 first quarter of FY2013.

The Department will continue to monitor at-risk areas within the munitions and missile sector through sustained S2T2 assessments and will identify additional mitigation strategies, as warranted.

DESIGN TEAMS

The loss or reduction in design teams and specialized engineering skills is a particular Department concern that cuts across multiple defense sectors – most notably the aircraft, missile, space, Command, Control, Communications, Computers (C4) and Information Communications Technology (ICT), and munitions and missiles sectors. The demand for new design and development is at a historic low with significant skill and experience loss expected due to an aging and retiring workforce and a shortage in qualified design engineers. The loss in design expertise may jeopardize U.S. technological edge and increase the execution risks for future DoD programs. Preserving and developing unique and highly-creative talent, skills, and technology are vital to the industrial base's ability to design and produce world-class products.

Science, Technology, Engineering, and Mathematics (STEM) education is essential toward ensuring the nation maintains a workforce capable of understanding and satisfying the technical and advanced design requirements of future defense systems. After a temporary rise during the internet boom of the 1990s, enrollments in university STEM programs have reverted to previous historical levels. There is growing concern within the Department that there may be an insufficient supply of qualified graduates to meet rising defense C4/ICT and other design-unique program requirements.

The Department is addressing STEM education issues with the National Science Foundation and the President's Networking and Information Technology Research and Development Program. DASD(MIBP) is also monitoring potential design team shortages through continued S2T2 assessments.

4.8 Shipbuilding Sector Industrial Summary

The shipbuilding industrial base is generally stable although consolidations at both the prime and sub-tiers are occurring . At the prime level, shipyards and major tier-one suppliers remain in relatively good financial health. General Dynamics (GD) Marine Systems reported an increase of 2.4 percent in operating earnings and an increase of 0.8 percent in operating margins for CY11. This is largely attributable to its ramp up to two VIRGINIA Class submarines per year and technology development for the OHIO Class replacement program at GD-Electric Boat. GD-NASSCO also received contracts for two mobile landing platforms and GD-Bath Iron Works received two new contracts for DDG-1000 Class ships and one contract for a DDG-51 Class destroyer.

Similarly, Austal USA's revenue increased by 23 percent in CY11, and Marinette Marine received one new contract for the LCS 7. The company is preparing for additional growth with the anticipation of two LCS contract awards in CY12. Huntington Ingalls Industries' (HII) operating margin improved to 6.9 percent from 4.6 percent last year. HII-Newport News' operating margin grew by one percent over last year to 10.7 percent and HII-Ingalls' operating margin was up 2.6 percent from last year.

While the U.S. Navy purchased 13 ships in FY2011, the largest single year purchase since 2005, sustained single digit annual ship production rates over the past few years have resulted in an increased number of transactions and consolidations in the shipbuilding industrial base.

For example, Northrop Grumman divested its shipbuilding business in March 2011. The new company, Huntington Ingalls Industries, is continuing with Northrop Grumman's proposed plan to close its Avondale, LA Shipyard in 2013, and to consolidate remaining operations at its Pascagoula, MS shipyard. General Electric's recent decision to acquire Converteam, Inc. and Daimler AG's and Rolls-Royce's decision to acquire joint control of Germany's Tognum AG, a recognized leader in engines and propulsion systems for off-highway applications and distributed energy systems, are two further examples of industry consolidations. The acquisition of Tognum AG expands Daimler AG's and Rolls Royce's portfolio to include MTU Detroit Diesel (now known as Tognum America), a manufacturer of propulsion systems and diesel engines for ships.

Additionally, GD NASSCO acquired Metro Machine Corporation, a small naval ship repair and conversion company, in October 2011. Metro Machine previously served as a prime contractor in Norfolk, VA for repair and conversion of combatant and amphibious ships for the U.S. Navy, including frigates, dock landing ships, and amphibious transport ships. The acquisition of Metro Machine and Earl Industries by GD NASSCO reduced the total number of small contractors in the Norfolk area.

There has also been significant consolidation at the sub-tiers. 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.

Consolidations are occurring in other sub-tier areas to include manufacturers of valves and actuators designed to meet military specifications. 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 to meet U.S. Navy requirements.

As part of the S2T2 assessment of the shipbuilding industrial base, several at-risk areas were identified. First, there is no maritime large medium-speed diesel manufacturer in the U.S. Currently, the sole source provider in the U.S. builds under a license to the European Diesel Manufacturers. Next, as discussed previously in the section on the Aircraft sector, Section 4.1, the shortage in heavy castings suppliers present challenges in defense shipbuilding. In addition, there are broad deficiencies in the domestic heavy forging sector, particularly in the 14,000 to 50,000 ton range. There is only one domestic supplier of super heavy forged products with the capability to produce critical items such as propulsion shafts and nuclear reactor containment vessels for U.S. naval vessels, periscope tubes for submarines, ring forgings for bull gears, and other DoD applications. Such capabilities are critical to sustaining naval shipbuilding programs and nuclear propulsion capabilities, as well as essential aviation components. Title III authorities are being employed to upgrade and refurbish antiquated equipment and facilities at this facility, and will be further applied to upgrade and refurbish equipment at their sub-tier steel ingot supplier.

HEAVY CASTINGS & FORGINGS

The Department relies upon heavy castings and forgings for metal components made from materials such as titanium, steel, and aluminum for use in many systems, including aircraft carriers, submarines, armored vehicles, and fighter jets. These systems depend on a variety of casting and forging techniques that vary in size, from small, complex nickel-alloy aircraft engine components to 70+ feet long propulsion shafts for Navy vessels. These heavy metal products are often in complex shapes or thicknesses (e.g. 1/100 of an inch) and are fabricated with higher-grade metals than in the commercial sector due to their use in extremely harsh operating environments and demanding functionality requirements. Many systems must be able to tolerate extreme temperatures, high altitudes, high or low pressures, as well as hostile environments where explosions can cause fire and overpressure damage. These systems must also remain corrosion resistant.

The issues facing the heavy casting and heavy forging industries are due to low-volume or Department demand and the unique requirements of size, complexity, and metal used. The industrial base that supplies these items has few, if any, commercial customers, and is therefore, dependent on Department acquisitions and investments to remain profitable. Many defense weapons platforms rely on a sole supplier and must encounter long lead times due to the need for complex molds, dies, or tooling. This problem is further exacerbated by the suppliers' inability to adapt quickly to design changes. From industry's perspective, challenges exist with inconsistent DoD purchase quantities and a lack of purchase forecasting. Additionally, companies typically assume significant start-up costs, as they scale-up operations, invest in tooling, and hire trained personnel.

4.9 Space Sector Industrial Summary

The overall health of the U.S. space industrial sector remains generally sound, but is at risk due to the global recession and increased foreign competition. U.S. companies occupy seven of the top 10 rankings in a *Space News* list of the top 50 global space companies (by sales). The U.S. government outspends all other nations combined ($64.63B in 2010), establishing 74 percent of the global total for government space budgets.[9] In the area of satellite manufacturing, the U.S. produced 38 percent of the world's satellites between 2001 and 2010.[10] In 2010 alone, the U.S. captured 52 percent of this market's global revenue.[11] In addition, the U.S. generated 32 percent of the world's successful orbital launches between 2001 and 2010.[12] For 2010, the U.S. garnered 28 percent of global launch revenue.[13]

The global space economy continues a multi-year string of growth since 2007. Increasing almost $20B in activity from 2009 to a total activity of over $276B in 2010, the space industry has weathered the global recession well. The Satellite Industry Association (SIA) reports that the global satellite industry has had five years of successive revenue growth, but has decreased from a four-year run of double-digit expansion. For 2010, the global satellite industry revenue topped $168B, up only 4.5 percent from 2009. The bulk of this revenue was concentrated in satellite services (60

[9] "The Space Report 2011: The Authoritative Guide to Global Space Activity," The Space Foundation, pg 56.
[10] "Futron's 2011 Space Competitiveness Index (Executive Summary)," Futron Corporation, 2011, pg 5.
[11] "State of the Satellite Industry Report," Satellite Industry Association, June 2011.
[12] "Futron's 2011 Space Competitiveness Index (Executive Summary)," Futron Corporation, 2011, pg 5.
[13] "State of the Satellite Industry Report," Satellite Industry Association, June 2011.

percent) with the remainder in ground systems equipment (31 percent), satellite manufacturing (six percent), and launch services (three percent). Global satellite manufacturing and launch revenue decreased from 2009 to 2010 by 20 percent and four percent, respectively. Global satellite services and ground equipment revenue had growth of nine percent and three percent, respectively. All of the segments demonstrated a reduction in revenue growth since 2008, corresponding with the global economic recession.[14]

The global recession has also had an impact on employment in the space industrial sector. According to the SIA, the U.S. satellite industry continued to lose jobs (6,856 jobs in 2009), just as it had the previous year (12,219 jobs in 2008). In 2010, every segment (as defined by SIA) lost jobs except ground equipment, which grew slightly (1.3 percent). Through the fourth quarter of 2010, the U.S. space industry had approximately 243,000 personnel across all four SIA-defined segments.

Although the U.S. is the overall world leader (and spender) in the space arena, its global dominance is eroding. Foreign countries have targeted space as a strategic industry, as evidenced by the growth in national space agencies from 40 in 2000 to 55 in 2009.[15] The Futron Space Competitiveness Index (SCI)[16] shows the U.S. SCI ranking has gradually decreased (about one to two percent) each year, with a four percent total drop from 2008 to 2011. For 2010, the United States manufactured 34 spacecraft, Russia produced 26, and Europe manufactured 24. China ranked fourth, but more than doubled their 2009 production. Japan, India, Israel, and South Korea also had various numbers of spacecraft production.

As part of the S2T2 assessment of the space sector, DASD(MIBP) reviewed the financial information for a sample of 33 companies that represented a broad cross section of the industrial base to include: satellites, launch services, ground systems, satellite components and subsystems, networks, engineering services, payloads, propulsion, and electronics. While there were a few exceptions, the space sector, as a whole, appeared financially sound. All sample companies were covering cost of goods sold with positive gross margin. Net margin was positive for all but four sample companies. The average return on assets was positive for all but two sample companies; the average return on equity was positive for all but four sample companies. In terms of liquidity and long-term debt, the space industry appeared solvent on average; but approximately one-half of sample companies had less than optimal liquidity and debt ratios. Four companies emerged as having both profitability and debt challenges, which DASD(MIBP) will continue to monitor as part of the Department's S2T2 assessments, in coordination with other DoD agencies.

[14] "State of the Satellite Industry Report," Satellite Industry Association, June 2011.
[15] "Number of Nations with Space Agencies is Rising," *Space News*, 1 March 2010, Vol. 21, Issue 9, page 9.
[16] Futron's Space Competitiveness Index provides annual statistical benchmarks, analysis, and business intelligence into national space activities.

COMPOSITES

Composites are a class of materials with special characteristics that can be tailored and formulated to enhance the structural properties of whatever structure or component to which they are integrated. A major advantage of composites is a reduction in weight with high strength. Not only is the weight of the prime component or structure reduced, but any supporting structure can be reduced as well, resulting in a reduction of total system weight. This weight reduction for military equipment can translate into reduced fuel consumption, greater range, and more payload capacity. Other benefits for composites include corrosion resistance, thermal stability, and low conductivity. Composites have both defense and commercial applications. For the DoD, composites are used in a variety of weapon systems such as satellites, launch vehicles, ships, aircraft, and missiles.

From a 2010 report by JEC Composites, the global composites industry has a market volume of approximately 8 million metric tons with a value of $60 billion Euros (over $82B (U.S dollars)). This market value is distributed almost evenly across the globe: North America (36%), EMEA [Europe, Middle East, Africa] (33%), Asia & Rest of World [ROW] (31%). By volume, it is distributed less evenly: North America (35%), EMEA (22%), Asia & ROW (43%). The industry supports approximately 550,000 jobs globally through the composites value chain in eight main industry application areas. The two largest markets are the United States and China. By 2013, 51 percent of the global market volume growth is projected to be in Asia.

The aerospace industry is an important application area. The aerospace industry has the highest average price per kilogram at almost three times the next highest industry application (wind energy). The composites industry expects aerospace applications to double in volume from 2008 to 2014. Composites usage within aerospace is expected to increase 11 percent annually during this period. North America will continue to dominate the aerospace applications segment with 55 percent of the consumption (both in 2009 and projected to 2014).

No major space defense acquisition program was terminated in 2011. Fragility in the domestic space industrial base and dependence on foreign sources can be found in a separate report with controlled access.

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5. Defense Mergers and Acquisitions

Robust, credible competition is vital in providing the Department with high quality, affordable, and innovative products. The Department is mindful about the loss of peer-to-peer competition caused by significant industry consolidations over the last decade. Increasingly, the Department finds itself evaluating proposed mergers, acquisitions, and teaming arrangements that create horizontal capability overlaps, problematic vertical supply arrangements, and potential conflicts of interest. 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 continues to evaluate its options on a case-by-case basis to address additional consolidations in light of the changes in the fiscal environment. The Department is also reviewing merger policies outlined in the DoD Directive 5000.62 guidance for review procedures.

DoD reviews several kinds of business combinations involving defense suppliers: (1) proposed mergers or acquisitions filed under the Hart-Scott-Rodino Antitrust Improvement Act of 1976 (generally, transactions valued at more than $66M in 2011); (2) 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 (3) 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.

The reviews are structured to identify impacts on national security and on defense industrial capabilities; 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; and 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 2011, the Department completed 44 detailed transaction reviews out of the approximately 300 defense-related mergers and acquisitions deemed to be relevant. In one acquisition case, the Department requested the acquiring company to formally agree that the purchased company would continue to be a merchant supplier to a company that competes with the purchaser – this is limited to specific products, for specific programs, and is for a limited time. In 2011, there was a notable increase in defense firm spinoffs including Huntington Ingalls Industries from Northrop Grumman (as noted in Section 4.8 of this report); Exelis from ITT; and Engility from L-3 (pending). In all of these cases, the companies worked closely with the Department to ensure that the structure of the companies was in the long-term interests of the Department.

5.2 Committee on Foreign Investment in the United States

In Section 2.4.2 of this report, we noted that DoD transferred CFIUS lead from USD(P)/DTSA to USD(AT&L)/MIBP. Section 721 of the DPA (50 U.S.C. 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.[17] 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). Implementation of Section 721 is managed by the interagency CFIUS, chaired by the Department of the Treasury.

Under Section 721 of the Defense Production Act, CFIUS has 30 days from the time it is notified of a foreign acquisition to initiate an investigation of the transaction. Notification is voluntary, although the Committee can initiate a review on its own authority. During the first 30 days after formal notification, CFIUS members conduct a preliminary review to determine whether the transaction poses credible threats to national security, and if so, whether there are means to adequately mitigate those threats under various statutes or departmental regulations. By the 30th day, the CFIUS must either approve the transaction, with or without risk mitigation measures, or initiate an additional 45-day investigation. There are no other options under the law; however, in some cases, the Committee may allow companies to withdraw their notice and refile. Once the CFIUS completes an investigation, it can impose mitigation on its own authority, if deemed necessary and negotiations with the parties do not achieve the same result. When an investigation is completed, cases may go to the President of the United States if the Committee recommends a termination or suspension of the transaction, or if the CFIUS is deadlocked, or for some other reason the Committee deems necessary.

Section 721 requires appointment of a lead member agency for review of each case, mandatory 45-day investigation for cases involving critical infrastructure or foreign government control (unless waivers are signed by certain senior officials of Treasury and the lead agency), certifications by senior officials of Treasury and the lead agency or agencies that no unresolved national security issues exist, extensive annual reports to Congress, as well as authority for CFIUS to reopen a closed CFIUS case under certain highly unusual conditions.

DoD is a member of the Committee. 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. The Department's guidance for processing CFIUS cases is in DoD Instruction 2000.25. In assessing foreign acquisitions, the Department's principal objectives are to: (1) protect the reliability and integrity of the supply of goods and services to the Department; (2) minimize the risks of unauthorized transfer of classified information and unclassified but

[17] Excepting the International Emergency Economic Powers Act.

export-controlled or sensitive military and dual-use technologies and information; and (3) eliminate any national security risk arising from co-location of the accorded assets and sensitive defense facilities. Simultaneously, the Department supports foreign direct investment in the U.S., including the defense sector, and believes such activity to be generally beneficial to the U.S. economy and the nation's defense over all. Foreign-owned firms located in the U.S. employ U.S. citizens, pay U.S. taxes, are subject to U.S. law, and increasingly make up a vital portion of our vital industrial base. With the appropriate security mitigation in place and regularly monitored, these transactions have provided our base with advance technologies, needed capital infusions, and greater competition.

The 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 of the acquiring firm and country that evaluates many risk factors.

Given the statutory constraints on public disclosure of case-specific CFIUS information and the lead role that the Treasury Department as CFIUS Chair has 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 Chair of the Committee.

6. Programs and Actions to Sustain Capabilities

6.1 The Defense Production Act (DPA)

The Department of Defense's primary approach to establishing and sustaining the defense technology and industrial base is to leverage its coordinated research, development, and acquisition processes and decisions to create a competitive environment that incentivizes industry to invest in technology development and make sound production capacity and facilitation decisions. When market forces are insufficient to meet essential national defense requirements, however, the Department may use the tools and authorities established by DPA (50 U.S.C. App. Section 2061 *et seq.*) to focus industry attention on critical technology development, accelerate technology insertion into manufacturing processes, create or expand critical production facilities, and direct production capacity towards meeting the most urgent Warfighter needs.

6.1.1 The Defense Production Act Committee (DPAC)

The DPAC, established in 2009 as part of the reauthorization of the DPA (Section 722), supports a whole-of-government approach to manufacturing production policy. The DPAC is comprised of the heads of federal government agencies with procurement authority and the Chairperson of the Council of Economic Advisors. The primary purpose of the DPAC is to advise the President on the effective use of DPA authorities. The DPAC accomplishes its mandate by: (1) conducting assessments of the U.S. industrial base to identify systemic risks within supply-chains that are essential to national defense and that would impact multiple Departments' missions; (2) conducting assessments of DPA authorities; and (3) providing recommendations for appropriate mitigation of discovered supply chain risks and recommendations for improving the authorities created by the DPA. To effectively accomplish these requirements, the DPAC regularly coordinates and exchanges information with the DASD(MIBP)'s DPA Title III Program Office and the DASD(MIBP)'s S2T2 assessments team.

On September 20, 2011, on behalf of the DPAC Chair, the Deputy Secretary of Defense convened 19 fellow DPAC Principals to formalize an organizational structure using study groups to advance the work of the DPAC and to greatly improve interagency DPA information sharing and collaboration. Initially, three Industrial Capability Study Groups were established to conduct assessments and to develop long-term strategies addressing the supply chains of specific industry sectors. A senior subject matter expert from a civilian agency serves as Chair and directs the work of each study group, while DASD(MIBP) provides operational staff and funding.

To date, study groups have been established to examine three critical areas: metal fabrication, led by the Department of Commerce (DoC); power and energy, led by the Department of Energy (DoE); and telecommunications, led by the White House

Office of Science and Technology. The DPAC Principals tasked each study group with identifying three to five sub-tiers, which agencies consider essential to national defense for analysis to be conducted annually. The DASD(MIBP) DPA Title III Program Office and analysts supporting DASD(MIBP) assessments routinely attend DPAC study group meetings to exchange information regarding unmet national defense requirements, results of supply chain analysis, and to coordinate mitigation recommendations using DPA Title III or other government authorities.

Metal Fabrication Study Group

For its initial assessment, 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 interagency discussions and subsequent industry engagements, the Study Group identified three primary crosscutting risk areas that are essential to national defense: castings, forgings, and machining.

(1) Forging: Much of the foundation for domestic forging was established several decades ago. Furthermore, the need for this capability has not diminished. The Study Group found that an inadequate supply of domestically-produced forged-quality parts, particularly those produced by mid- and heavy-sized forging plants, has the potential to impair capabilities of the industrial base to meet the needs of several agencies, including the DoD, DoE, NASA, the Department of Transportation (DoT), and others. As discussed in Sections 4.1, 4.8 and 4.9 of this report, many sectors of the defense industrial base have components affected by this issue such as aircraft wheels and landing gear, vehicle armor, steam generators, large rotor disks for power turbines, and rocket engine parts.

(2) Castings: As previously discussed in both the Aircraft (4.1) and Ship (4.8) industrial base sectors, the domestic castings industry lacks the ability to efficiently adapt processes and create tools for low-volume demand items that the Department frequently requires. Some essential systems affected include complex parts for advanced aircraft turbine engine components, airfoils, gas turbine casings, nuclear power components, and railroad truck frames.

(3) Machining: Based on its analysis, the study group did not find a shortage of domestic machining capacity or capability. However, the cost impact of material waste and tooling development can be significant with virtually every critical defense system relying on machined components. Advances in machining process efficiency – and the promise of near net-shape processing prior to machining as discussed in section 4.1 – will reduce the use of machining processes with likely economic advantages. Additionally, advances in additive manufacturing capabilities may complement traditional machining, particularly for small lot sizes, when processing expensive materials or when complex advanced designs challenge the inherent capability of machining.

The study group determined that forged-quality metal components represent the highest priority industrial base shortfall within metal fabrication due to the current capability gap, the likelihood that industry may not be able or willing to address the issue unilaterally, and the lack of economically viable solutions. The study group also notes, however, that there are specific identified needs in the area of castings that should be further examined and supported as future DPA funding becomes available.

Finally, in coordination with the two other DPAC study groups, the Metal Fabrication study group has recommended that the government focus its attention on the potential for additive manufacturing to revolutionize the mass customization of various metal parts as well as polymer-based, and direct-write electronic components. If production capabilities in this area successfully scale-up, this technology will enable parts fabrication as soon as the 3D digital description of the part is created, thus establishing a new market for on-demand, mass customization manufacturing. The need for tooling and material waste is minimized, and the supply chain is drastically compressed. In addition, novel components and structures can be produced from additive manufacturing processes that cannot be cost effectively produced from conventional processes. In sum, advancements in additive manufacturing have the potential to transform the manner in which products are created, and substantially reduce both the cost and lead-time associated with many specialized low-volume essential government requirements.

Power and Energy Study Group

The study group surveyed senior acquisition officials from across the federal government and determined that it should focus on shortfalls related to: fuel cells, lightweight materials, and gallium nitride on silicon carbide. In addition to the joint DPAC study groups' recommendations on additive manufacturing included in the Metal Fabrication Study Group section, the Power and Energy Study Group work has so far revealed the following:

(1) 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 government. The U.S. Government has an essential need for adaptable and highly efficient energy production and conversion devices. The *2011 Department of Defense Operational Energy Strategy* emphasized the requirement for enhanced combat energy effectiveness that reduces the risk and cost of military missions. Specific 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).

Manufacturing inefficiencies and industrial base shortfalls have hindered widespread implementation of these devices. 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 determined that, largely due to uncertainty in demand, industry is not adequately incentivized to respond to these issues. Mitigating the technical and financial risks by addressing manufacturing shortfalls in these areas would likely increase efficiencies, reduce costs, and stabilize demand. The study group is currently in the process of prioritizing potential solutions to mitigate these fuel cell manufacturing shortfalls.

(2) Lightweight Materials: Availability of advanced lightweight materials (e.g., carbon fiber) is a crosscutting requirement vital to improving energy efficiency. Critical government systems that are affected range from automotive and aircraft to enabling effective alternative energy sources such as wind power. The Study Group determined that development of advanced lightweight materials has been hampered by difficulties in forecasting demand. Moreover, supply uncertainty and price volatility for materials have prevented the commercial sector from joining in the manufacturing of these materials. As a result, technical breakthroughs, such as alternative precursors, composite forming, or material joining, may be difficult to develop and insufficient to spur the level of commercialization needed to expand the availability and affordability of advanced lightweight materials.

The study group is working with DPAC member agencies to develop solutions for addressing this industrial base shortfall. Due to the breadth of scope and application for lightweight materials, at the next DPAC Principals meeting (expected to occur in the summer of 2012) members will be presented with a proposal to create a new study group entirely dedicated to the topic. DPAC staff has received commitments from DoE and the Army to serve as co-chairs for the proposed lightweight materials study group.

(3) Gallium Nitride (GaN) on Silicon Carbide (SiC): Unique government missions result in a low-demand need for power electronic systems related to transmit-and-receive modules (e.g. electronic warfare capabilities, such as counter-IED devices and active radar systems, and frequency jamming) that require specialized GaN on SiC substrates. As noted in Section 4.2.2 of this report, GaN MMICs are critical components in the electronic warfare industrial base. Significant capital investments are needed to develop advanced integrated circuit fabrication capabilities that use GaN on SiC, and they have prevented industry from expanding or upgrading their facilities to meet government demand. Requirements for these components are likely to increase at a pace greater than industry's ability to produce these parts.

Indeed, collaboration with the Navy's Program Executive Officer for Integrated Warfare Systems is expected to address some of these requirements through DPA Title

III. The DPAC is currently attempting to identify appropriate resource requirements; the issue will be presented at the next DPAC Principals meeting.

To address this production challenge, the Study Group recommends the DPA Title III program expand its current efforts on GaN analysis to include GaN on SiC to address industry's ability to meet government demands.

Telecommunications Study Group

Consolidation of the global carrier market has forced communications equipment vendors to follow suit. Large equipment vendors have generally become one-stop shops with global and diverse product portfolios integrated with lifecycle Original Equipment Manufacturers (OEM) support services. Companies that do not offer a full suite of products are unable to sell to large carriers. As a result, fewer vendors are able to compete in the telecommunications market.

In order to address the changing dynamics of the communications equipment market, the Telecommunications Study Group determined that a market examination approach would be optimal and focused its analysis on five key areas: routing and switching equipment, optical transport equipment, sub-components with an emphasis on application-specific integrated circuits (ASICs), wireless, and operating system software (OSS) with a focus on network management software (NMS).

Based on their analysis, the study group identified several crosscutting industrial base shortfalls and challenges to include: 100 gigabit and faster data transmission capabilities, carbon-nanotube fiber, photonic switching and routing, field-programmable gate arrays (FPGAs), shared fabrication facilities, and deployable fifth and sixth generation wireless capabilities. The Telecommunications Study Group is in the process of prioritizing these issues for possible mitigation, and has issued a RFI to solicit information from industry that will help supplement and confirm the study group's analysis. Finally, the study group supports the joint DPAC study groups' recommendation that additive manufacturing be the focus of the NNMI pilot institute, which is included in the Metal Fabrication Study Group, section 6.1.1, of this report.

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

Title I of the DPA 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 12919 and Executive Order 13603, which superceded Executive Order 12919 on March 16, 2012, delegate these authorities to various federal departments and agencies.

The Secretary of Commerce has authority to manage industrial resources. To implement its authority, the DoC administers the DPAS. The DoC has further delegated authority to the DoD under the DPAS to: (1) apply priority ratings to contracts and

orders supporting national defense programs; (2) request the DoC provide SPA to resolve conflicts for industrial resources among both rated and unrated (i.e., non-defense) contracts and orders; and (3) 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.

In some cases, DASD(MIBP) may convene and chair a Priority Allocation of Industrial Resources (PAIR) task force to resolve quickly 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 multiple defense requirements create competing demands on the same industrial resources. DASD(MIBP) works closely with the Joint Staff, Combatant Commanders, Military Departments, Civilian Departments, and allied foreign nations to ensure effective prioritization of materials, and to expedite delivery of urgently needed materials and services.

For example, DASD(MIBP) engaged with the U.S. Navy and a defense contractor on behalf of a coalition partner to expedite the repair and redeployment of several marine environmental control systems. An investigation was completed to determine the contractor's ability to deliver these systems to the foreign government quickly without unacceptable disruption of competing Navy system repairs. Direct and open communication and cooperation between all parties concluded with the relief of industry constraints and enabled the prioritization of delivery requirements using DPAS priority rating authority. This process resulted in a mutually acceptable accommodation that preserved both the Navy's and allies' fleet deployment schedules.

DPAS SPECIAL PRIORITIES ASSISTANCE CASES – Oct 2010- Dec 2011			
Date(s)	**Item**	**Assistance for**	**Summary**
11/10	Ordnance	Air Force	Accelerated production and fielding of new weapon to accommodate operational requirement
12/10 and 4/11	Counter Improvised Explosive Devices	Coalition Partner	Provided rating authority and accelerated receipt of devices to meet troop deployment date
2/11	Ordinance Guidance Controls	Coalition Partner	Provided rating authority and accelerated receipt of devices to address security treat
6/11	Satellite Systems	National Oceanic and Atmospheric Administration	Provided rating authority to protect delivery schedule and support national civil emergency preparedness
9/11	Overseas Installation Protection	State Department	Provided rating authority to ensure timely installation of facility security improvements
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./CAN memorandum of agreement

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.[18] 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, executes and manages the portfolio of projects on behalf of the Secretary of the Air Force. During CY11, the Title III Program had 40 projects underway, six of which were in the acquisition phase to select domestic firms. Title III successfully completed six projects during the year, 27 projects were continuing at the end of the year, and an additional seven projects are to be awarded in early 2012. At the end of 2011, 29 domestic firms are under agreement/contract with an additional 9 or 10 to be added in early 2012. The highlights of these DPA Title III successes, along with brief descriptions of the remaining active Title III projects, can be found in Appendix C.

Funding for individual Title III initiatives is provided by the sponsoring Defense Component in the form of a transfer of budget authority for the estimated cost of the project from the Component to the DPA Title III Fund. Projects are developed in response to specific government requirements and associated funding as provided for these efforts.

When identifying potential projects, the Title III program leverages the work of the DPAC, S2T2 industrial base assessments, and other tools to better understand the health and vitality of the domestic industrial base in sectors that are important to national defense. Reviews of DASD(MIBP)'s limited S2T2 assessments of the defense industrial base and of DPAC study groups' analyses are helping to 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, it is predicted that DPA Title III programs will initiate within the next 12-months in the areas of heavy forging, fuel cell systems, power electronics, 'trusted' information, and communications technology production. It is also expected that projects related to lightweight materials and additive manufacturing will be initiated, thereafter.

Additionally, planning has been initiated for a project to ensure the advanced drop-in biofuels industrial base is sufficient to meet the Department's goals for alternative fuel in aviation platforms.

6.2 DoD Manufacturing Technology Program

For over 50 years, the DoD Manufacturing Technology (ManTech) Program, 10 U.S.C. Section 2521, 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

[18] The DPA Title III Program Office does not currently utilize the loans or loan guarantees authority provided under the law.

provides the crucial links from technology invention to production of defense-critical needs in areas beyond normal investment risks within industry. As noted in Section 2.3, ManTech ensures technology is affordable and producible, which are key to the Department's BBP initiative and 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.

Such success is evidenced in ManTech work benefitting the Joint Strike Fighter Program. Indeed, four projects undertaken in collaboration with OSD by the Navy and Air Force ManTech programs totaling only $14.5 million are projected to reduce F-35 program costs by $1.1 billion over 30 years of production. These investments, which supported production advances for aircraft door edge seals, wing skin fiber placement, radar improvements, and thermal protection for F135 engine nozzles, will lead to industry standards to reduce costs and bolster capabilities affecting various current and future defense programs, aside from the F-35. The Joint Strike Fighter program office has acknowledged these important achievements stressing how its partnership with ManTech "has helped produce a series of affordable and producible technologies that have yielded significant savings for both F-35 production and sustainment."[19] Appendix C.2 describes other prominent ManTech contributions.

The ManTech program is a fundamental tool in advancing the manufacturing and industrial base priorities of DASD(MIBP). As a new core mission of DASD(MIBP), ManTech is to sustain an environment that ensures the manufacturing and industrial base on which the Department of Defense depends is technologically vibrant, maintains superior capabilities, and is financially fit. ManTech supports this mission by monitoring the industrial base for innovation opportunities or weakness in the supply chain, and delivering process technology solutions that enable transition of Department R&D investments into the defense industrial base. ManTech collaborates with the DPAC by supplying analysis of production capabilities required for critical national security needs. DPAC priorities are often addressed through a combination of ManTech and DPA Title III investments. ManTech first develops and prototypes the required process technologies and then Title III authorities are used to facilitate implementation through infrastructure investments within the U.S. industrial base. ManTech is both a consumer and contributor to ongoing S2T2 assessments.

The ManTech program has a unique perspective of the defense industrial base, particularly at the second, third, and fourth tiers of the supply chains. Before developing investment requirements, ManTech first analyzes suppliers' current capabilities and viability, along with prospective alternatives. ManTech's emphasis on enhancing cross-cutting industrial base capabilities and productivity provides insight into dependency of particular suppliers among various programs, as well as areas of limited

[19] Venlet, VADM David J. Program Executive Officer, Joint Strike Fighter Program. Letter of Appreciation for Manufacturing. December 15, 2001.
http://www.acq.osd.mil/mibp/docs/JSF_ManTech_letter_from_Adm_Venlet.pdf

competition. Highlighted in Section 3 of this report is the fifth track of S2T2, which entails supply chain information provided by the ManTech program. Additionally, analysis of the S2T2 repository of collected data will contribute to ManTech program plans through identification of emerging gaps in manufacturing technology or production capability.

The Manufacturing Technology Program is found in title 10 United States Code (U.S.C.) Section 2521:

> *[T]o 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.*

The program's mission broadly encompasses the defense industrial base and is vital to the current efficiency initiatives of the DoD; 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 the U.S. defense industrial base that provides defense systems and services to the Warfighter.

Section 139c of title 10, U.S.C. directs that DASD(MIBP) have the responsibility for executing the authorities of the ManTech Program, as provided in Section 2521. Additionally, policy guidance contained in DoD Directive 4200.15, "Manufacturing Technology Program," requires the ODS ManTech manager to:

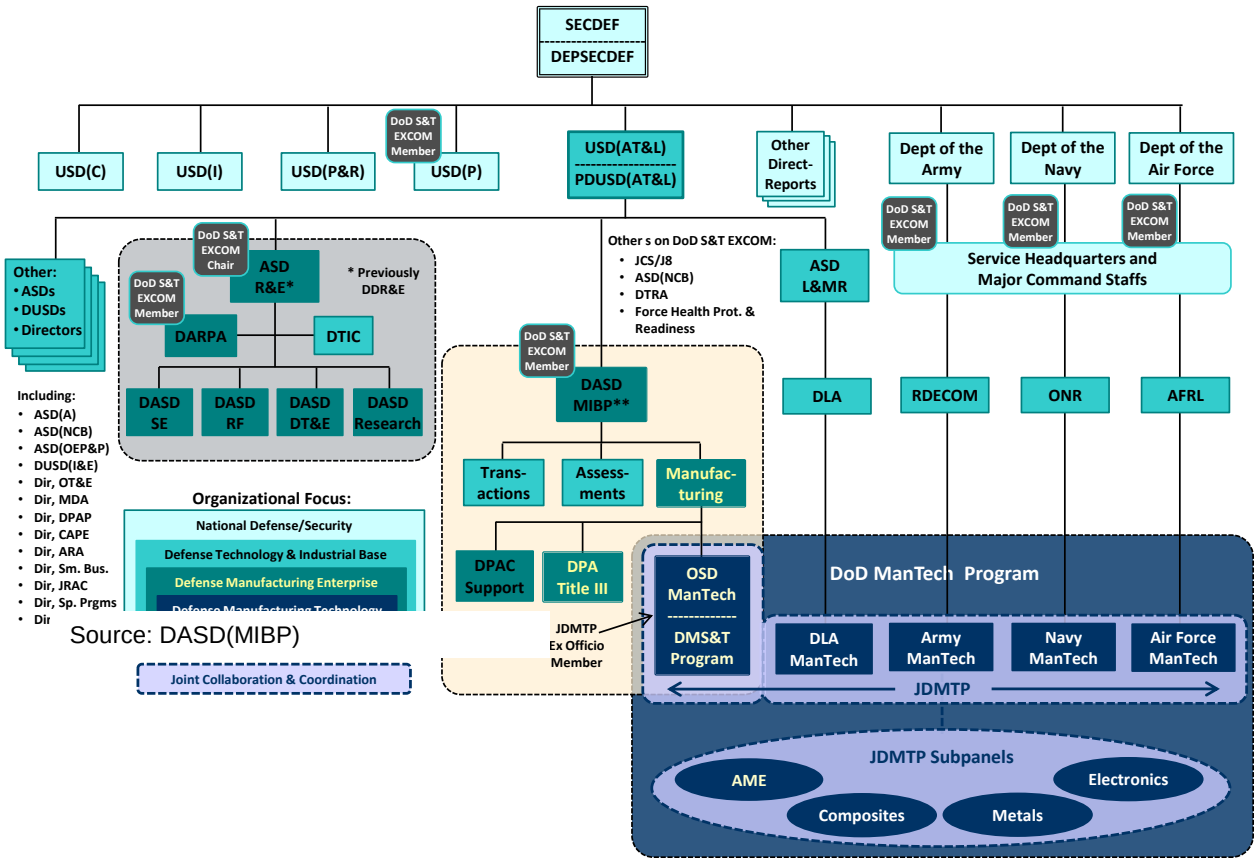
(1) Provide centralized guidance and direction for the ManTech Program within the DoD and ensure that it is executed in accordance with set directives.

(2) Develop and maintain a joint planning process and use that process in preparing centralized program guidance.

(3) Ensure coordination between the ManTech Program and industrial preparedness and similar manufacturing programs of DoD, other Departments and Agencies, and the private sector.

To ensure that investments are sufficiently distributed across the spectrum of Warfighter needs, a ManTech division with an associated Program Element (PE) is located within each of the Military Departments (Army, Navy, Air Force), as well as DLA, with OSD oversight. There is an additional PE entitled "Defense-Wide Manufacturing Science and Technology" (DMS&T) located within OSD that funds crosscutting initiatives.

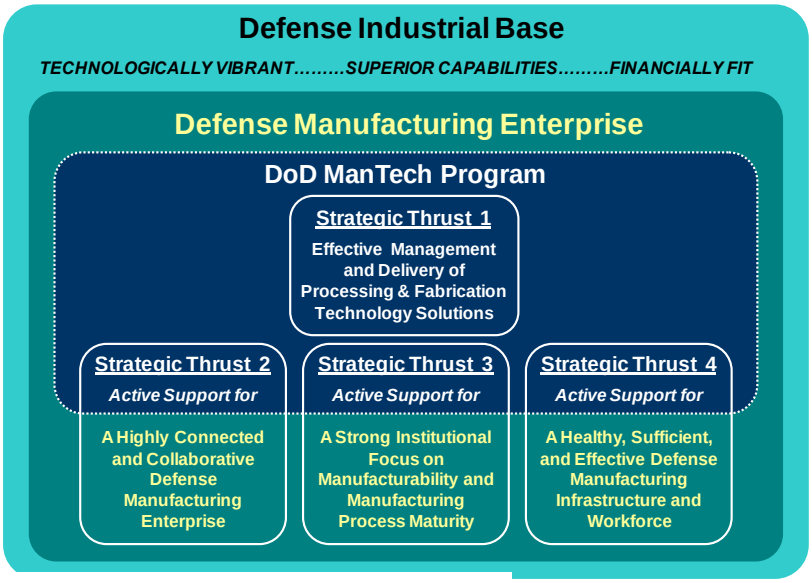
In essence, the DoD ManTech Program consists of a federation of DoD component-managed R&D investment portfolios in each of the Military Departments and participating agencies, with OSD responsible for policy and program oversight (diagram below). This federated structure reflects the twin objectives for the ManTech program in each of the Military Departments: 1) deliver solutions to component-specific manufacturing priorities and 2) collaborate on multi-component solutions to broader, defense-wide challenges. Multi-component projects are developed and co-funded when priorities overlap. Additionally, the subpanel structure ensures that the entirety of the investment portfolio for all component ManTech programs is reviewed each year to eliminate duplication and to ensure the highest leverage of research and development results. OSD has two roles within the ManTech governance structure: as the owner of a funded ManTech Program Element, and as the oversight executive for the program. These dual roles are depicted in the figure below, which shows the OSD organizational leadership extending from DASD(MIBP), through the Manufacturing Directorate, to the OSD ManTech office, and finally ending in the DMS&T Program. Section 139c of title



Source: DASD(MIBP)

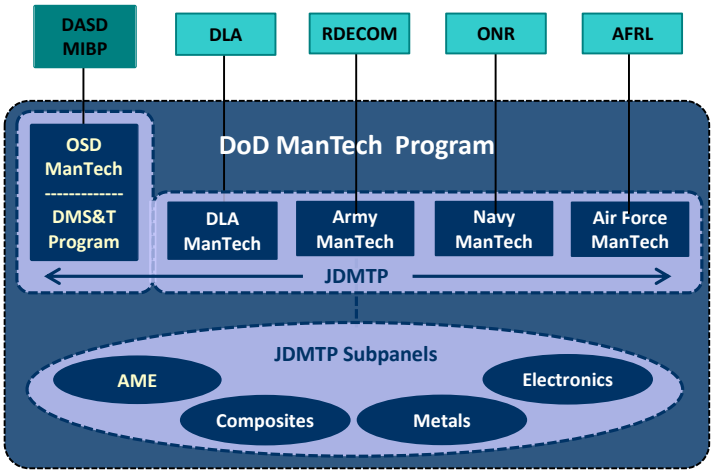
10 U.S.C. directs that DASD(MIBP) have the responsibility for executing the authorities of the Manufacturing Technology Program as provided in Section 2521. Within DASD(MIBP), there is a Manufacturing Directorate, which has responsibility for ManTech, Title III Authorities of the Defense Production Act, and Executive Secretariat roles for the Defense Production Act Committee (DPAC). The OSD ManTech Director reports to the Director of Manufacturing and manages the dual roles of oversight and DMS&T program execution.

The DoD ManTech program directly supports the initiatives encompassed in Better Buying Power: Target Affordability and Control Cost Growth. In keeping with its role to address needs in the larger context of defense manufacturing, ManTech has developed a strategy that balances its traditional emphasis on processing and fabrication technology solutions with active support for broader defense manufacturing needs. The theme of the DoD ManTech Program is *Delivering Defense Affordability*, and its four strategic thrusts focus ManTech community investments on this theme. Strategic Thrust 1 positions the core mission of ManTech as managing and delivering processing and fabrication solutions as predominantly within ManTech's span of control, recognizing that ManTech is the only DoD program that has this as its primary mission. Thrusts 2, 3, and 4 commit active support for enterprise level solutions, manufacturability and process maturity, and manufacturing infrastructure and workforce, respectively, and recognize it is beyond the program's charter and resources to fully satisfy these thrusts.



Source: DASD(MIBP)

Coordination among each of the Military Department ManTech programs is recognized by all as essential to achieving broader outcomes. This critical need for cross-Service leverage and technical portfolio management prompted the creation of a coordination body known as the Joint Defense Manufacturing Technology Panel (JDMTP). In accordance with 10 U.S.C. Section 2521(e), the mission of the Panel is to: (1) identify and integrate requirements for the program, (2) conduct joint planning for the program, and (3) develop joint strategies for the program. This organization recognizes two tiers of required coordination (reflected in the following diagram): a "principal" panel comprised of a senior technology manager from each military department or agency with a ManTech Program, overseeing a series of technical "subpanels," each associated with specific technology sectors. The subpanels provide for joint-Service primary membership, industry ex-officio members, and technical taxonomy for each sector (presently Metals, Composites, Electronics, and Advanced Manufacturing Enterprise).



Source: DASD(MIBP) – Joint Defense Manufacturing Technology Panel

The JDMTP principals typically conference monthly to guide the panel's strategic mission and high-level investment topics, while the entire panel meets semi-annually to monitor the execution of ManTech initiatives and provide status updates for working group activities. The technical subpanels meet quarterly to develop multi-service investment topics, assess the technical portfolio, and plan technical coordination activities. The subpanels are responsible for developing investment roadmaps for high priority defense requirements, by identifying projects with application across the Military Departments. Each Subpanel publishes a list of investment priorities by technical taxonomy area (see figure below). To facilitate this process, and to provide support for peer review and technology transfer, the JDMTP has developed a structured annual review of the ManTech portfolio of projects, divided by technical topic area and conducted by the subpanels and selected subject matter experts and users.

JDMTP Subpanel Investment Priorities

- **Electronics Subpanel**
  - RF Devices
  - Power and Energy
  - Infra-red and Electro-Optics
  - Nanotechnology
  - Sensors
  - Packaging
- **Composites Subpanel**
  - Light Weight Structures
  - Marine Structures
  - High-temperature Structures:
  - Specialty Structures
  - Rapid Manufacturing
- **Metals Subpanel**
  - Advanced Materials
  - Advanced/Intelligent machining
  - Additive Manufacturing
  - Joining
  - Casting and forgings
- **AME Subpanel**
  - Net-Centric Manufacturing Networks
  - Model Based Enterprise, the Digital Thread
  - Intelligent Manufacturing Planning and Execution
  - Industrial Base Infrastructure and Readiness

Source: DASD(MIBP)

6.3 Other Programs and Actions to Sustain Industrial Capabilities

In 2011, the Department acquired and/or maintained facilities, equipment, or components, or took other actions needed to meet projected and actual military contingency requirements.

- Defense Logistics Agency (DLA) currently has contracts in place that guarantee immediate availability of up to $363M in medical materiel for surge and sustainment. This coverage increases to a total of $800M, over a six-month period, if fully executed in accordance with the Statement of Work. 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 $800M 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.

- DLA invested $10.9M for FY2012 for an Industrial Base Maintenance Contract (IBMC) to Meridian Medical Technologies (MMT) to retain a capability to satisfy the Services' wartime surge and sustainment requirements for Nerve Agent Antidote Autoinjectors (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 Services' wartime requirements for NAAA. An industrial base assessment study of the IBMC was conducted during 2007. The study concluded that IBMC is vital and should be funded.

- The long-term contract with the Warstopper investment in lead-time materials expired in August 2011. Prior to the contract expiring, a pre-defined exit strategy was used, and the contractor was directed to convert the $6.1M of pre-positioned materials to finished AM-2 pallets and ship to DLA facilities to ensure full recovery of the industrial investment. The vendor also reimbursed the Government $262,388 for the buyback of 1,400 extra end frames. Once capability assessment plans are reviewed, industrial specialists will determine if the follow-on contract will require an industrial capability investment to ensure production can be surged to meet wartime demand.

- Significant requirements for Meals Ready-to-Eat (MREs) have continued in Southwest Asia, as well as in support of natural disasters such as earthquakes and hurricanes within the continental United States. Additionally, industrial specialists continuously monitor the MRE vendors and have noted that the

production capacity of the current commercial industrial base is more than capable of handling the added surge. The addition of several pieces of government furnished equipment at vendor facilities has further increased the surge production capacity within industry. This equipment is earmarked for use with the family of Polytray rations but can also be utilized with MREs.

- The need to assure that the industrial base is able to provide sufficient quantities of combat rations when demand is higher than normal (surge) led to the establishment of a DLA Manufacturing Technology program for combat rations. The Combat Rations Network for Technology (CORANET) was developed in response to previous industrial capability assessments. These assessments indicated both a need and an opportunity to implement newer, more advanced processes and methods into current Operational Ration manufacturing plants.

  The CORANET program is a key enabler to transitioning technology. It has resulted in ultrasonic sealing technology, horizontal forming, filling, and sealing technology, and non-destructive seal testing protocols that have reduced defects, 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.

- DLA completed the Joint Service Lightweight Integrated Suit Technology (JSLIST) Filter Fabric Industrial Capability Minimum Sustainment Rate Assessment in August 2010. Customer requirements have steadily declined for the last several years. Requirements for FY2011 have declined below the estimated minimum sustaining rate, which threatens the viability of this industry. OSD requested a validation of the filter fabric production minimum sustainment rate in the FY2010 Resource Management Decision. 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, which is scheduled for FY2012, is necessary to mitigate future industrial base shortfalls if the vendor is forced to reduce its capacity or terminate production completely. The IBMC will maintain a warm industrial base during periods of lower demand and keep vital infrastructure in place in the event of a surge in requirements.

- DLA obtained "no charge" surge coverage on 532 contracts. This coverage represents a cost avoidance of $73,014,727 that neither DLA nor the Military Departments will have to expend for supplies to ensure that critical war/contingency items will be available. "No charge" coverage is a supplier commitment to provide contingency items at wartime quantity and delivery schedules without additional expense to the Government.

6.3.1 TARDEC Visibility and Communication Database (December 2011)

Tank-Automotive and Armaments Life Cycle Management Command (LCMC) Tank Automotive Research, Development and Engineering Center (TARDEC) developed an Industrial Base Visibility and Communication decision support tool entitled "VisCom." The tool enhances TARDEC's industrial base capabilities by increasing visibility and communications used to monitor, evaluate, and communicate with the manufacturing and the engineering services companies. VisCom's inherent ability to monitor the health of the TACOM Life Cycle Management Commands (LCMCs) Industrial Base supports proactive management of industrial base risks and issues. The information system was created by identifying and loading all of the suppliers and their CAGE codes associated with providing parts directly to TACOM. This includes both TACOM direct suppliers (approximately 3,000) as well as the suppliers supporting TACOM, which are managed by DLA (approximately 11,000 - 12,000). The system does not provide visibility of the various original equipment manufacturer (OEM) sub-suppliers unless the suppliers are common suppliers to TACOM. The VisCom tool integrates Dun and Bradstreet (D&B) financial health indicators for those companies having a current rating with D&B. Other key components of the tool include company information such as key contacts, company size, location, small business classification (if applicable), supplier capabilities, and Federal Supply Classes (FSCs) that companies can provide. Having visibility of both TACOM direct and DLA-managed suppliers for TACOM affords the ability to monitor and assess the health of TACOM's industrial base, which supports the 3,500 TACOM-managed weapons systems.

TACOM also has visibility of additional suppliers that may be of interest to resolve current and future obsolescence risks and issues. Suppliers are deliberately and strategically added to VisCom as the need arises. It is not the intent to add all U.S. suppliers, only those whose capabilities align with a specific need for a TACOM related weapons system. In addition, TACOM has collaborated with various organizations such as Society of Automobile Engineers, Local and Nationwide Procurement Technical Assistance Centers (PTACs), Trade Associations, and others to identify other potential suppliers. Potential suppliers also have the ability and are encouraged to provide visibility of their capabilities. A manufacturer can go to the Diminishing Manufacturing Sources and Material Shortages (DMSMS) website (at no cost to the company) and provide relevant company data including key capabilities, contacts, FSC, and North American Industrial Classification System (NAICS) information. After a quick screening process to ensure it is not a duplicate entry, the information is integrated into the VisCom tool. The system stays current by providing e-mail requests automatically every 120 days to ensure data is refreshed and accurate. These updates also afford the companies the opportunity to add or delete capabilities, change points of contact, phone numbers, etc. TACOM currently has approximately 20,000 suppliers nationwide in the VisCom tool. VisCom provides a means to communicate with the suppliers that are in the database via an integrated e-mail client. This is a key function, since this action supports active communication with the suppliers and provides the ability to track responses in a consolidated repository.

For example, if a weapons system manager needs to find a supplier capable of providing a specific part or service, it would typically post a request onto FedBizOps and hope a supplier will discover the request, understand the information provided, and then determine whether there was a matching capability. With the VisCom tool, if there is a need to identify a capability, TACOM has the ability to identify to which FSC the particular part belongs and which particular suppliers within VisCom might match the needed capability. TACOM can then send out a focused nationwide request to those relevant suppliers. This method streamlines the process and significantly improves the odds of matching a specific need to a viable source(s) of capability. It is important to note that this is not circumventing the contracting and acquisition process but is merely identifying viable sources to resolve a particular need. The contract provides the ability to supply small quantities of parts on an emergency basis.

6.3.2 Automation Alley Contract (December 2011)

Automation Alley, Michigan's largest technology business association, is currently on contract with TARDEC to provide industrial base support for the TACOM LCMC DMSMS program. The contract with Automation Alley has created the capability to establish commercial industrial base visibility and communicate TACOM LCMC requirements with companies across the U.S. Automation Alley Capabilities include the following:

- Repair part analysis and data-mining capability for families of vehicles
- Manufacturing/industrial base capability, trend, and risk knowledge
- Reverse engineering and administration to provide replacement parts and Technical Data Packages (TDPs)
- Locating and vetting suppliers for specific components or manufacturing technology
- Industrial Base VisCom tool – manufacturer's contact information and integrated e-mail communication capability
- Prototype demonstration, and test planning and support
- Technical competencies in many mechanical/electrical areas

In instances where companies quote exorbitant amounts of money for TDPs, the VisCom Tool can identify companies capable of doing the reverse engineering. In one instance, over 30 companies were brought in by Automation Alley to bid on a particular project. The company that was awarded the project reversed engineered the system (under Automation Alley Management); used modeling and simulation; built, tested, and delivered the prototype for a reasonable price, with a complete Model Based Engineering (MBE) TDP, which TACOM owns.

6.3.3 Sustainment Engineering Risk Assessment Tool (December 2011)

The Sustainment Engineering Risk Assessment (SERA) tool allows the ability to utilize a disciplined and focused approach to identify sustainment-related risks associated with a weapon system, platform, or across platforms. For example, it identifies all of the National Stock Numbers (NSNs) or parts that are being required for service for a particular vehicle. A recent weapons system that was evaluated had over 18,000 NSNs. The various Army databases; i.e., Logistics Support Activity (LOGSA), Logistics Information Warehouse (LIW), Federal Logistics Data (Fedlog), Operating and Support Management Information System (OSMIS), Integrated Logistics Analysis Program (ILAP), etc. are then queried to acquire all of the supply, maintenance, or industrial base related data available on those NSNs. In all, approximately 70 different data elements are acquired on each of the relevant NSNs. Some of the more critical data elements are identified as Risk Indicators ("Flags") and each is assigned a relative weighting factor (Scale of 1.0 - 5.0). Some examples of Risk Indicators are Single Source, Persistent Back Order, No Technical Data, High Financial Risk Supplier, and No Recent Orders. Currently, there are 20 Risk Indicators evaluated for each NSN. If a particular NSN (part) possesses several or many of the Risk Indicators, its relative sustainment-related risk starts to increase and begins to move to the "top of the list." This disciplined methodology of evaluating potential sustainment-related risk provides managers with the ability to focus on the "right" issues, as well as the ability to mitigate risk proactively instead of resolving issues in a reactive manner as they arise. Heading off potential issues in a disciplined manner will also allow the potential for significant cost avoidance.

A SERA can be performed on a one-time basis or periodically. It is an excellent means of evaluating a weapons system's sustainment and maintenance strategy that is required by regulation (AR 700-127). This new SERA tool provides the Government Project, Product, and Weapon System Managers the ability to move from reactive Industrial Base/Manufacturer management to a focused proactive planning, management, and risk reduction approach. In essence, the SERA will help direct leaders to focus on which manufacturers are having difficulty meeting requirements, having financial issues, going out of business, etc.

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, page 66, accompanying S. 1253, the National Defense Authorization Act for Fiscal Year 2012, noted 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 therefore directed 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

Consolidated Steel and Specialty Metals Trend Analysis (July 2011)

DASD(MIBP) requested the Defense Contract Management Agency, Industrial Analysis Center (DCMA IAC) to update the semi-annual Steel and Specialty Metals report. The purpose of the report is to provide trends and analyses to the DoD acquisition community detailing short, medium, and long-term impacts of steel and specialty metals on the industrial base as they apply and influence DoD programs and systems.

The report assesses pricing, capacity utilization and other industry factors that influence current and future conditions of marketplace trending for steel, titanium, aluminum, copper, nickel, and stainless steel. The intent of the trend analyses is to assist DoD acquisition community in preparing budgets and program plans in an economic environment of dynamic price movement. The report also identifies major influences on the metal markets, as well as providing near-term, mid-term, and long-term forecasts.

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

The findings in the August 2011 Steel and Specialty Metals pricing trend analysis and industry assessment show continued overall market improvement. Although metals pricing commenced a downward trend in September 2008 and reached a bottoming phase during the first quarter 2009, markets have now returned to pre-economic downturn levels. During the economic downturn, the industry consolidated and rationalized their operations in order to adjust with a period of prolonged low demand. As of late fall 2010, metals demand has steadily increased, and in mid-2011, industry's profit margins and capacity utilization rates returned to historical norms. Going forward, five of the six primary metals will likely double in price from the January 2009 reporting period. Metals demand transition to actual production is dependent upon the North American economy's ability to sustain a Gross Domestic Product (GDP) growth rate above three percent. If in 2012, the North American GDP grows at the current pace of 2.2 percent or lower, then look to see steel demand and associated prices stagnant during the first half of 2012. Copper, nickel, aluminum and titanium should also see a

flatter growth if the North American GDP stays below the requisite three percent growth rate.

Military Helicopter Design and Engineering Capabilities Assessment (July 2011)

DCMA IAC was tasked by DASD(MIBP) to perform a Military Helicopter Design and Engineering Capability Assessment. The purpose of the assessment was to address concerns expressed to the DoD Science and Technology community pertaining to workforce and future engineering and design capabilities deterioration for next generation helicopters. DoD helicopters incorporate defense-unique advanced technologies into systems such as fire control, armor, weaponry, night vision, advanced avionics, stealth, speed, and heavy lift.

The analyses focused on the following: industry R&D investment and funding trends; advanced air vehicle development, workforce attributes, engineering competencies, technology development, facilities, sub-tier supplier strategies, and issues regarding the state of the industry.

For this assessment, military helicopter design and engineering capabilities are defined as technologies and critical skill sets necessary to design, research, develop, manufacture, and test next generation helicopters for DoD. Surveys were sent to the industry prime contractors and data was validated through site visits, meetings with company representatives, independent research, historical data trends and comparative analyses, and DCMA subject matter expertise.

DCMA IAC analysis of the industry revealed several concerns in the area of skills and future helicopter development. Presently, 82 percent of the scientists and engineers are under age 54. While the industry may be relatively well positioned with younger engineers, concerns remain with the hardest to develop skills possessed by the most experienced engineers. The aging workforce may or may not be an issue depending on the design and technology requirements for next generation helicopters. Industry currently projects total R&D employment to remain stable through 2017 and each contractor is monitoring and/or has programs in place to identify and attempt to fill skill set shortages. Another concern expressed by industry pertained to prototype development, and enabling emerging technology funding. Industry considers current funding inadequate to significantly advance next generation helicopter technology. In addition, industry also expressed concerns with future viability of government test facilities. Additional areas explored included dependency on subcontracted R&D efforts (both domestic and foreign) and supply base. Dependency of subcontracted R&D engineering and design efforts is not significant as contractors retain critical engineering and design capabilities in-house. No foreign outsourcing of R&D engineering and design work was reported. The industry reported it continually evaluates the capabilities of its supply base. The following are assessment recommendations:

(1) As DoD further defines next generation requirements, a review of unique military helicopter competencies and skill shortages should be performed to determine if monitoring and strategies of further investment are required.

(2) Review industry-identified emerging and enabling technologies, determine needs based on Department requirements, and ensure adequate future funding is available to sustain or advance technologies.

(3) DoD and other government agencies should consider coordinating funding to maximize emerging and enabling technology investments.

(4) Where practicable, industry should be encouraged to share internal approaches and collaborate with academia to mitigate skill shortages.

(5) DoD should develop and communicate funding/commitment strategies to industry regarding government-owned test facilities utilized in support of helicopter R&D prototyping and testing.

Joint Program Executive Office for Chemical and Biological Defense NORTHCOM, First Responder Chemical Biological Defense Sector Industrial Base Assessment (September 2011)

The Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD) (via its Joint Logistics Advisory Council IB Working Group (IBWG)) requested support from DCMA during the conduct of a United States Northern Command (USNORTHCOM) First Responders study of the Chemical, Biological, Radiological, and Nuclear (CBRN) Industrial Base (IB). JPEO-CBD has a Memorandum of Agreement with DCMA to support CBRN IB studies in which the IAC is designated the office of primary responsibility, and a member of the IBWG. JPEO-CBD requested the study to determine the capability of the IB to sustain operations during a weapon of mass destruction (WMD) scenario(s) that requires resupply of critical CBRN items within USNORTHCOM area of operations for incidents that occur within the United States and U.S. Territories.

For this assessment, the IBWG constructed the project scenario based on Homeland Security Council's National Planning Scenarios. Five CBRN events or scenarios considered priority threats to the nation were assessed: 10-Kiloton (KT) nuclear device; delivery of a biological mycotoxin agent; a Sarin gas release; a dirty bomb; and a chemical plant explosion releasing toxic industrial chemicals. The analysis objectives included the identification of 20 critical manufacturers and suppliers covering the JPEO-CBD Joint Program Management Sectors: Collective Protection, Contamination Avoidance, Decontamination, Individual Protection, and CBRN Medical Defense. The study also considered unique technologies, and single point failures within the responding CBRN industrial and manufacturing base. The IAC coordinated site visits to seven contractor facilities, supported the development of briefings, and contributed to the writing of the report.

Key contractors were surveyed to determine throughput capacities, essential capabilities, supply chain risks, surge capacities, personnel turnover/training times, production/administrative lead times, and other potential areas of concern regarding manufacturing CBRN equipment at their facility. The CBRN/First Responder Industrial Base (IB) contains a very diverse gathering of manufacturers that includes specialized and potentially irreplaceable science and technology expertise.

The overall rating of the CBRN/First Responder IB is low risk with a small sub-population of programs rated moderate risk. The risks identified that negatively impact the CBRN/First Responder IB include: dwindling Local/State/Federal/DoD financial resources, business mergers, single point failures, off shore production, and dependency on foreign sources within the supply chains. The continued reduction of funding will result in an end state of fewer products, fewer manufacturers, and less competition. However, over the last several years, the First Responder population has created new equipment requirements that were largely supported by COTS manufacturers.

Munitions Industry Production Capabilities Analysis (October 2011)

Joint Chiefs of Staff Logistics (JS/J4), Supply Division, Munitions Branch requested DCMA IAC perform a Munitions Industry Production Capability Analysis (MIPCA). The purpose of the MIPCA was to assist J4 in a rapid and effective transition from peacetime planning activities to monitoring, assessing, planning, and directing logistic operations for crisis response and contingency operations that require time sensitive munitions data. The MIPCA report is an annual tasking, and analysis is shared with the DASD(MIBP) and the Military Departments.

J4 originally tasked DCMA to demonstrate responsiveness in acquiring weapons systems industrial base capabilities information as well as conduct surge analysis. This analysis supports deliberate planning, contingency operations, and the Defense Production Act to help ensure the timely availability of industrial resources to meet current national defense and emergency preparedness program requirements. For this iteration of the MIPCA, DCMA IAC and J4 identified 48 munitions programs that include 7 prime contractors and 11 facilities. The programs selected are essential to meeting current and future national security objectives. This data helps evaluate the ability of the munitions sector of the industrial base to sustain these programs throughout the programs' operational lives, and that prime and sub-tier suppliers are capable of meeting current and future production requirements.

DCMA surveyed contractors and collected data on production capabilities including manufacturing capacity, lead times, and production rates (minimum, current, and maximum). The result of the analysis includes the identification of prime contractors and programs as well as critical components and suppliers illustrating subcontractor program support and dependency. This analysis identified limiting factors on the munitions programs, prime contractors, and its supplier base. The munitions

industry, which includes precision guided munitions (PGMs), missiles, bombs, and rockets, is directly dependent on the level of DoD investment. Due to this dependency, the IAC also analyzed munitions program procurement quantities and cost data from the fiscal year Defense Budget Materials from the Office of the USD Comptroller for each prime contractor from FY2010 to FY2016, with actual data reported by the prime contractors.

Each of the prime contractors analyzed possesses the requisite industrial capabilities (skills, knowledge, processes, equipment, facilities, and technologies) required to research, design, develop, assemble, test, and produce the identified programs. All munitions prime contractors are fully dependent on its subcontractor base. Recommendations include: monitoring the effects of the budget reduction on the munitions sector of the industrial base and potential impact to the prime contractors' and subcontractors' capacity for critical components on identified programs; and continuing to perform targeted industrial capabilities assessments on complex critical munitions components and contractors as requested. The munitions sector industrial base data and associated assessments should be shared within the DoD community to enhance high-level decision-making and to reduce the data collection burden on the contractor base.

Liquid Rocket Engine Industrial Capabilities Assessment (December 2011)

DASD(MIBP) tasked DCMA IAC to perform an Industrial Capabilities Assessment (ICA) of the Liquid Rocket Engine (LRE) industry. The purpose of the ICA is to assess the industrial base supporting commercial, government, and NASA launch vehicles and provide findings, conclusions and recommendations that will alleviate risk in meeting the DoD objective of a reliable, cost effective, and sufficient industrial base.

P.L. 111-383, the Ike Skelton National Defense Authorization Act for Fiscal Year 2011, Sec. 917 (*Review and Plan on Sustainment of Liquid Rocket Propulsion Systems Industrial Base*), states that the Secretary of Defense, with NASA, shall review and develop a plan to sustain the liquid rocket propulsion systems industrial base. The LRE ICA supports that effort. The assessment identified current and future required capabilities and provided an analysis on the health of the LRE industry. There are at least four production-ready engines for upper and lower stages, with others in various phases of development. Industrial capabilities were assessed for critical components, including the combustion chamber, thrust nozzle, injector, turbo-pump, oxidizer tank, and various valves. Seven prime LRE manufacturers and over 30 sub-tier suppliers were identified, surveyed, and visited to analyze the capabilities to support LRE development and production requirements.

For the ICA, industrial capabilities are defined as the skills and knowledge, equipment, processes, facilities, and technologies necessary to research, develop, manufacture, and test LREs and its critical components. As directed by DoD Instruction 5000.02, industrial capabilities were evaluated and analyses were performed using risk

criteria established in accordance with DoD 5000.60H. Financial analysis was conducted using the DCMA Financial Capability Group's Corporate Financial Assessment Rating (C-FAR) process.

Analysis indicates the LRE industry is currently producing at minimum sustaining rates with a lack of development programs to sustain capabilities. More than 50 percent of the prime contractors' capacity is underutilized. Some components are at risk due to sole sourcing, low volumes, and an aging workforce. Lower commercial demand and the cancellation of the Constellation and Space Shuttle programs has led to excess inventory, low production rates, and over-capacity. Additionally, many commercial satellites have been launched by foreign launch services due to lower costs and subsidies. Prime contractors are consolidating assets to maintain profitability and competitiveness. Most of the sub-tier supply base is currently stable, but relies on LRE production for a significant portion of their business. Some sub-tier suppliers are in a production gap and may exit the business due to low LRE demand. Component long lead times results in material obsolescence and skill retention issues, which affects cost and sustainability. The lot buy procurement process leaves suppliers susceptible to cost increases between buys. The industrial capabilities to design, develop, and produce LREs are assessed as moderate industrial risk. While there are several engine makers, there is only one reliable source providing the industrial capabilities for each engine. No alternate qualifiable sources are available within acceptable time and cost parameters. Nearly half of the companies in the LRE supply base are assessed as moderate financial risk. DCMA recommends extending the block buy approach to provide stability to the industrial base and minimize price increases; investing in new LRE programs to replace aging and foreign made boosters; using a competitive bid process to exercise design and development skills and minimize cost; and providing incentives for U.S. commercial satellites to use U.S. launch vehicles. Additionally, all of the companies assessed as moderate financial risk should be re-evaluated on a semi-annual basis for changing financial conditions.

B.2 Army

Raw Materials Sector Assessment Update (September 2011)

The U.S. Army Research Development and Engineering Command's Aviation and Missile Research, Development and Engineering Center (AMRDEC), Engineering Directorate's Industrial Operations Division is continuing a Raw Material Sector Assessment process which periodically assesses the availability status of key raw materials. Currently, assessments on aluminum, ammonium perchlorate, beryllium, butanetriol, copper, iron based alloys, magnesium, molybdenum, nickel, rare earth elements, rhenium, and titanium are updated on a regular basis. Each material assessment looks at the raw materials supply sources including geopolitical issues that can impact supply, manufacturing processes used, end users of the raw material, pricing, and Aviation and Missile Command (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 of 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.

Joint Land Attack Elevated Netted Sensor (JLENS) Program Industrial Capabilities Assessment (October 2011)

The Joint Land Attack Cruise Missile Defense Elevated Netted Sensors (JLENS) Product Office (JPO) tasked DCMA IAC to perform a JLENS Industrial Capabilities Assessment (ICA). JLENS is a tactical, theater-based, advanced sensor system, with over-the-horizon detection and tracking capabilities required to defeat the proliferating cruise-missile threat. The purpose of the ICA was to assess the ability of the current JLENS prime and key System Development and Demonstration (SDD) sub-tier contractors to support the JLENS Program progression into the low rate initial production (LRIP) Milestone C phase.

Four major JLENS sub-systems were assessed: Platform (four suppliers); Communication and Processing Group (CPG) (three suppliers); Fire Control Radar (FCR) (five suppliers); and Surveillance Radar (SuR) (four suppliers). All sub-system end items have a stable design baseline.

As directed by DoD 5000.02, industrial capabilities were evaluated and analyses were performed using risk criteria established in accordance with DoD 5000.60H. Financial analysis was conducted using the DCMA Financial Capability Group's Corporate Financial Assessment Rating (C-FAR) process. For the purposes of this study, industrial capabilities are defined as the skills, facilities/equipment, processes, and technologies necessary to research, develop, manufacture, test, and evaluate the specified JLENS systems/subsystems/products.

Overall, the prime contractor and the key SDD suppliers surveyed possess the requisite industrial capabilities (skills, processes, facilities/equipment, and technologies) and capacity necessary to design, manufacture, and test the JLENS components to support Milestone C LRIP requirement of one JLENS Orbit system per year. The Platform suppliers have potential single points of failure, although no major production-related issues are anticipated. The CPG and FCR suppliers have potential component obsolescence issues that will need to be closely monitored and addressed to ensure a stable production base. Due to the uniqueness of the SuR system, qualification of alternate suppliers could potentially have a significant cost/schedule impact to the JLENS Program. Financial analyses were accomplished for eight out of the 14 assessed sub-contractors. Only one contractor was rated a high financial risk. This rating indicated if this contractor's financial performance continues to weaken, the contractor may not have adequate financial resources to remain financially viable in the long-term without substantial support from the parent company.

Army Industrial Base Baseline Assessment (December 2011)

In support of the Army Materiel Command's (AMC) Strategic Plan and supporting Industrial Base Program, the AMC Industrial Base Capabilities Division developed a cyclic assessment program with the first increment establishing the current baseline of the Army's Industrial Base (IB). The Army Industrial Base Baseline Assessment (IBBA) determines the health of selected IB areas, which are critical to the support of the U.S. Army and Joint Services operations. In order to identify current and future IB shortcomings, the assessment scope includes the commercial and organic portions of the IB targeting FY2011 through Program Objective Memorandum (POM) cycles FY2017. 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 IB base sustainment. The end state is to ensure the AMC IB is capable of meeting Warfighter requirements through the retention of critical industrial capabilities, which foster a vital and responsive IB.

Chemical, Biological, Radiological and Nuclear Industrial Base Capabilities Assessment (December 2011)

The Joint Program Executive Officer for Chemical and Biological Defense (JPEO-CBD) tasked the Joint Logistics Advisory Council for Chemical and Biological Defense Industrial Base Working Group (IBWG) to conduct an analysis on the IB status and associated risks with Chemical, Biological, Radiological, and Nuclear (CBRN) systems. The end state is to provide an assessment of CBRN items, identify risks, and develop potential mitigation strategies that support the IB's ability to respond in times of surge, national emergencies, and periods of lower requirements. The objective of this analysis is to determine the capability of the IB to sustain operations during a Weapon

of Mass Destruction (WMD) scenario(s) that requires resupply of critical CBRN items within the U.S. Northern Command (USNORTHCOM) area of operations for incidents that occur within the U.S. and U.S. Territories. Multiple sources of supply and demand data are captured in the IB Assessment System, which provides the baseline for conducting the initial scenario-based assessments. Areas of concern are identified to conduct more detailed and specific analysis. This detailed and specific analysis provides the framework for identifying risk, which can then be mitigated through the use of industrial preparedness measures, courses of action, and IB action plan recommendations. The draft resulted in the identification of critical CBRN systems, identification of critical manufacturers, development of market sector analysis, and risk mitigation strategies/action plans. The finalized CBRN ICA will be forwarded to HQAMC.

CECOM Joint Tactical Radio System Ground Mobile Radio Industrial Capabilities Assessment (December 2011)

The Communications and Electronics Command (CECOM) Life Cycle Management Industrial Base Office facilitated an Industrial Capabilities Assessment (ICA) for the Joint Tactical Radio System (JTRS) Ground Mobile Radio (GMR) through Booz Allen Hamilton. The primary objective of the ICA was to evaluate the industrial base capability to produce, maintain, and support the JTRS GMR program and assess program maturity supporting a Milestone C Decision. The JTRS is a joint program that includes the Army (USA), Navy (USN), Marine Corps (USMC), and Air Force (USAF). The JTRS is a family of interoperable, modular software-defined radios, which operate as nodes in a network to ensure secure wireless communication and networking services for mobile and fixed forces. The ICA assessed program elements, which include program technology, manufacturing, program management, and contractor financial assessment. The software technology insertion/refreshment and Technology Readiness Assessment (TRA) rated Low risk. The acquisition strategy, programmatic, and financial risk assessments also rated as Low risk. These assessments were conducted on the JTRS GMR contractor team (Boeing, Northrop Grumman, Rockwell Collins, British Aerospace Electronic (BAE) Systems, and Harris Corporation) and found the contractor team to have adequate financial stability to successfully produce the JTRS GMR.

Following a critical Nunn-McCurdy breach of the JTRS GMR program, the Department of Defense (DoD) conducted a reassessment pursuant to Section 2433a of Title 10, United States Code (U.S.C.). As a result of the Nunn-McCurdy breach and reassessment, DoD decided not to certify the program. On 13 October 2011, Acting USD(AT&L), Frank Kendall, formally informed Congress that the GMR program would be terminated due to affordability. The critical cost breach was a direct result of a reduction in quantity of GMRs from 86,209 to 10,293. The reduced quantity was the result of a revised Basis of Issue Plan, which was based on new Operational Network Architecture and the cancellation of the Future Combat Systems. A series of contractor

and program execution issues, as well as additional information assurance requirements, were also cost growth contributors.

After reviewing several options, the conclusion was to adopt a modified Non-Developmental Item (NDI) strategy with a low cost, reduced size, weight, and power variant with wideband networking waveform and soldier radio waveform. Other performance attributes were adjusted which would render a smaller and more affordable radio. A competitive market emerged with the potential to deliver radios to meet the capability at a reduced cost. After the contract ended in March 2012, a new program emerged managing the evaluation, test, and delivery of an affordable low cost, reduced NDI product fielded to operational units in FY2014.

Market Research of Military Rechargeable 18650 Lithium-Ion Battery Cells (December 2011)

This assessment by the Communications and Electronics Research, Development and Engineering Center (CERDEC) is an on-going study of the 18650 lithium-ion battery cells. This assessment contains responses to a market survey solicitation seeking battery industry parties interested in maintaining and/or establishing a U. S.-based manufacturing and production capability of military-grade rechargeable 18650 lithium-ion battery cells. Market survey solicitation was issued 5 April 2011 with a 20 May 2011 suspense date. The following was requested of interested parties:

- Provide experience in the manufacture/production of lithium-ion rechargeable cells in general and 18650 cells in particular
- Provide experience in the research and design of lithium-ion rechargeable batteries in general and 18650 cells in particular
- Provide requirements for maintaining and/or starting a warm U. S. production/manufacturing base (level of production, costs, additional capital investment requirements, etc.) for 18650 cells
- Provide projected per cell cost based on minimum annual production requirements and state the requirements
- Provide a data sheet(s) for current U.S.-manufactured 18650 lithium-ion cells, if available

The assessment contains responses from seven producers. Overall, there are significant sources of lithium-ion cells. Since this is on-going study, more analysis is needed to determine the ability of the base to meet DoD needs as the commercial market demand for these types of cells is high.

Redesign of Hydraulic Manifold on the Aviation Ground Power Unit (December 2011)

An Aviation Ground Power Unit (AGPU) is a mobile, wheel-mounted power unit, which provides services required by all stationary rotary aircraft during servicing and diagnostic testing prior to flight. Within the hydraulic system of the AGPU, thermostatic switches that monitor hydraulic fluid temperature are a procurement challenge and are cost-prohibitive due to Defense Logistics Agency (DLA) contractor unit costs between $1,400 and $4,300 each with a lead-time for delivery of up to ten months.

The purpose of this project was to determine the most viable, economical approach to purchase thermostatic switches, and machine the hydraulic manifold block in which Commercial Off the Shelf (COTS) switches could be used. The team contacted an array of thermal switch manufacturers and suppliers. Each company was given an extensive list of specification criteria that each thermal switch had to meet to be accepted. There were a few companies that came close to meeting all the criteria, but only one company met them all with the exception of the thread size. After selecting the thermal switches, the team began investigating the machining aspect for the AGPU hydraulic manifold. Blocks of 6061-T6 aluminum were procured along with the required tooling, and thread gages to machine a complete hydraulic manifold block that accommodated the selected switches. The team shipped two machined manifolds equipped with the four required thermal switches (one of each temperature range) to Letterkenny Army Depot for operational testing.

The ManTech/NCDMM team identified and verified readily available thermostatic switches and redesigned the current AGPU manifold block to accommodate the COTS switches. By using COTS thermal switches, the expected savings for total replacement of all the AGPUs is estimated to be approximately $16,355,180 over the next 15 years.

Ultra Light-Weight Camouflage Net Systems (ULCANS) Production Capabilities Analysis (December 2011)

The ULCANS camouflage system used by the U.S. Army consists of one hexagonal and one rhomboidal screen, available in both woodland and desert version. It features a simplified interconnect system and effective shape disrupters. These multi-spectral camouflage nets offer improved concealment for vehicles and field positions by masking visual, thermal, near infra-red, and broadband radar signatures. This assessment by CERDEC included a plant visit with two contractors. The contractors provided information regarding the degree of production technology, the ability of vendors to shutdown and start-up production at a later date, the risk of recreating the industrial base, the ability to surge, the time to surge, the viability of sub-vendors, and the degree of vertical integration. The assessment looked at the skills, knowledge, processes, facilities, and equipment needed to design, develop, and manufacture ULCANS. A major concern regarding the possible reductions in requirements would be a financial decision by ULCAN contractors to discontinue production and no longer

provide the product to the Army, thereby possibly creating a national security risk to the DoD. This was found not to be major concern for several reasons.

First, there is a contract currently in place until 2016 that provides the U.S. Army with a warm base from which future requirements can be met. Second, MIL-PRF-53134, ULCANS, provides a well-defined performance specification baseline for contractors to use. This specification covers the ULCANS for tactical equipment and field installations including helicopters and fixed-wing aircraft. Third, reconstitution of the ULCANS industrial base has been rated as fairly easy to moderately hard. This range of reconstitution is due to different contractor capabilities.

The assessment reveals that current requirements can be met, and there is no danger of not supporting Army Forces. Any possible reduction in Army requirements poses no national security risk and does not warrant intervention by ASA(ALT). The ULCANS industrial base capability can be reconstituted if an out-of-production situation occurs. A new source of supply can be established, but would require investment in capital and time.

B.3 Navy

Production Capability Assessment of the MK323 MMOD 0.50 Caliber Polymer Case Ammunition (January 2011)

The Marine Corps Systems Command (MARCORSYSCOM) Program Manager for Ammunition (PM AMMO) tasked DCMA IAC to conduct a production capability assessment of the MK 323 MOD 0 0.50 Caliber Polymer Case Ammunition. Polymer Case Ammunition is being developed and produced by a single firm through a Title III funded project. The purpose of the analysis was to assess whether the Title III project company possessed the skills, knowledge, processes, facilities, and equipment needed to design, develop, and manufacture small arms ammunition to support future United States Marine Corps (USMC) production contracts. DCMA IAC was also tasked to evaluate capabilities of a critical supplier to the company.

Under the authority of Title III of the Defense Production Act of 1950, as amended, the U.S. Government was seeking to develop, optimize, and qualify a polymer case 0.50 caliber cartridge to be used as a replacement for the standard 0.50 caliber M8 (Armor Piercing Incendiary) and M20 (Armor Piercing Incendiary–Tracer) currently fired from the M2HB (Heavy Barrel) 0.50 caliber gun system. The MK 323 was developed using a polymer caselet in place of the traditional brass cartridge casing and designed to meet specifications as a drop in replacement for conventional brass case 0.50 caliber ammunition.

DCMA IAC and DCMA Contract Management Office subject matter experts visited the company; validated an industrial capability/business base survey; and performed Physical Configuration and Quality Audits. As part of this assessment, DCMA also conducted a Break-Even Analysis, and a Financial Risk Analysis on the Company. Financial analysis was conducted utilizing the DCMA Financial Capability Group (FCG) Corporate Financial Assessment Rating process. For purposes of this study, industrial capabilities were defined as the skills, equipment, facilities, processes, and technologies necessary to research, develop, manufacture, test, and evaluate the MK 323 Polymer Case Ammunition.

The requisite industrial capabilities necessary to develop and manufacture the MK 323 0.50 Caliber Polymer Case Ammunition exist at the company. At the time of the assessment, only 50,000 rounds of MK 323 ammunition had been produced. Qualification testing and evaluation of the MK 323 Polymer Case Ammunition had not been accomplished at the time of the assessment. Therefore, industrial capabilities risk could not be determined since it is not known if the MK 323 will successfully meet qualification requirements. Based upon the limited unaudited financial information available, the DCMA FCG considers the Company financially viable in the near-term but its future viability is questionable without continued U.S. Government support in providing required capital and test equipment. It is recommended the MK 323 0.50 Caliber Polymer Ammunition Production Capability Assessment be revisited in 12 to 18

months to assess the Company's production/financial progress and capability of its critical supplier.

Aim-9X Block II Sidewinder Active Optical Target Detector Industrial Capabilities Assessment (June 2011)

NAVAIR Program Manager Air-259 (PMA-259) Air-to-Air Missiles (program office for Sidewinder AIM-9X) in Patuxent River, Maryland, tasked DCMA IAC to perform an Industrial Capabilities Assessment (ICA) of the AIM-9X Active Optical Target Detector (AOTD). The purpose of the ICA is to identify industrial base risk or areas of deficiency, perform a financial analysis, and make recommendations for corrective actions or risk mitigation actions, if required, as well as assist in understanding the industrial base and its capability to support AOTD Full Rate Production (FRP) and the Milestone C decision.

The AIM-9X Block II build of the Sidewinder missile has an upgraded AOTD as well as other technical improvements. The Program approached an Acquisition Program Baseline (APB) cost threshold for the AOTD due to the upgrade, resulting in the requirement for an ICA on the AOTD for Milestone C. The Milestone C decision was scheduled for June 2011. The AIM-9X-2 Sidewinder is a Major Defense Acquisition Program (MDAP) Acquisition Category IC (ACAT IC) Joint Air Force/Navy program with the Navy designated as lead service. The purpose of the AOTD is to detect the presence of a target and to enable detonation of the warhead increasing its kill probability. This assessment focused on the critical components of the AOTD: Final Assembly and Test, Transceiver Assembly, Circuit Card Assembly, Laser Detector, Data Link T/R Module, and Laser Assembly. Six key subcontractors manufacture these components.

For the ICA, industrial capabilities are defined as the skills, knowledge, equipment, processes, facilities, and technologies necessary to research, develop, manufacture, and test components of the AIM-9X AOTD. As directed by DoD 5000.02, industrial capabilities were evaluated and analyses were performed using risk criteria established in accordance with DoD 5000.60H. Financial analysis was conducted using the DCMA Financial Capability Group's Corporate Financial Assessment Rating (C-FAR) process.

The industrial base can support AIM-9X-2 AOTD production through the Milestone C decision and into FRP starting with Lot 10 and Lot 11. All of the AIM-9X-2 AOTD key components, including Final Assembly and Test, were assessed as moderate industrial capabilities risk. There is only one domestic source capable of providing the requisite industrial capabilities and capacity needed to design, develop, and produce each AOTD component within acceptable time and cost parameters to meet the June 2011 Milestone C schedule and performance requirements. Certain AOTD key component suppliers were experiencing quality and on-time delivery issues. The Laser Assembly had multiple suppliers with quality issues and long lead times. Second sources for problem subcomponents were being pursued using ManTech

Phase II funding. A small quantity of black polyimide is used in the Laser Detector and is purchased from a Japanese supplier. There is no domestic source. Due to low demand, there is a concern that the Japanese company may decide to stop making the polyimide and the Laser Detector supplier would need either to find an alternate source or modify the detector design to use a different coating material. The quality, delivery, and availability of these components should be closely monitored. The AIM-9X-2 AOTD was assessed as a moderate industrial base risk. The six companies in the study were financially viable. Four of the companies were assessed low financial risk and two were assessed moderate financial risk. DCMA recommends that all companies rated moderate financial risk be monitored by DCMA and NAVAIR on a semi-annual basis for changing financial conditions.

Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (August 2011)

This assessment published in August 2011 describes the results of a study performed by the Acquisition and Technology Policy Center of the RAND National Defense Research Institute for Navy's PMS 408. PMS 408 is the DoD Program Management Office assigned to develop Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (CREW) technology. This assessment was undertaken to identify small to mid-sized vendors that (1) have innovative technologies likely to be relevant to the Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (JCREW) program, (2) have been successful in competitive markets, and (3) the JCREW program might not be aware of.

The assessment for simplicity, calls the firms identified as "technology innovators." RAND addressed two principal research questions: Is the U.S. technology innovator vendor base available and sufficiently robust to provide components and modules integral to the U.S. Navy's modular architecture developed for JCREW systems? What steps can the Navy take to increase the involvement of these vendors throughout the overall acquisition lifecycle of JCREW systems?

The assessment documents RAND's development of a JCREW technology innovator vendor database, provides summary information about this database, and presents capsule summaries of the capabilities of the companies in the database. It also describes the protocol and process that RAND used to identify barriers to participation in the JCREW 3 acquisition process through interviews with companies that attended "Industry Days" held by the Navy and companies in the vendor database. Finally, it presents RAND's findings on the breadth of the vendor base and RAND's recommendations of actions that the Navy should consider to promote technology innovation and reduce barriers to participation in the JCREW acquisition program.

The assessment will assist PMS 408 in making CREW acquisition decisions in FY2012 and out years. The JCREW Increment One, Block Two (I1B2) program will in particular make use of the results of this assessment and its associated database.

B.4 Air Force

Flares Industry Market Assessment (March 2011)

Flares are countermeasures to protect aircraft from air or ground launched infrared heat-seeking missiles. The material in a flare is a composition based on magnesium or other metal that burns at a high temperature. The combustion temperature of the flare needs to be equal to or greater than the engine exhaust temperature so the missile will be drawn to the flare rather than the aircraft. Although military aircraft can use towed decoys, decoy flares, or ground illuminating flares, this report focuses on decoy flares. The objective of the report is to categorize the current market for flares in terms of manufacturing capability and procurements.

During the past six years, DoD procurements of flares have averaged more than $275M annually. The operations in Iraq and Afghanistan have provided the bulk of the demand. Three companies supply flares to DoD. Two are U.S. owned; one has a United Kingdom (UK) parent company. These three companies operate five manufacturing facilities in the U.S. The UK owned firm has approximately half the market, with the two U.S. firms splitting the balance. All three companies are currently rated a low financial risk. One new flare manufacturer entered the market in 2009. It is a French company with a Navy contract to design, develop, and manufacture off-shore flares.

During the past decade, the Army procured the most flares. Planned procurements from FY2010 through FY2012 show an average annual decline of more than 50 percent from the previous decade. Recently, Army requirements dropped off significantly leaving the Air Force as the majority purchaser with over two-thirds of DoD purchases. The changing operational requirements directly impact sales and capacity of the suppliers. There is some synergy in terms of sustaining skills and production capabilities with producing Cartridge Actuated Devices and Propellant Actuated Devices (CAD/PAD) used in applications such as ejection seats and automobile airbags. Two of the company's manufacturing flares also produce these explosive devices.

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.

Space Critical Technologies Assessment (May 2011)

In support of National Security Space objectives, the Air Force assessed the risk associated with space-related critical technologies and the corresponding industrial base. The analysis uses a common risk rating method that charts likelihood of occurrence against severity of risk. Likelihood of occurrence takes into account factors that represent a potential loss or disruption of a technology and/or supplier; these include single/sole/foreign sourcing, unique expertise/infrastructure, and financial

stability. Severity of risk assesses the impact in terms of time, cost, and mission criticality. The survey of subject matter experts covered 97 technologies in the following categories: Payload Sensors and Related Technology; Electrical Power System Elements; Attitude Determination and Control Elements; Structures/Mechanisms/ Materials/Thermal Elements; Electronic Components; Propulsion for Life and Orbit Maintenance; Command, Control, and Communication; and Auxiliary Equipment, Software, and Services.

The space industrial base continues to face challenges adapting to market conditions. Domestic demand is, in some cases, insufficient to keep all suppliers operating at efficient production levels. As a result, the space sector has a significant number of sole source suppliers some of which are foreign owned or based. While the large defense contractors are healthy, concern exists over the long-term viability of key lower tier suppliers.

Approximately two-thirds of the identified technologies were evaluated as medium risk along with several known materials and technologies remaining assessed as high risk due to supply vulnerability, declining sales due to the restructuring of DoD and NASA programs, and space qualification requirements that limit substitutions.

The Air Force is using this assessment to prioritize and conduct in-depth studies to identify policy, programmatic and/or investment opportunities to mitigate risks associated with each technology. In addition, the Air Force will continue to monitor these critical technologies and suppliers within the space industrial base as individual decisions are made regarding development programs, procurements, and overall market conditions impacting commercial production operations.

Next Generation TACAIR (F-X) Industrial Base Quick Look (June 2011)

This study assesses the ability of the domestic aerospace industry and the government to mature the technology and develop, produce, and sustain an advanced air superiority aircraft in the likely event there is a transition gap between the development of current generation tactical aircraft and the initiation of a next generation tactical aircraft. During this transition gap, some specialized capabilities and expertise associated only with tactical aircraft will atrophy. The assessment identifies where that atrophy is likely to occur, evaluates its consequences for the future, and offers recommendations to mitigate the impact.

Across the range of TACAIR technologies assessed, the average U.S. margin of leadership today is estimated at five years. In several areas (e.g., airframe mechanical systems, navigational avionics, and electronic components), domestic capabilities are roughly even with rivals. U.S. firms' capabilities modestly lead their foreign rivals in areas such as airframe materials, software, and sensors. Even where U.S. companies significantly lead foreign competitors (e.g., systems integration and propulsion), the advantage will be reduced as the transition gap increases. The consensus view of the

responding industry and government experts is that synergy with other segments of the aerospace industry such as commercial transport, extended duration mission (strike and surveillance) platforms and unmanned platforms is limited in terms of fully realizing the maturation of advanced technologies and their integration into tactical aircraft.

Without a near-term investment decision to sustain these key engineering and manufacturing capabilities, the margin of competitive technological superiority is likely to shift against U.S. firms in many areas vital to the development of future TACAIR. Failure to focus attention in these areas will erode domestic capabilities and foreign rivals will become the technology leaders. The longer the delay in launching a new tactical aircraft program, the longer it will take to regain lost capabilities, the more costly it will be to do so, the thinner the margin of technological superiority, the more internationalized the industrial and technological base, and the more permanent the international technological division of labor. Stakeholders responding to a survey chose initiating multiple next generation prototypes and technology demonstration projects as the most effective means, short of a new program start, for maintaining critical TACAIR capabilities during a lengthy transition gap, one that could stretch out to 2030.

This assessment is supporting ongoing advanced development investment planning within the Air Force. The assessment has broader implications to overall R&D portfolios within the Services.

2010 Intercontinental Ballistic Missiles IB Assessment Study (June 2011)

This report addresses the capability of the defense industrial base to support Air Force Intercontinental Ballistic Missiles (ICBM) programs through 2030. Commercial and government capabilities will be needed to preserve the long-term integrity of these missiles and, if required, develop the next generation replacement. The study sought to understand the status of the industrial base by collecting information on the health and viability of the ICBM supply chain, the state of the ICBM workforce, the uniqueness of the workforce, and several other factors from over seventy commercial suppliers and government facilities.

During the past decade, major modification efforts refurbished key portions of the Minuteman III (MM III) weapon system and sustained portions of this unique industrial sector. Through 2009, annual modernization program funding averaged $400M to sustain expertise and facilities within industry and the government. MM III modernization efforts focused on the replacement of propulsion, guidance, and reentry subsystems. Starting in 2010, modernization programs were reduced to less than 10 percent of previous levels. This reduction is resulting in significant changes to the ICBM workforce including retirements, re-assignments, or relocation to other industries. Many MM III suppliers have discontinued product lines or exited this line of business, prompting lifetime buys of certain products/materials. The majority of suppliers are sole/single source; the development of a replacement vendor is both costly and time consuming due to re-qualification requirements. The decline in modernization funding

has also made it difficult to maintain efficient production flow resulting in severely underutilized facilities and equipment.

The study assessed the risks to the ICBM industrial base by breaking it down into several areas. The first area was prime contractors and suppliers of reentry vehicle/reentry subsystem, guidance, and propulsion systems. Suppliers of propulsion components and materials exhibited the highest risk to remaining viable long-term suppliers due to a lack of sufficient and stable demand for DoD and NASA launch systems. Commercial manufacturers of command/control systems, ground electronics, and power subsystems are rated, on average, low to medium risks, due to sales of products and services in other markets. Key government facilities evaluated included those for test, maintenance, and storage. Maintenance facilities were rated as a high risk based on their ability to retain an experienced workforce and modernize equipment given the forecasted decline in Air Force budgets. An effective combination of focused R&D, maintenance upgrades, and a minimum sustaining rate production line for key subsystems/components are required to retain critical skills and capabilities existing in the current industrial base.

The Air Force is currently employing a holistic approach working with DoD and industry partners to preserve a national industrial capacity to develop, produce, and deploy strategic missile capabilities. This comparative assessment of risk is being used to evaluate programmed budgets for sufficiency and prepare strategic roadmaps that highlight additional investments to infrastructure and technology development.

Direct Digital Manufacturing Technologies IB Assessment (August 2011)

Direct Digital Manufacturing (DDM) refers to a broad set of technologies providing the capability to produce parts directly from a computer-generated file. The advantage of these technologies to DoD is rapid, affordable production of low volume/demand parts. The assessment divides DDM into three categories: additive, subtractive, and hybrid digital manufacturing. The assessment reviews each area and provides insight into the technical maturity, capability, and opportunities for development of each technology. In addition, the assessment identifies and evaluates the manufacturing base for DDM equipment.

Subtractive manufacturing is the most mature category of DDM; it includes processes such as computer numerical control (CNC) machining, electro-discharge machining (EDM), and water jet machining. These technologies are used in mass production of components across a variety of industries including aerospace. Laser Micromachining is an example of an emerging area in subtractive manufacturing. For metal parts, Direct Metal Laser Sintering (DMLS) and Electron Beam Melting (EBM) show the most promise for additive net shape part fabrication. DDM currently requires a significant amount of upstream engineering and programming combined with downstream heat treating, machining, and polishing that results in significant total part cycle times.

Twenty-two domestic companies were identified as producers of digital manufacturing equipment. They were evenly split between manufacturers of additive and subtractive processing equipment. Most were involved in research to mature and market advanced product lines. About a third of the domestic companies exhibit moderate financial risk. The assessment also identified 18 foreign producers of digital manufacturing equipment. Three of the identified technologies are available only from foreign equipment manufacturers: direct metal laser sintering, electron beam melting, and abrasive micro water jet systems.

Investments in additive DDM technologies are the most prevalent. The goal of these technologies is to build production parts up layer-by-layer starting with raw material inputs. Manufacturing equipment capabilities vary based on supplier, type of materials (plastics or metals) and the desired application of finished parts. DoD will need to work with both the DDM equipment manufacturers and aerospace firms to evaluate the new manufacturing processes and their ability to meet the required military specifications for a broad range of applications. Characteristics such as material properties (conductivity, strength, finish) and reliability will have to be tested to ensure parts manufactured with DDM technologies qualify for use in military systems.

This assessment is supporting investment planning within the Air Force and broader DoD research and development communities.

Integrated Inertial Navigation System/Global Positioning System for Highly Jammed and/or GPS Denied Environments for Application on Small Unmanned Aerial Systems and Mini/Micro Munitions Industrial Base Study (August 2011)

The study assessed the industrial base for next generation integrated inertial navigation and global positioning systems suitable for current and emerging small unmanned aerial systems (SUAS) and Mini/Micro Munitions. Next generation Integrated Inertial Navigation System/Global Positioning System (INS/GPS) for these applications should provide jamming mitigation and/or alternative navigation processes when GPS signals are unusable. In addition, technologies that address size, weight, power, and cost/cooling (SWaP-C) issues need to be producible for this capability to mature and transition into future systems. The assessment identified manufacturers, key suppliers, and potential demand based on planned near and mid-term AF customer requirements.

For this study, SUAS and mini/micro munitions are defined as those weighing less than 300 pounds. Micro munitions are defined as a subset of mini/micro munitions weighing less than 100 pounds. Inertial Navigation Systems provide a wide range of accuracies. This assessment focused on tactical grade, the accepted standard for munitions applications, when used with GPS. The tactical grade INS with the highest performance, and largest and highest cost, are based on Fiber Optic or Ring Laser gyroscopes. Micro Electromechanical Systems (MEMS)-based INS currently occupy

the lower end of the tactical grade performance range while their excellent SWaP-C characteristics make them appropriate, when integrated with GPS, for many SUAS and munitions applications. Sixteen companies were identified as active in the design and/or manufacture of miniaturized INS, GPS, or integrated navigation systems. All the firms were financially healthy. Seven manufacturers have been certified as meeting critical Air Force performance specifications.

There is ongoing research in alternative navigation sensors/technologies, such as vision based and RF based to aid the INS in an integrated system when GPS is unavailable. However, there is no program yet to develop a specific system and transition it to operational use. This is due, at least in part, to the fact that the vehicle market is fragmented, with small numbers of different types of vehicles being acquired by different organizations using quick response acquisition and other mechanisms. A consequence of this is that there is not a unified user demand for performance and/or SWaP-C characteristics for integrated INS/GPS navigation systems for these vehicles.

This assessment is supporting investment planning within the Air Force and broader DoD research and development communities.

Domestic Integrated Printed Circuit Board Industry IB Assessment (October 2011)

This assessment focuses on capabilities and trends in the domestic Printed Circuit Board (PCB) industry and how to improve its responsiveness to DoD requirements. Several reports have documented the overseas migration of the manufacture of PCBs and related supplies/materials and equipment. There is concern over how this trend affects the long-term viability of the domestic PCB industry and the ability of DoD to assure that weapon systems meet ever more stringent security, reliability, and performance requirements.

While there are over 300 domestic PCB manufacturers, only 38 firms are on DLA's Qualified Manufacturers List (QML). Three-quarters of the domestic PCB manufacturers on the QML are small, privately held companies. Only 37 percent of the companies are considered a low financial risk. Overall, domestic PCB industry revenue declined by 74 percent since 2000 and production has been on a steady decline since 2002. Three companies account for a third of the U.S. aerospace PCB sales while the top 13 companies are responsible for 80 percent of military purchases. Currently three manufacturers of avionic systems either have or are re-establishing an in-house PCB fabrication capability. In an industry that relies heavily on acquired design and production knowledge, the domestic PCB engineering workforce is aging and initiatives to capture their expertise are limited. The PCB needs of DoD for a combination of high technology with a low production volume are insufficient to support an industry driven by volume.

Currently, DoD contractors and subcontractors are able to find qualified domestic sources for PCBs. Advances in PCB technology have been driven by

improvements in integrated circuits and commercial demands for high volume/low cost applications. By comparison, complex certification processes, low volumes, long product life cycles, and a unique combination of demand for leading-edge technology with extremely high reliability and durability characterize the military/aerospace market. Requirements to operate at higher frequencies and with increased bandwidths have driven suppliers to develop new base materials and alternative technologies. For example, DARPA has funded development of optical interconnects to replace traces of copper. To maintain legacy systems, two organic DoD PCB facilities provide sustaining engineering, prototyping, first article qualification, and low rate production.

This report recommended advocating a broad approach for both DoD and the Services in terms of policy and programmatic strategies. Challenges include establishing forums for Government/Industry collaboration; periodic monitoring the health of the PCB sector; identifying future technology investments relevant to electronic interconnects; maintaining a utilization and modernization plan for DoD organic PCB fabrication facilities; and assessing the impact of system assurance policies on PCB technology and the industry.

B.5 Defense Contract Management Agency

Industry Economic Assessment - Aerospace (July 2011)

The Defense Contract Management Agency Industrial Analysis Center 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 fiscal years 2010-2011. The report addresses the economic and federal budget outlook, supply and demand, and industrial base issues of the three major aircraft sectors: Fixed Wing, Helicopters, and Unmanned Aerial Systems.

The findings and analysis in this report is provided for use by the DoD community and is used for strategic planning. The assessment determines current supply and demand and the impact on the defense industrial base. The report also provides an assessment of industry factors that affect current and future conditions of the aerospace marketplace that may affect the industrial capacity of military specific aircraft. IAC identifies major prime and sub-tier contractors and provides production forecasts and trends.

Using government and external data sources, the assessment evaluated the macro-economic issues, federal budget trends, DoD budget trends, census data, technology trends, aircraft production trends, and financial health of firms in the aerospace industry. Several reliable data sources used for the assessment include companies' annual reports, aerospace forecast databases, and industry periodicals. The IAC also used insight gained from interviews with company officials during the course of normal business operations, as well as the results of applicable Industrial Capabilities Assessments.

Since 2001, DoD aircraft accounts have increased steadily, especially for the Operations and Management accounts and funding for DoD helicopter programs. DoD aircraft production also increased during the past ten years, with peaks in 2008 and 2010. However, the U.S. Budget Control Act of 2011 and the eventual redeployment from Iraq and Afghanistan will likely adjust the military sector's demand downward. DoD aircraft accounts will likely compete against mandatory accounts as target areas for federal budget reduction. The commercial aircraft sector, however, is expected to increase production because of increase demand. DoD helicopter demand is likely to remain stable for 2012-2013 due to the recapitalization of fleets returning from overseas contingency operations. The challenge for DoD helicopter recapitalization efforts is to stabilize cost growth in an era of federal austerity. DoD manned fixed wing demand, although stable for 2011, is seen as a visible target for spending reduction beyond 2012. DoD unmanned aerial system sector looks promising with robust growth rate. Moreover, increasing demand for DoD unmanned aerial systems could be viewed as a trade-off for lower cost fixed wing capabilities.

Industry Economic Assessment - Space and Missiles (July 2011)

DCMA IAC conducts an annual economic analysis of the Space and Missile Sectors. The purpose of the assessment was to review industry trends and the economic outlook for fiscal year 2010. The report addresses the economic and federal budget outlook, supply and demand, and industrial base issues for space (including launch vehicles and satellites) and missiles (including tactical, strategic, and precision guided munitions (PGMs)).

The findings and analysis in this report is provided for use by the DoD community for strategic planning. The assessment covers determining supply and demand and the impact on the defense industrial base. The report also provides an assessment of industry factors that affect current and future conditions of the space and missile marketplace that may impact the industrial capacity of space and missile systems. DCMA identifies major prime and sub-tier contractors and provides production forecasts and trends.

Using government and external data sources, the assessment methodology focused on the demand and supply factors that affect the Space and Missile Sector. The assessment evaluated macro-economic conditions, census data, federal budget trends, DoD budget trends, technology trends, space systems production trends, and the financial health of firms in the space and missile industry. Several reliable data sources used for the assessment include companies' annual reports, space and missile forecast databases, and major periodicals. The IAC also used insight gained from interviews with company officials during the course of normal business operations, as well as the results of applicable Industrial Capabilities Assessments.

The Space and Missile Sector budget is projected to decline because of record government deficits. With declining demand and budget resources from DoD, the Space Sector of the industrial base must control rising programmatic costs or face additional budget reductions and program cancellations. A faltering economy is affecting demand of commercial space products. NASA (National Aeronautics and Space Administration) is undergoing significant change as the agency retires the space shuttle, cancels the Constellation program (manned moon missions by 2019), and begins contracting out cargo and later manned space flights to the International Space Station (ISS). These actions by NASA are likely to cause a gap of at least four years with no manned space flights until a new replacement vehicle becomes available. The Space and Missile Sectors of the industrial base (like the overall industrial base) are impacted by skill shortages as older workers retire. With fewer new workers to replace them, this creates a dire need for both government and industry to address this issue. While most companies in the Space and Missile Sectors of the industrial base are in good financial condition, the Solid Rocket Motor Subsector's financial condition is worse due to declining demand. The Missile Sector is also impacted by declining budgets and rising development costs. The key budget driver here is end of operations in Iraq and the winding down of operations in Afghanistan. Inventory replacement will keep the decline modest and may lead to some increases in missile procurement funding after

2012. Rising development and other costs result in fewer programs that cover multiple missions, such as the JAGM (Joint Air-to-Ground Missile). Limited budget resources will preclude full production of JAGM and other programs until after 2018. With current budget reductions and programmatic issues, further facility consolidations will be likely over the next decade. Additionally, excessive International Traffic in Arms Regulations (ITAR) restrictions are adversely impacting the ability of U.S. space and missile product producers to compete in international markets.

B.6 Defense Logistics Agency

Manufacturing Base Analysis (October 2011)

DLA Aviation conducted 334 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 11 existing long-term contracts. Visits were made to contractor facilities at Continental Connector in Reading, PA, Triman Industries in West Berlin, NJ, Herndon Products in O'Fallon, MO, Essex Cryogenics in St. Louis, MO, and Aerospace Filtration Systems in St. Charles, MO. These contracts covered 28 National Stock Numbers. All of the evaluated contracts were determined to comply with the surge provision. DLA Aviation utilized the ProModel® Simulation Software to assess manufacturing capacity during compliance review for surge validations.

The Industrial Preparedness Team ensured that the manufacturing base was considered in the development of DLA Aviation's sourcing strategies by reviewing 530 acquisition plans and performing over 113,289 Defense Priority and Allocation System reviews. Additionally DLA Aviation performed five 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 five assessments was determined to be at risk (have negative impact to the industrial base) due to the proposed acquisition strategy.

Mine Resistant Ambush Protected Vehicle Tires (October 2011)

Demand has exceeded production capacity for size 16.00R20 tires used on the Mine Resistant Ambush Protected (MRAP), as well as Armored Security Vehicle (ASV), Heavy Expanded Mobility Tactical Truck (HEMTT), Palletized Loading System (PLS), Heavy Equipment Transporter (HET), Medium Tactical Vehicle Replacement (MTVR), and Logistics Vehicle System Replacement. Michelin and Goodyear are producing 16.00R20 tires at a capacity of 6,900 per month, Michelin at 6,300 per month, and Goodyear at 600 per month. To alleviate Warfighter impact, the Defense Priorities and Allocations System (DPAS) is being used to move production on the MRAP ahead of that for the HET, HEMTT, and PLS. Other measures to satisfy customer demands include breaking down excess wheel assemblies on other programs, harvesting carcass tires that meet serviceable criteria, extending shelf life, and using tires off new trucks that are not yet required for fielding. Other future options to expand production capacity are being explored with Michelin, Goodyear, and Bridgestone but require significant investment and implementation, which could take as long as two years. The tire manufacturers believe they should have been provided more lead time to address the surge in demand for the 16.00R20 tire. The lack of lead time is the result of the increase in use of Improvised Explosive Devices in-theater, and a requirement to simultaneously make the 16.00R20 tire for both MRAP-All Terrain Vehicle production

and the additional Underbody Improvement Kits. Production of the kits resulted in an unplanned requirement. The industrial capability issue is expected to be resolved by near the end of FY2012.

Rapid Wall, Force Protection Barriers (October 2011)

DLA commissioned a 2011 study to update the data, findings, and recommendations originally presented in the *2005 HESCO Bastions, Ltd. Industrial Base Study*. Specific tasks called for in this study were: (1) a revalidation of wartime requirements for HESCO products; (2) a reassessment of HESCO's current capability and surge capacity using the Warstopper-funded material currently in place; (3) an evaluation of sub-tier vendor capability and possible need for adjustments in Warstopper-funded materials; and (4) a recalculation of the Government's return on investment for any changes in raw material investments.

The study team found requirements had not changed significantly, and the Warstopper-funded materials provided because of the 2005 study facilitated major improvements in productivity. The industrial base for sub-tier suppliers was robust, with improvements in lead times since the 2005 study. As a result, HESCO's maximum factory production capability was nearly double the new proposed surge requirement.

The study team recommended that DLA maintain current levels of Warstopper-funded inventory until the current contract expires in June 2013. Two short term actions were also recommended: (1) simulation modeling of the HESCO supply chain in FY2012 to evaluate the impact of options to maintain, change, or eliminate current levels of prepositioned material in the next contract; and (2) for the Class IV Division of the DLA Troop Support Construction and Equipment Supply Chain, to coordinate with the Warstopper Program Manager when selecting an appropriate Warstopper exit strategy from the current contract.

Ballistic Helmet (November 2011)

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.

Market Intelligence for Strategic Sourcing Decisions (November 2011)

DLA Land and Maritime's purpose for this project is to develop a market intelligence capability along with companion acquisition strategies to procure multiple National Stock Numbers (NSNs) of a similar nature. A successful market intelligence capability would identify the underlying manufacturing processes, materials, and existing commercial business-relationships to visualize and gain insight into the way that industry organizes itself to do business. Forming DLA acquisition strategies that align with the natural way that industry functions should yield synergies for industry and the Department of Defense. The goal of the strategy is to decrease costs and improve delivery lead times.

DLA Land and Maritime performed a spend analysis that identified the top NSNs and Federal Supply Classes (FSCs) based on sales. One of the top FSCs is 4720, Hose and Flexible Tubing. The Industrial Base Support Group (IBS) assisted in finding methods to group the items and identify industrial sources of supply. The IBS developed a manageable list of 988 items from FSC 4720 to research as a pilot study. Deliverables from the pilot study are NSN groupings of the pilot NSNs, list of potential sources for each NSN, evaluation of the role of a DLA-industry relationship in the market intelligence process, and access to a platform adapted for DLA to test and evaluate the emerging market intelligence capability. Interaction in the pilot study was enhanced by the formation of a Market Intelligence Working Group with both National Association of Hose and Accessories Distributors and DLA membership. The Working Group, with DLA R&D support, fosters a two-way flow of information in a structured and sustained way, as well as, a forum for decision support processes.

Upon a successful milestone evaluation, the scope will be expanded to challenge the pilot process by: (1) validating robustness by increasing NSN load by volume; (2) introducing other commodity groups that may or may not respond similarly to FSC 4720; and (3) enhancing the interim operating capability based on user and performance feedback.

Petroleum, Oil, and Lubricants (November 2011)

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 (10-year base plus two five-year options) with reliable suppliers. There were no interruptions of supply during FY2011 for either product. DLA Energy delivered 100 percent of its hydrazine and N_2O_4 shipments to customers without incident.

In FY2011, DLA Energy awarded one alternative fuel contract for 11,000 gallons of alcohol to jet fuel to be delivered to Wright-Patterson AFB, Ohio, in support of the Air Force’s testing/certification programs and alternative fuel goals. DLA Contracting

Services Office exercised the option on an alternative fuel from organic sources research and development contract on behalf of DLA Energy to deliver an additional 75,000 gallons of algae-derived F-76 to NAS Patuxent River, Maryland, and FLC Puget Sound, Washington.

DLA Energy continues to support the Air Force 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. DLA Energy is issuing an RFP for new contracts in FY2012. DLA Energy encounters difficulties in securing suppliers of JPTS due to the extensive qualification process required to be a certified supplier.

Warstopper Industrial Base Studies Program (December 2011)

The Warstopper Program had an active year of industrial base studies. The completed studies included ones for bastions barrier material, lithium batteries, and a supply chain simulation model for ballistic helmets.

The purpose of the bastions study was to revalidate wartime requirements for HESCO Bastion force protection products, re-assess industrial capability, and re-assess surge capacity using the Warstopper-funded material currently in place. The study also evaluated the sub-tier vendor capacity and recalculated a return on investment for any proposed changes in raw material investments. The study found that surge requirements had not changed significantly from the original 2005 study and that HESCO's maximum factory production capability had increased. The study recommended keeping the existing investment in place and developing a pre-determined contract exit strategy for use when the current contract expires in June 2013.

The lithium battery study's purpose was to assess the effectiveness of DLA's current lithium battery acquisition strategy, its impact on the industrial base, benchmark commercial industry acquisition practices, and determine the surge requirements for lithium batteries. The study team's research of commercial best practices revealed that non-DoD battery customers are using lean supply chain strategies, including highly collaborative Just-in-Time or consigned inventory supply arrangements, to achieve cost savings beyond price reduction. DLA is making huge strides in maintaining the industrial base for batteries by pursuing long-term contracts with multiple sources. DLA is also utilizing Customer Direct arrangements for items with short shelf-life and

maintaining stock levels for items with long production lead times to balance the appropriate support to the Warfighter. DLA is also promoting commercial best practices by utilizing a Vendor Managed Inventory model for commercial type batteries, achieving success in the area of fill rate. Moreover, DLA has reduced overall backorders in the battery area by 49 percent over the last 14 months.

The purpose of the ballistic helmet study was to assess opportunities for production lead-time reduction for the Army's Advanced Combat Helmet and to develop an implementation plan, including the assessment of Warstopper investment opportunities in order to improve wartime readiness. The study team developed a ProModel® (decision-assisting software) simulation to assess the impact of buffer materials in the supply chain during a wartime surge event and identified the optimum buffer size and location. The team looked at several scenarios to assess the impact of buffer materials at a "low" and "medium" starting capacity for the first 60 days followed by a ramp-up to full capacity through 180 days. In addition, the team ran a three-month mini-surge scenario that maintained the supply chain at a "low" capacity with restricted hours to demonstrate the flexibility of the buffer strategy. Based on this analysis, the team recommended a potential future Warstopper investment (as Government furnished material) of 75 uncoated fabric rolls and 6,250 unfinished molded helmets at one of the ACH producers.

Appendix C - Related Activities

C.1 Title III – Defense Production Act Summaries

Technical efforts were successfully completed for the following six projects in 2011.

Armstrong Titanium Production

In 2011, the Title III Program completed a three-year partnership with International Titanium Powder (ITP), a Woodridge, IL, company, to establish a first-of-its-kind pilot production plant to produce lower cost titanium powder using the patented Armstrong Process®. The current industry standard for titanium production, the Hunter/Kroll process, is a multi-step, energy-intensive, batch process. The Armstrong Process is a low-energy, controlled, continuous, chemical reaction process that produces pure, high quality titanium powder by injecting chlorinated titanium (TiCl) into a stream of liquid sodium (Na). Standard and novel alloys can also be produced by injecting chlorides of the alloying elements into the TiCl/Na stream. The new production facility, located in Ottawa, IL, houses two production lines with a combined output of four million pounds of titanium powder per year. The Armstrong Process is a disruptive technology in the titanium manufacturing market because of its potential to significantly reduce titanium component manufacturing cost and lead time for both commercial and military manufacturers. Using Armstrong powder, direct consolidation techniques can be employed to form near-net-shape components, sheets, plates, blocks, or pipe. Making titanium affordable for more ground-based military systems can increase force mobility, survivability, and reduce total lifecycle costs.

This project was funded through Congressional increase to the Title III budget. Total Title III funding was $4.5M, augmented by $4.5M of contractor cost sharing. This was a sole source solicitation as a single domestic source was identified as having an appropriate readiness level for the technology of interest.

Beryllium Production

This project allows the United States and its allies to be assured of an uninterrupted supply of primary (high-purity) beryllium metal. Current inventories of National Defense Stockpile beryllium ingots are projected to be exhausted in the near future. Imports of beryllium cannot meet the purity levels required for many defense applications. Essential strategic uses, where there is no suitable substitute for high-purity beryllium, include: airborne Forward Looking Infrared (FLIR) systems for fighter aircraft and attack helicopters; guidance systems on existing strategic missiles; surveillance satellites; ballistic missile defense systems; and reflectors for high flux, nuclear test reactors.

The Title III Program entered into a partnership with Materion Corporation (then Brush Wellman, Inc.) in November 2005, thereby initiating construction of the beryllium "Pebbles Plant" in Elmore, Ohio. Since project award, Materion has successfully established the infrastructure, facilities, and equipment necessary to support a production capacity of 160,000 pounds per year of high-purity beryllium metal. Today, the completed plant stands 73 feet tall, contains three levels, has a 51,045 sq. ft. footprint, and contains 124,358 total square feet of floor space. The plant produced its very first batch of beryllium pebbles on 15 April 2011. Beryllium pebble qualification and the Initial Operational Capability of the plant were achieved in December 2011, with normal plant operations beginning in January 2012.

Initial funding was provided through DoD increases to the DPA Title III budget. Additionally, Congressional increases were added to accelerate the restoration of this critical domestic production capacity. Total Title III funding on this project was $73.23M. Materion provided an additional $26.4M in company cost share for the project. Materion's cost share consisted of the building, supporting infrastructure, tie-ins, and ancillary laboratory equipment. This was a sole source solicitation as a single domestic source was identified for the specific technology of interest.

Flexible Aerogel Materials

This Title III venture established affordable production by a domestic supplier of flexible aerogel materials. Aerogels are nanoporous solids with up to 99 percent open porosity often called "frozen smoke." The nanoscale lattice and pores provide high performance with minimal weight and space. Military applications are expected for high-temperature thermal insulation, acoustic protection, infrared suppression, and energy absorption. Many commercial applications for these same qualities are expected at lower temperatures. Work on this project has included testing and qualification of the materials for potential applications, cost reduction, and the establishment of a full scale, high-volume production capacity for high-temperature aerogels.

This project was funded through Congressional increase to the Title III budget. Total Title III funding was $17.1M augmented by $38M of contractor cost sharing. This was a competitive solicitation.

Polycrystalline Laser Gain Materials (PLGM)

This Title III program established a domestic resource for Polycrystalline Laser Gain Materials (PLGM). PLGM are high-strength, optically transparent materials with good thermal properties that are doped with rare-earth metal additives to produce laser gain materials for use as lasing media. These materials can be shaped and polished to yield high-power laser line emission at a variety of infrared wavelengths depending on the dopants. This effort developed a manufacturing capability for design, fabrication, finishing, coating, and testing of PLGM that can be used in military high-energy laser

weapon systems and that have additional applications for range finding, laser radar, and infrared countermeasures.

This project was funded through Congressional increase to the Title III budget. Total Title III funding was $4.7M, augmented by $1.4M of contractor cost sharing. This was a competitive solicitation.

Polyhedral Oligomeric Silsesquioxanes (POSS™) Nanotechnology

Through Title III authorities, the world's first and only high-volume production capacity for Polyhedral Oligomeric Silsesquioxane (POSS®) Nanochemicals® has been established. POSS is the first entirely new, green, nontoxic, environmentally friendly, and recyclable polymer feedstock developed since 1950. It marries the beneficial properties of plastics (processibility and toughness) with those of ceramics (hardness and stability) while being able to be incorporated directly into existing formulations without modifying manufacturing processes. The result is immediate turnkey applicability and usability.

Through this project, production capacity grew 900 percent, and product price dropped to a fraction of what it sold at in a laboratory environment.

As a nanochemical, POSS molecules are small – only 1.5 nanometers in diameter, but the uses of this versatile chemical are wide and varied. POSS has been researched and/or commercialized in a plethora of applications such as food packaging, solar cell covering, dental materials, radiation hardening, epoxy resins, lead-free solders, UV-cured paint dispersants, super hydrophobic surfaces, and fire proof composites.

Medical history was made in 2011 with the world's first synthetic organ transplant. A terminally ill cancer patient received a new lease on life with the transplant of a synthetic trachea made from POSS. Seeded with the patient's own stem cells, the inert POSS windpipe scaffold became an organ indistinguishable from a normal healthy one. The patient's body accepted the POSS polymer trachea with no infection or inflammation, and without the need for strong anti-rejection drugs.

DoD is actively engaged in developing a POSS-based hemostat to enable revolutionary advancement in hemostasis and stabilization of soldiers with noncompressable hemorrhagic wounds. This effort is to develop a highly deployable injectable/pourable liquid hemostat that forms a durable transparent viscoelastic clot with a soldier's own blood and tissue. Since 2010, in-vivo experiments have led to astonishing results as POSS has repeatedly proven to stop deep incompressible bleeding within a matter of seconds. On initial testing, POSS appears to act as a mild antiseptic with treated areas showed no sign of infection or deterioration.

This project was funded through Congressional increase to the Title III budget. Total Title III funding was $16.9M, augmented by $0.2M of contractor cost sharing. This was a competitive solicitation.

Reactive Plastic CO2 Absorbent

In this project, the Title III Program partnered with Micropore, Inc., of Elkton, Maryland to expand domestic production capacity of carbon dioxide (CO2) absorbent products and develop improvements for several CO2 absorbent applications. Reactive Plastic CO2 absorbent material is a technology that secures CO2 absorbing material to a plastic sheet in a polymer matrix bond. It is used in military scuba, submarine, space, anesthesia, firefighting, and rescue applications to “clean” CO2 from air needed for breathing. The Title III Program worked with Micropore to expand their absorbent manufacturing capacity and develop new, improved manufacturing processes and equipment. This capacity expansion allowed the production and timely delivery of emergency submarine curtains for Virginia class submarines. During this project, Micropore became ISO 9001:2000 certified and implemented a Quality Management System. This project also allowed Micropore to develop additional applications quickly for Reactive Plastic CO2 absorbent. The U.S. Navy utilizes the advantages of Reactive Plastic CO2 absorbent in SCUBA rebreather gear and emergency submarine use. Advantages to military SCUBA diving over previous products include extended diving duration and reduced diver breathing effort. Compared with previously used absorbent products, the Micropore emergency CO2 absorbent curtains in use aboard military submarines allow significant space savings, longer product life, easier and safer product handling, and reduced product life cycle costs.

This project was funded through Congressional increase to the Title III budget. ManTech added additional funds. Total government funding is $12.1M, augmented by $2.1M of contractor cost sharing. This was a sole source solicitation as a single domestic source was identified for the specific technology of interest.

The following highlights are brief descriptions of each of the remaining active Title III projects.

Advanced Carbon Nanotube Volume Production

This Title III project will provide infrastructure for the world’s first manufacturing production facility of carbon nanotube (CNT) yarn and sheet material. Project emphasis is being placed 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.

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.

ALON® and Spinel Optical Ceramics

Military weapon platforms such as the Stryker and High-Mobility Multipurpose Wheeled Vehicle (HMMWV) require lighter weight, higher performance, and lower cost optical materials. Aluminum oxynitride (ALON) and spinel (magnesium aluminate spinel) are extremely durable optical ceramics with excellent ballistic and transmission capabilities. ALON® and spinel components demonstrate characteristics 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. Title III is supporting an initiative to establish an integrated, flexible manufacturing process capable of producing these two materials in the shapes and sizes required for aircraft transparencies, missile domes, reconnaissance windows, and transparent armor applications. 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 $17.2M, 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. By the conclusion of the project the ALD process will transition to production, and the DoD will have a qualified, domestic source for the ALD hermetic coating.

This project was funded in part with offsets transferred to the Title III budget from the Missile Defense Agency and Navy. Other funds were transferred from the Army and Navy. Total government funding was $5.4M, combined with $0.5M in cost sharing by the contractor. This was a sole source solicitation as 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, lower structural capability, hazardous for fire, and 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 replacing components in naval ship exhaust and ventilation systems and rapid development of manufacturing tooling. It exhibits similar properties as other materials at a lower cost, and outperforms other products at 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.

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 a single domestic source was identified for the specific technology of interest.

Conductive Composites

This Title III Conductive Composites project is establishing a domestic source of high performance CVD coated materials to provide the DoD with resources to answer current and future Warfighter materials problems. The project will scale-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, 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 will be placed on business planning and activities that will support sustainable economic viability.

This project was funded through Congressional increase to the Title III budget. DPA Title III funding is $2.526M, augmented by $0.65M of contractor cost sharing. This was a competitive solicitation.

Extremely Large Domestic Expendable and Reusable Structures

Current domestic production of large-scale (diameters greater than five meters) advanced composite structures is constrained by manufacturing process limitations. Structures and components currently made of metal add weight to space launch and delivery vehicles, adversely affecting payload capacity. Composites technologies have successfully demonstrated the ability to provide lighter weight, higher strength structures for current and next generation space launch and delivery systems. This Title III initiative will improve manufacturing processes and increase manufacturing capacity for domestic production of large-scale advanced composite structures via the incorporation of "state-of-the-art" automated composite fiber placement technologies. Several DoD, NASA, and U.S. commercial space industry programs involving crew and heavy cargo lift requirements will benefit from more efficient and expanded production capabilities.

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, below.

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 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.

This project was funded in part with offsets transferred to the Title III budget from the Missile Defense Agency and 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 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.

Heavy Forgings Capacity Improvement Project

The purpose of this Title III project is to upgrade and refurbish the single domestic source for heavy forgings; DoD applications include propulsion shafts for surface and sub surface naval vessels, periscope tubes, and ring forgings for bull gears. 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 special 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 bottleneck operations and single points of failure that are critical to maintain supply of heavy forgings to the DoD. This project is critical to shore up the single domestic source for heavy forgings.

The total project funding level is $3.27M, which includes Government funding of $2.89M and Contractor Cost Share of $0.33M. 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.

Integrated Advanced Composite Fiber Placement

Current process/production capabilities for large advanced composite structures are slow and time-consuming, and cannot keep pace with demands projected for the government and commercial aerospace industries. This Title III project will expand the domestic supply base for automated composite structure and production technologies, maximize processing/cost benefit ratios, and provide cost effective production of advanced composite structures for military and commercial customers. The project is creating commercially viable production capabilities, and will share manufacturing enhancements with the commercial composite production community as appropriate.

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 a single domestic source was identified for the specific technology of interest.

Light-Weight Ammunition and Armor

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, lower transportation/shipping costs 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 .50 caliber 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 validated for the polymer-cased .50 caliber ammunition, which weighs approximately 25 percent less than standard brass ammunition and has a brass base. Full qualification testing will take place in 2012.

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 $12.9M, augmented by $10,000 of contractor cost sharing. This was a sole source solicitation as a single domestic source was identified for the specific technology of interest.

Lithium-Ion Battery Production

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 the developed batteries today. Additional advantages include better recharging capability with no memory effect and increased temperature operating ranges. This technology offers designers a weight saving option compared to other battery types for overall weapon systems performance.

This project was funded initially by funding provided from the DoD Title III budget, plus other funding transferred from the Air Force and another government agency. A one million dollar Congressional increase for Title III was provided during project execution. Total government funding is $42.5M, augmented by $11.7M of contractor cost sharing. This was a competitive solicitation.

Low-Cost Military Global Positioning System Receivers

Military Global Positioning System (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 GPS receivers, soldiers are at a loss for 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.

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 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.

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 is currently supporting an enterprise that will establish a domestic low-volume production facility for mini-refrigerant vapor compressors. The program's industry partner recently purchased a production facility, and Title III is assisting with plant facilitation, to include the purchase of manufacturing, assembly, and test equipment. 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.

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.

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.

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 0.35 micron, deep sub-micron Complementary Metal Oxide Semiconductor (CMOS) Radiation-Hardened Cryogenic Readout Integrated Circuits (ROICs) 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, reduction of particle counts that improve production yields, and improved fabrication cycle times. All of these improvements will collectively increase the mission capability of the systems.

This project was funded through 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.

Radiation-Hardened Microprocessors

This Title III project is scaling up production capacities for high-performance radiation-hardened microprocessors with 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 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 ROIC's 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.

Beyond DPA Title III, funding, additional funds were added by another government agency. Total government funding is $10.5M for two vendors augmented by 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.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $4.9M, augmented by $4.2M 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.

The U.S. Army, Force XXI Battle Command, Brigade and Below Program Office provided Title III funding for this project. Total government funding is $3.0M, with no contractor cost sharing. This project was awarded via a competitive solicitation.

Thermal Battery Production

The objective of this Title III initiative is to strengthen and expand a domestic source for advanced thermal batteries. Military unique, high performance batteries are the only viable power source for many defense systems. The Missile Defense Agency and Service program offices have identified several high performance battery technologies for which there is insufficient availability or producibility to meet known and planned program requirements. The Title III program is developing incentives for a domestic company to scale up production and expand internal capacity. The applicability of these batteries to a wide variety of DoD weapons systems offers Army, Navy, and Air Force program offices the ability to greatly enhance system performance.

This project was funded through Congressional increase to the Title III budget. Total Title III funding is $14.4M. This was a competitive solicitation.

Titanium Metal Matrix Composites

Titanium Metal Matrix Composites (TiMMCs) 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 TiMMCs to support the Warfighter and assist the development of a database of TiMMC material characteristics and the processes required to produce TiMMCs.

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 a single domestic source was identified for the specific technology of interest.

Traveling Wave Tube Amplifiers for Space

Traveling Wave Tube Amplifiers (TWTAs) are a critical component aboard communications satellites and are 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 constantly increase data rates. The primary objective of this Title III project is to improve, sustain, and grow the only domestic space qualified K-band TWTA product line for future higher power applications and to meet the Commercial and DOD demand for faster data rates. The K frequency band, 18-21 GHz, is primarily a communications band. Government uses for TWTAs include military, scientific, and national security. DoD satellites using these K-band TWTAs will support the growing need for real-time information and controls among deployed assets.

Additional funds were added by another government agency. Total government funding is $12.9M, augmented by $13M of contractor cost sharing. This was a sole source solicitation as a single domestic source was identified for the specific technology of interest.

Vacuum Induction Melting, Vacuum Arc Remelting Furnace Capacity

Low alloy Vacuum Induction Melting, Vacuum Arc Remelting (VIM-VAR) steel is highly refined steel that is processed through multiple melts under vacuum to reduce excess gases and other impurities. VIM-VAR alloy steel is essential for many military applications including engine bearings, helicopter rotor shafts, transmission gears and engine mounts. This Title III initiative to increase VIM-VAR capacity will reduce the order lead times and ensure the domestic supply of clean alloy steels for critical military components.

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.

The Title III Program Office was executing acquisition processes for seven additional projects at the end of 2011. These projects should see award of agreements/contracts with 10 or 11 domestic firms within the first quarter of 2012. The projects in the acquisition phase are:

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

This project will increase the availability of domestically produced visible imagers, manufactured using Advanced Complementary Metal Oxide Semiconductors (CMOS) technology, that are designed to enable flexible visible imaging systems for use on-board satellite systems for Department of Defense and other U.S. Government needs.

Bio-Synthetic Paraffinic Kerosene

Bio-Synthetic Paraffinic Kerosene (BSPK) is a biomass-based alternative jet fuel product capable of achieving these objectives. This Title III project will increase current domestic BPSK production capacity of 500,000 gallons to approximately 10 million gallons annually.

Cadmium Zinc Telluride Wafer Substrate Production Capability

This project will establish a domestic, economically viable, open-foundry merchant supplier production capability for Cadmium Zinc Telluride [CdZnTe] Wafer Substrates employed for Mercury Cadmium Telluride [HgCdTe] detector growth.

Gallium Nitride on Silicon Carbide Advanced Electronic Warfare Monolithic MMIC Production Capacity Project

This project will establish a domestic, economically viable, open-foundry merchant supplier production capability for wide bandwidth, high frequency GaN on Silicon Carbide [SiC] MMICs for power amplifiers applications in electronic warfare.

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.

Space Qualified Solar Cell Supply Chain Project

This project will establish a qualified domestic source for the manufacture of solar cell germanium substrates to meet National Security Space requirements.

Terahertz (THz) 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 explosives, chemical agents, and biological 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 will be suited to operating in field (non-laboratory) environments.

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/yr) 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.

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. ManTech exists to reduce manufacturing affordability and producibility risks to enable transition of critical technologies to Programs of Record. The program accomplishes this through demonstration of effective, efficient and adaptable processes and encourages strong internal and external partnerships.

The Deputy Assistant Secretary of the Army for Research and Technology (DASA R&T) has overall responsibility for the Army ManTech Program. Within this office, system domain directors provide oversight and coordination of ManTech consistent with Science and Technology (S&T) domain areas. 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 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 Strategic Plan and application of systems engineering during projects to promote effective project planning and execution.

Investment Strategy

The investment Strategy for the Army ManTech program is to ensure that ManTech addresses relevant requirements and achieves technology transition. RDECOM engages with the Army S&T community, Program Executive Officers (PEOs), Program Managers (PMs) and Industry to strengthen ManTech products in support of DASA (R&T) priorities. 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, reviewed by the Joint Defense ManTech Panel (JDMTP) and coordinated in concert with RDECOM Technology Focus Teams (TFTs) and System Integration Domains (SIDs). Projects are approved by the RDECOM Board of Directors.

Investments are strategically organized by the following domains:

Air Systems - to include investing in rotary wing and unmanned air vehicle ManTech efforts, embedded sensors for composite structures;

Ground Systems and Precision - 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 to include network centric model based enterprise data to support integrated weapons system life-cycle.

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 10 percent reduction in total system weight. The strategy for ManTech investments bring 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 deliver maximize ballistic efficient of all constituent materials. This program is continuously coordinated with PM Soldier to ensure relevance to specific weight reduction requirements and 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 Soldier's investment in issuing a new specification for improved body armor.

This same strategy was utilized to achieve success in the award winning completed Army ManTech project, "Improved Warfighter Protection" through helmet manufacturing. The Army Research Lab, in close collaboration with the Natick Research, Development and Engineering Center (NSRDEC) and PM Soldier, used Army ManTech and leveraged Small Business Innovation Research (SBIR) funds to address technology barriers that enabled the use of these new helmet materials. These barriers included preforming and thermoforming technologies associated with thermoplastic composite materials (in contrast to the existing domestic manufacturing base which is optimized for thermoset materials). The project attained a Manufacturing Readiness Level (MRL) of 8 and was instrumental in supplying production-representative helmet shells for ballistic evaluation by PEO Soldier. The technology was transitioned through a TTA with PEO Soldier, and manufacturing specifications were transferred by the PEO to all helmet manufacturers as part of the implementation

strategy. This technology, due to the processes developed and demonstrated by the ManTech program, has already been successfully fielded to the Special Operations Forces (SOF) as the FAST (Future Assault Shell Technology) helmet, and the Enhanced Combat Helmet (ECH) is currently in First Article Testing (FAT). Cost benefits are estimated at $88.3M, with an ROI projected at 16.6 to 1, based on the Army ManTech investment of $5.7M. However, the key impact of the Army helmet ManTech program is unprecedented levels of performance – over 37 percent higher fragment stopping power – over current Army Combat Helmets.

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 Navy ManTech Program is managed by the Office of Transition within the Office of Naval Research (ONR), 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 through its Centers of Excellence (COEs) with expertise in specific technology areas. ManTech's nine COEs are: Benchmarking and Best Practices Center of Excellence (B2PCOE) (Philadelphia, PA); 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); Navy Joining Center (NJC) (Columbus, OH); 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 and is currently focused on affordability improvements for four major shipbuilding acquisition platforms: DDG Family (DDG 1000 and DDG 51), CVN 78 Class Carrier, the Littoral Combat Ship (LCS), and the VIRGINIA Class Submarine (VCS). Additionally, Navy ManTech has recently added a secondary affordability focus on Joint Strike Fighter (JSF). It is ManTech's focus to help these programs achieve their respective

affordability goals by transitioning needed manufacturing technology which, when implemented, results in a cost reduction or cost avoidance (measured as a per-hull or per-aircraft cost reduction).

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 bought off by 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.

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 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,

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 that 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 (FY2005 $) 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 2011 Affordability Assessment which was vetted through PMS 450). To date, twenty-one of the ManTech affordability projects have implemented or are in the process of implementation. Realized cost savings/ hull of approximately $19M have been recognized by the VIRGINIA Class Program Office and General Dynamics Electric Boat. These real acquisition cost savings for VCS have been negotiated into the Block III VIRGINIA Class submarine procurement. 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 recent implementation success for Navy ManTech's new Joint Strike Fighter (JSF) Affordability Initiative was for automated fiber placement (AFP) for carbon fiber bismaleimide (BMI) material. In this effort, Navy ManTech teamed with Lockheed Martin Aerospace, Hitco Carbon Composites, MAG Cincinnati, and Cytec Engineered Materials to optimize the AFP process for BMI material used for JSF wing skins to reduce weight and improve operational performance. Through the ManTech effort, the team determined material, machine, and process interactions in the manufacturing environment to enhance productivity and make the fabrication of wing skins and nacelle structure more affordable. With an investment of approximately $3M, this effort led to increased lay-down rates of BMI AFP fabrication for both the wing skins and nacelle structure and eliminated the need for additional composite fabrication machinery and tooling. The manufacturing protocols and support fabrication technology were inserted real-time into the production of flight hardware for all three versions of the JSF aircraft - CV, STOVL, and CTOL. Total cost savings for this effort is expected to exceed $100M.

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.

"ManTech's $3M investment in BMI placement has produced substantial efficiencies in our manufacturing processes. This includes a 50 percent reduction in part cycle time and 300 percent improvement in fiber lay-down rates. These efficiencies stand to not only reduce aircraft production costs, but also reduce the need for additional composite machinery and tooling. In all, the efficiencies gained through this ManTech initiative are expected to reduce F-35 program costs by $100M over the next 25 years."

VADM David J. Venlet,
Program Executive Officer - F-35
Lightning II Program,
30 September 2011

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 and 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 is increasingly characterized by accelerated change and heightened system complexity. The Factory of the Future is characterized by an environment 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 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 absolutely 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 and 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.

Digital Radiography: Non-Destructive Evaluation (NDE) of a casting during qualification and production is expensive and time consuming with limited ability to share data with other vested parties. The cost of film used in traditional radiographic techniques has been rising 9-20 percent per year over the past five years due to decreasing demand for film from medical conversion to digital and the increasing price of silver, which is used in the manufacture of radiographic film. Inspection cost per part varies depending on casting size, geometry, alloy and criticality. On a yearly basis a single aerospace qualified foundry will consume more radiographic film than a very large metropolitan hospital. Digital radiography technology is becoming increasingly available as an in-house inspection tool for metal casting quality assessment. However, without proven equivalency to film, accepted digital reference standards, industry standard training, and standardized implementation requirements digital radiography cannot be used as a final part acceptance inspection method in the aerospace industry. The Air Force and the Defense Logistics Agency have collaborated with industry, the industry associations, and academia to work together with ASTM to create the required standards for digital reference radiographs and eliminate other barriers to implementation of digital radiography. The digital standards are being developed to create reference images that replicate current universally recognized radiographic film standards. Implementation requirements (including training) were standardized via an Industry Guidelines Document (soon to be ASTM certified) to ensure parts could transition to digital inspection under a unified aerospace specification, reducing cost of conversion. Benefits include industry standardization for greater proliferation of digital inspection methods and sharing of data, projected $80M in cost reductions for DoD cast components over the next 10 years, reduced cycle time up to 50 percent depending on configuration, improved environmental compliance through elimination of the need for hazardous chemicals and establishment of a platform for future casting digital innovation such as Integrated Computational Materials and Manufacturing Science and Engineering and Automated Defect Recognition.

Robotic Drilling: Historically air inlet ducts for jet aircraft are manually drilled from the inside to fasten structural members to the duct skin. This process is labor-intensive and ergonomically difficult, e.g. for the F-35 the inlet duct is barely large enough for one person to lie down inside. The AF ManTech program, leveraging SBIR funding, developed an innovative laser-guided robotic drilling technology with first application to the F-35. Three F-35 Inlet Duct Robotic Drilling (IDRD) cells have been implemented for the F-35 program. The three inlet duct cells will drill all three composite inlet ducts and aluminum frames. The new cells began production operation in 2011 with full-rate capability for the F-35 by 2014. The technology developed utilizes a laser coordinate

measurement device to guide an articulated robot arm during the drill process. The net effect is that the equipment achieves positional accuracies of +/-0.006" compared to +/-0.030" with a manual process, and without the need for a large, bulky mechanical system. Although this technology development program is specific to the F-35, the techniques and lessons learned are applicable to a variety of platforms. Benefits include reduced span time from 50 hours to 12 hours per duct and a Unit Recurring Flyaway (URF) cost savings of $7.8K per ship set. Cost avoidance, including recurring and non-recurring cost, to the JSF Program is in excess of $40M. The technology also has non-quantifiable benefits of improved worker ergonomic conditions that reduce medical expenses and improve the quality of the aircraft. Future benefits include the ability to achieve ever more stringent manufacturing tolerances which allow for lighter weight, higher performance aircraft.

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's ManTech Program directly supports the lower tier industrial base of six DLA supply chains: Land, Maritime, Aviation, Construction and Equipment, Combat Rations, and Clothing and Textiles. DLA-managed weapon system items help maintain weapon systems' readiness and keep military repair depot lines adequately supplied so they can operate efficiently. DLA's troop support items keep Warfighters nourished and safe.

DLA is investing 76 percent of its FY 2012 ManTech budget for weapon systems support. The largest weapon systems support investment is in the Advanced Microcircuit Emulation (AME) Program. AME helps mitigate mismatches between modern electronic component life cycles, which are measured in months, and weapon systems life cycles, which are measured in decades. AME provides a reverse engineering and processing capability that is needed to produce small-lot, multifunction, non-procurable microcircuits, quickly and efficiently. One AME part for the Air Force's B-1B aircraft provided over $4M in cost avoidance, compared to redesigning, producing, and qualifying the next higher assembly to replace a non-procurable part. Over time, AME has provided over 100,000 microcircuits for 350 weapon systems with estimated cost avoidance in excess of $700M.

The Customer Driven Uniform Manufacturing (CDUM) program is the largest DLA ManTech program focused on troop support. CDUM develops the business processes needed to obtain total supply chain visibility from the raw material fabric producers to the end consumer. The mechanism used to achieve supply chain visibility is item-level radio frequency identification (RFID), which has been implemented at important manufacturing facilities throughout the United States. CDUM-enabled supply chain visibility has resulted in a $7.9M draw down of inventory while maintaining or improving customer fill rates.