

# **Annual Industrial Capabilities Report To Congress**



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Office of Under Secretary of Defense  
Acquisition, Technology & Logistics  
Industrial Policy

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## 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 1<sup>st</sup> 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.”

This report contains the required information.

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# 1. Executive Summary

The Department of Defense relies on a robust and capable defense industry to develop, field, and maintain high quality goods and services vital to our national security. Just as we depended on a healthy and stable industrial base to build the “Arsenal of Democracy” during World War II, today we continue to rely on the defense industrial base to ensure that our military personnel are supplied with the world’s best equipment, logistics support, and information systems.

The current strategic environment facing our nation dictates that more must be done to change the way the Department of Defense does business. Over the past two decades, the Department has consolidated and contracted around platforms that possessed singular capabilities with little to no cross-mission functionality. The Department’s future requirements demand timely investment in a broad and flexible portfolio of systems, capable of detecting, deterring, and when necessary, defeating both conventional and unconventional threats across the entire spectrum of conflict.

The Department will continue to rely on market forces to create, shape, and sustain the industrial, manufacturing, and technological capabilities necessary to provide our fighting forces with systems that can engage and win full-spectrum warfare. However, when absolutely necessary the Department will intervene to create and/or sustain competition, innovation, and essential industrial capabilities.

On April 6, 2009, Secretary Gates offered the most fundamental restructuring of the Department of the past twenty years, taking the unprecedented step in post-Cold War history of terminating or restructuring major acquisition programs that were not meeting performance, cost, or whose schedule rendered them no longer essential in the rapidly changing threat environment.

The Office of Industrial Policy, as directed by Public Law 111-23, section 303 of the Weapons Systems Acquisition Reform Act of 2009, will continue to conduct assessments on the effects of program terminations on the defense industrial base. The Department’s policy and program decisions affect industry, and industry decisions limit or expand DoD options. To gain greater insight into this relationship the Department has established criteria to evaluate the extent to which the industry supporting defense exhibits the most important desired attributes, reliability, cost-effectiveness, and sufficiency. These industry metrics include funding levels and funding stability in defense market segments, contractor financial and economic performance, segment competitiveness, known/reported problem areas, and on an ad hoc basis, key contractor workforce capabilities necessary for successful programs.

The Office of Industrial Policy also assesses the ongoing financial viability of the U.S. defense industry by measuring and tracking productivity, financial risk, and valuation of the industry against a market baseline. Central to these assessments is the

important, and often overlooked, role that the financial community plays to ensure the health of our industrial base. From the small technology start-ups which seek venture funding to pursue new products and systems, to the debt markets which provide capital support to evolving and maturing programs, the Department must ensure that we do not take for granted this access to capital and work to promote the transparency and stability in our requirements that are the bedrocks of any long-term investment plans.

To ensure that the Department can continue to rely on a dynamic defense market to meet shifting requirements, robust competition is vital for providing high quality, affordable, and innovative products. The Department is concerned about the loss of competition caused by significant industry consolidation over the last decade. The pace of these consolidations does not seem to be slackening, either. In 2009, the Office of Industrial Policy reviewed 42 transactions involving selected companies that operate in the defense sector; 40 of these cases were approved without incident, one case required intervention by the antitrust agencies, and one case required a behavioral agreement to protect continued competition. These numbers suggest that more evaluation is needed to address continued consolidation and the flux of the competitive environment.

Along with domestic merger and acquisition monitoring, the Department also continues to take a close look at foreign M&A activity through membership on the Committee on Foreign Investment in the United States (CFIUS). In assessing foreign acquisitions, the Department's principal objectives are to protect the reliability of supply of goods and services to the Department; to minimize the risks of unauthorized transfer of classified information and export-controlled military and dual use technologies; and assure there is congruence of strategic interests between the acquiring firm and DoD. The Treasury Department, as the chair of the CFIUS interagency team, provides Congress with annual reports on M&A activities involving foreign buyers.

This past year, U.S. aerospace companies have maintained their financial health with relatively low debt and large free cash flow throughout the recent economic downturn. The aircraft industrial base sector is projected to remain healthy despite ongoing market pressures as the vast majority of DoD aviation production programs continue to be supported near-term in the budget process. However, the impact of top line budget constraints on future procurement, Research, Development, Test and Engineering (RDT&E) funding levels, and on future industry design and development capabilities has yet to be determined.

The Command, Control, Communication, Computers, and Information and Communications Technology (C4/ICT) industrial sector remains primarily driven by commercial forces and is forecasted to remain so for the foreseeable future. Nevertheless, given simultaneous military operational requirements for high-mobility, high-security, and high-bandwidth, often in areas with no infrastructure, there will still be some defense-specific products. The new paradigm, however, for these defense products is less about technology or advances in science or engineering but rather



meta-technology or the application, software development, and systems integration of existing commercial technology into defense products.

The ground vehicles industrial base sector continues to benefit from significantly increased requirements in support of ongoing contingency operations. Full-rate production of 1,000 M-ATVs per month, a continued demand for spare parts for fielded vehicles and increased rates of overhaul and maintenance enable the beneficiaries of this work to remain sustainable.

The missile industrial base sector funding profiles have remained fairly stable over the past decade. However, this trend has recently started to change in the strategic and missile defense segments. Projections and forecasts for DoD investments in missile programs are subject to the results from the Nuclear Posture Review, the Ballistic Missile Defense Review, and the Quadrennial Defense Review. As constrained DoD budgets become more strained by higher priority programs, investments in missile research & development and procurement may be more challenged.

Over the past five years, the services industrial base sector has seen exceptional growth and today accounts for roughly 40 percent of all DoD spending. This shift in DoD spending, while necessary, has also brought to bear new challenges to the Department. In-sourcing of “inherently governmental services,” revising and updating the Defense Federal Acquisition Regulation Supplement to address Organizational-Conflicts-of-Interest (OCI) concerns, and retaining competition in niche service segments, are but three areas in which the Department is vigilantly working to establish fair and transparent guidelines for our industry partners.

The shipbuilding industrial base sector, consisting of six major U.S. shipyards building nearly all of the Navy’s ships, continues to produce the most capable warships in the world. While the quality of the ships being produced for the Navy has remained high, the quantity of ships the domestic shipbuilding base can produce in one year pales in comparison to the leading international shipyards. A low volume of production makes it extremely difficult for U.S. shipyards to match the improvements in technology and productivity seen in the international shipyards. Serial production and a stable design are key elements that U.S. shipyards must have to increase productivity and reduce the cost of shipbuilding for the U.S. Navy.

In the space industrial base sector, fifteen of the top U.S. space companies remain financially healthy. The companies were generally profitable at a five percent return on assets or better with all companies having positive gross profit margin. All but one of the companies had increased backlog from the previous year, indicating guaranteed work in the queue. While about half the companies had debt ratios above 60 percent (two of which appear to have high leverage and low liquidity), most were liquid with quick ratios close to or above one.

In order for the defense industry to remain a source of strategic advantage well into the future, the Department and our nation require a consistent, realistic, and long-

term strategy for shaping the structure and capabilities of the defense industrial base. Toward this end, the Department is committed to being more forward-leaning in its ongoing assessments of the industrial base – refocusing our efforts on our future needs, not just our past performance; closer OSD cooperation with the Services to foster an integrated approach to the overall industrial base; and placing transparency and dialogue with industry at the forefront of our agenda.

## 2. New DoD Policy

### Weapon Systems Acquisition Reform Act of 2009

Section 303 of the Weapon Systems Acquisition Reform Act of 2009 (Public Law 111-23) requires that the Department conduct an assessment of the effect of the termination of major defense acquisition programs on technology and industrial base capabilities. To meet this requirement, the Department will report on the conclusions of those assessments as part of the Industrial Sector Summaries, Section 5, of this Annual Industrial Capabilities Report to Congress. On April 6, 2009, Secretary Gates offered perhaps the most fundamental restructuring of the Department in at least two decades, taking the unprecedented step in post-Cold War history of terminating or restructuring major acquisition programs that had issues with performance, cost, or rationale. Specifically, Secretary Gates terminated:

- The Multiple Kill Vehicle missile defense program because of “its significant technical challenges,”
- The \$26B Transformational Satellite program in favor of two more advanced extremely high-frequency satellites as alternatives,
- The CSAR-X search and rescue helicopter program citing its “troubled acquisition history” and questioning whether the intended mission could be better done by a joint asset vice an Air Force-specific aircraft, and
- The VH-71 presidential helicopter program saying that buying the first increment of helicopter would be “neither advisable nor affordable” since these would have only a five to ten-year useful life and do not meet the program’s requirements.

There were also several weapons programs whose fate, according to Secretary Gates, would be determined during the Quadrennial Defense Review. These systems include the Army Ground Vehicle Modernization program, the Air Force’s Long Range Bomber, the Navy’s Shipbuilding strategy (next generation cruiser program (CG-X), aircraft carriers, amphibious warfare ships, and sea-basing concepts), and the Marine Corps’ Enhanced Fighting Vehicle program.

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## **3. Defense Mergers and Acquisitions**

### **3.1 Introduction**

Robust, credible competition is vital to providing the Department with high quality, affordable, and innovative products. It is the Department's policy to oppose business combinations that reduce or eliminate competition and are not in its ultimate best interest. The Department is becoming concerned about the loss of competition caused by significant industry consolidation over the last decade; and the pace of such consolidation shows no signs of slackening. Increasingly, the Department finds itself evaluating proposed mergers, acquisitions, and teaming arrangements that create horizontal capabilities 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. However, it is not clear that benefits the Department expected from past transactions have materialized. The Department is evaluating its options to address continued consolidation and the flux of the competitive environment.

The Department believes that the competitive pressure of the marketplace is the best vehicle to shape an industrial environment that supports the defense strategy. Therefore, the Department of Defense takes action to intervene in the marketplace only when necessary to maintain appropriate competition and develop and/or preserve industrial and technological capabilities essential to the defense industrial base that the marketplace, left unattended, would not. 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 that ensure that the future defense industrial base is both healthy and vital. In doing so, the Department maintains focus 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 warfare. Additionally, however, the Department also wants to ensure that the competitive, innovative, and cutting-edge technical support found in small and mid-sized firms is not compromised by large firms acquiring such small firms.

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 \$63.1M); 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 contractors 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 & National

Security Act of 2007, Pub.L. 110-49. The first two reviews types described are conducted under Major Defense Supplier M&A reviews pursuant to DoD Directive 5000.62.

### **3.2 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 impacted 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 merger and acquisition reviews are identified in DoD Directive 5000.62. While these reviews can include transactions that are also evaluated in the CFIUS review process, the issues considered are distinct.

In 2009, the Department reviewed more than the 42 transactions shown in the following table (the table does not include potential transactions that were not made public). The Department selectively identifies transactions for review and thus the below listing does not encompass all mergers and acquisitions involving companies that do business with the Department. Of those cleared by the Antitrust Agencies, one required intervention by the Antitrust Agencies. In one case, the Department requested a behavioral agreement to protect continued competition outside of the antitrust mitigation process. The Department identified concerns on a limited number of transactions:

- Microsemi and Semicoa were the only two suppliers of qualified high-reliability, small-signal transistors. Further, at the time of the acquisition, Semicoa was in the final stages of developing a capability to compete with Microsemi on high-reliability, ultra-fast recovery diodes, a market dominated by Microsemi. The Department objected to the transaction and worked with the Department of Justice in preparing for trial. Microsemi ultimately agreed to divest the business.

- Department objected to Atlantic Marine's acquisition of Boston Ship Repair. However, the antitrust agency determined that the evidence would not be sufficient to successfully proceed with litigation required to remedy the Department's concern.

While the Department did not formally object to the antitrust agencies regarding L-3's proposed acquisition of Chesapeake Sciences Corporation, it requested L-3 to commit to remain a merchant supplier of Towed Array Integrated Product Team telemetry systems and components for a limited time.

<b>MAJOR DEFENSE SUPPLIER MERGER AND ACQUISITION REVIEWS – 2009</b>				
<b>Acquirer</b>	<b>Acquired Company</b>	<b>Value (\$M)*</b>	<b>Disposition</b>	<b>Product Area</b>
AAR	Aviation Worldwide Services		No Objection	Aircraft MRO
Agilent	Varian	\$1,500	No Objection	Gas Chromatography
Allegheny Technologies	Crucible Powder Metals	\$41	No Objection	Nickel-based Superalloy Powder Metals
Applied Materials	Semitool		No Objection	Epitaxy / Vapor-deposition
ATK	Eagle Industries		No Objection	Soldier Tactical Gear
Atlantic Marine Holding's	Boston Ship Acquisition		Object, but insufficient case for Antitrust Agencies to intervene	Military Sealift Command Ship Repair
Chemring	HiShear	\$132	No Objection	Cartridge and Propellant Actuated Devices
Chemring Group	Non-Intrusive Inspection Technology	\$40	No Objection	Robot and Vehicle-Mounted Mine Detection Systems
Cisco	Tandberg	\$3,200	No Objection	Videoconferencing
Cobham	Argotek	\$36	No Objection	Intelligence Support
Computer Associates	NetQoS	\$200	No Objection	Network Management Software
Crane Co.	Merrimac Industries	\$52	In Process	RF microwave Components
FLIR Systems	Salvador Imaging		No Objection	Visible and Low-light Imaging Systems
General Atlantic and affiliates of Kohlberg Kravis Roberts	Northrop Grumman's TASC	\$1,650	No Objection	SETA Services

**MAJOR DEFENSE SUPPLIER MERGER AND ACQUISITION REVIEWS – 2009 (CONTINUED)**

<b>Acquirer</b>	<b>Acquired Company</b>	<b>Value (\$M)*</b>	<b>Disposition</b>	<b>Product Area</b>
General Dynamics	Axsys Technologies	\$643	No Objection	EO-IR Sensors
General Dynamics	AxleTech International		No Objection	Wheeled Vehicle Axles
Goodrich	J.F. Lehman's Atlantic Inertial Systems	\$375	No Objection	Guidance, Stabilization and Navigation
Harbinger Capital Partners	Inmarsat	\$2,400	In Abeyance	Satellite Communications
Harbinger Capital Partners	SkyTerra	\$280	No Objection	Satellite Communications
IBM	Sun Microsystems	\$7,000	No Objection	High Performance Computing
Inmarsat	Segovia	\$110	No Objection	Satellite Communications
Kodak	Bowe Bell + Howell Scanner Business		No Objection	Records Scanning
L-3	Chesapeake Sciences		Merchant Supply Agreement	Undersea Warfare Sensors
Lockheed Martin	Gyrocam		No Objection	EO-IR Sensors
Merck	Schering-Plough	\$41,000	No Objection	Pharmaceuticals
Microsemi	Semicoa	\$25	Objected. Supported Divestiture	Space-Qualified Transistors & Diodes
Nammo Talley	Composite Solutions		No Objection	Munition Tubes
OM Group	EaglePicher	\$172	In Process	Energy Storage
Oracle	Sun Microsystems	\$7,400	No Objection	Networking Middleware and Database Mgmt.
Pfizer	Wyeth	\$68,000	No Objection	Pharmaceuticals
Pratt & Whitney	ARDE		No Objection	Pressurant Tanks
Precision Cast Parts	Fatigue Technology	\$66	No Objection	Fasteners
Precision Castparts	Carlton Forge Works	\$850	No Objection	Forged Engine Products
Rackable Systems	Silicon Graphics	\$43	No Objection	High Performance Computing
Raytheon	BBN	\$362	No Objection	Networking Technologies



<b>MAJOR DEFENSE SUPPLIER MERGER AND ACQUISITION REVIEWS – 2009 (CONTINUED)</b>				
<b>Acquirer</b>	<b>Acquired Company</b>	<b>Value (\$M)*</b>	<b>Disposition</b>	<b>Product Area</b>
Roche	Genentech	\$46,800	No Objection	Pharmaceuticals
SAFRAN	GE Security's Homeland Protection Business	\$580	No Objection	Trace Detection and Non-Destructive Testing
SCHOTT North America	DiamondView Armor Products		No Objection	Transparent Armor
ShotSpotter	QinetiQ's Shot Detection Product Line		No Objection	Gunshot and Explosion Detection and Location
Tailwind Financial	Allen-Vanguard Corp.	\$35	Deal Failed	IED Defeat
TI	Qimonda		No Objection	Dynamic Random Access Memories
Versa Capital Management	Allen-Vanguard Corp		In Process	IED Defeat

### **3.3 Committee on Foreign Investment in the United States**

The Exon-Florio Amendment to the Omnibus Trade and Competitiveness Act of 1988 established Section 721 in the Defense Production Act. Section 721 was revised by the Foreign Investment & National Security Act of 2007, Pub.L. 100-49 (FINSIA). Section 721 authorizes the President to suspend or block foreign acquisitions, mergers, or takeovers of U.S.-located firms when they pose credible threats to national security that cannot be resolved through other provisions of law.<sup>1</sup> Implementation of the Exon-Florio-Amendment is managed by the interagency Committee on Foreign Investment in the United States (CFIUS), chaired by the Department of the Treasury.

Under Exon-Florio, the President has 30 days from the time he is notified of a foreign acquisition to initiate an investigation of the transaction. 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 30<sup>th</sup> day, the CFIUS must either approve the transaction, with or without risk mitigation measures, or initiate an additional 45-day

<sup>1</sup> Excepting the International Emergency Economic Powers Act.

investigation. There are no other options under the law. Once CFIUS completes an investigation, it can send the case to the President with a recommendation to block or suspend a transaction or CFIUS can unanimously impose mitigation measures, as long as these measures do not involve the Presidential blocking or suspension powers which are reserved only to the President.

Amendments enacted in 2007 by FINSA require appointment of a lead agency for 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), extensive annual reports to Congress, certifications by senior officials of Treasury and lead agency that no unresolved national security issues exist, as well as authority for CFIUS to reopen a closed CFIUS case under certain highly unusual conditions, such as when the prior case was approved by CFIUS based on a material misrepresentation or misstatement by the companies.

The Department of Defense is a member of the nine voting member interagency 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. In assessing foreign acquisitions, the Department's principal objectives are to: (1) protect the reliability of supply of goods and services to the Department; (2) minimize the risks of unauthorized transfer of classified information and export-controlled military and dual-use technologies. Simultaneously, the Department recognizes that foreign direct investment in the United States, including the defense sector, generally is beneficial to the U.S. economy and the nation's defense. Foreign-owned firms located in the United States employ U.S. citizens, pay U.S. taxes, and are subject to U.S. law.

To assist in achieving these objectives, the Department determines in each case whether the firm being acquired possesses critical defense technology or is otherwise important to the defense industrial and technology base. Pursuant to FINSA, the Director for National Intelligence prepares an analysis of any threat to the national security of the United States (incorporating the views of all appropriate intelligence agencies) posed by a covered transaction. The Director for National Intelligence is also a non-voting ex-officio member of CFIUS and does not serve any policy role.

Given the statutory constraints of the Exon-Florio Amendment, as revised by FINSA, the Department cannot publicly discuss specific CFIUS reviews. After each covered transaction is reviewed by CFIUS, relevant members of CFIUS transmit to members of Congress Certified notice of completion of review or investigation describing the Committee's action taken on a particular transaction. Treasury, as the chair of CFIUS, provides a statutorily required annual CFIUS report to Congress and is responsible for all CFIUS inquiries. The annual report, among other things, includes basic information on each party to the transaction, the nature of business activities or products, and any withdrawals and Presidential actions.

## **4. Industrial and Technological Capabilities Assessments**

### **Methods and Analyses**

The U.S. defense industrial base and the global defense market provide the industrial and technological capabilities which support the needs of the warfighter for capable and reliable weapon systems. The Department periodically conducts analyses/assessments to identify and evaluate those industrial and technological capabilities needed to meet current and future defense requirements. It then uses the results of these analyses/assessments to make informed budget, technology investment, acquisition, and logistics decisions.

"DoD-wide" industrial assessments evaluate and address changes in key system, subsystem, component, and/or material providers that supply many programs, and affect competition, innovation, and product availability. DoD Components conduct their own assessments when: (1) there is an indication that industrial or technological capabilities associated with an industrial sector, subsector, or commodity important to a single DoD Component could be lost; or (2) it is necessary to provide industrial capabilities information to help make specific programmatic decisions. These assessments generally are conducted, reviewed, and acted upon internally within the DoD Components. Additionally, the Defense Contract Management Agency supports DoD-wide and DoD Component industrial assessments by utilizing its broad knowledge across industrial sectors and its on-site presence in many contractor industrial facilities.

### **4.1 DoD-Wide**

#### **Image Intensifier Tubes Industrial Capability Assessment (February 2009)**

The United States Special Operations Command (USSOCOM) Acquisition & Logistics Center requested the Defense Contract Management Agency (DCMA) Industrial Analysis Center (IAC) to perform an Industrial Capability Assessment (ICA) of the Image Intensifier Tube Industry. USSOCOM's request included specific study requirements pertaining to the industry capacity, capability and broader global industry posture. The assessment will be used by SOCOM to support acquisition strategies and planning for the critical components for their night vision devices.

To accomplish the study requirements, DCMA IAC performed research on the Image Intensifier Tube Industry (both domestic and foreign) to determine the study population. In addition, a survey was developed and distributed to the targeted companies for input, and survey information was validated by performing on-site visits. Based upon analysis, discussions with company representatives and on-site visits, the industrial capabilities supporting the production of Image Intensifier Tubes, though

fragile and not without challenges, is considered low risk. DCMA IAC contacted eight prime contractors (ten facilities) established in the business of Night Vision production and concludes the following: Two prime contractors currently have the industrial capability to meet MX -10160 GS specifications; one contractor would require a waiver for certain portions of the MX -10160 GS specifications to begin production; and another contractor would require more than two years before a viable production line could be operating, and would require a waiver of certain portions of the MX -10160 specifications.

The analysis also concludes that the four prime integrators are running at or near capacity. Based upon data provided for this assessment and on-site visits, two primes are operating 24/7 in order to keep up with demand.

### **Solid Rocket Motor Industrial Base Assessment Report to Congress (March 2009)**

Section 1050 of the National Defense Authorization Act for Fiscal Year 2008, Public Law 110-181, dated January 28, 2008, required the Secretary of Defense to submit to the congressional committees a report on the status, capability, viability, and capacity of the solid rocket motor industrial base in the United States. Industrial Policy submitted the Solid Rocket Motor (SRM) Industrial Capabilities Report to Congress in April 2009. The report was signed on April 2, 2009.

The report consists of two assessments. The first assessment was an industrial capabilities assessment of the SRM industry to determine the Department's ability to maintain current and future programs with SRMs through their operational lives. The second assessment focused on the Department's ability to maintain its strategic systems through their planned operational lives.

The analysis from the first assessment determined that the SRM industrial base was capable of meeting most technological and production requirements today. However, the report clearly showed production demand for SRMs was declining, especially for those systems that required large SRMs due to the completion of the NASA shuttle program, lower strategic requirements and the completion of the Minuteman III Propulsion Replacement Program, and the expectation of a commercial space launch market that never materialized. While there was consolidation at the prime contractor level, the low projected demand for large SRMs may result in further consolidation in the industrial base in the form of possibly reducing the number of prime contractors from two to one, or Alliant Techsystems, Inc. may have to consider rationalizing its large SRM facilities at Promontory and Bacchus to one for more efficient operations. The report indicated that the Department had inadequate investments being made in large and small SRM research and development, reducing the reliability and cost effectiveness of the industrial base. Without new development programs, the SRM industry will continue to lose its capability to be able to design and produce new generation SRMs. The lack of meaningful production orders and the limited development efforts for the next decade is not conducive to the long-term well-being of

the SRM industry. The limited competitive opportunities for SRM activities will make it hard for prime contractors to attract and retain a skilled engineering and manufacturing workforce which in turn will make it difficult to retain the design and engineering expertise necessary to develop and produce our next generation large and small SRMs.

The analysis from the second assessment indicated that the Department will be able to maintain its strategic systems through their operational lives provided there are no changes in the stability of existing SRM programs.

### **Strategic & Critical Materials Working Group (April 2009)**

The Strategic & Critical Materials Working Group submitted a report in response to Congressional requests in the House report to accompany H.R. 1815, The National Defense Authorization Act for Fiscal Year 2006, H.R. Rep. No. 109-89, page 476, the House report to accompany H.R. 5122, the National Defense Authorization Act for Fiscal Year 2007, H.R. Rep. No. 109-452, page 444, and the Senate Report to accompany the Department of Defense Appropriations Bill, 2008, S. Rep. No. 110-155, page 189, concerning the National Defense Stockpile (NDS). The report included a review of the current policy to dispose of material in the National Defense Stockpile (NDS) and recommendations regarding reconfiguration of the NDS to adapt to current world market conditions to ensure future availability of materials required for defense needs.

Material management is a complex and rapidly changing field. Increasing global competition for raw materials has added a new depth of complexity, and continued reliance on the strength of U.S. buying power is proving problematic. Ensuring the current and future availability of strategic and critical materials requires a more integrated and responsive approach on the national level. The NDS has been successful in acquiring and holding strategic material, but has had isolated success in using the material strategically. Transforming the NDS into a Strategic Materials Security Program (SMSP), a more comprehensive and flexible risk management process would enable the Nation to more quickly adapt to current world market conditions and ensure the future availability of materials required for defense and national security needs. The proposed attributes being considered for the SMSP include a broader internal Department profile with a reduced physical footprint, an expanded interface with other federal agencies, greater latitude in entering and exiting markets, and flexibility to develop risk-based value propositions.

The first step is for the reengineered program to be more properly aligned to sense and respond to today's military material needs in scenarios ranging from non conflict to full mobilization. The current NDS is designed to respond to global war scenarios – those requiring national mobilization of all sectors of the economy – whereas today's military must respond to asymmetric national security threats wherever and whenever they occur; frequently on several simultaneous fronts. Further, the global growth in demand for scarce raw materials and the industrial surges in China, India,

Russia, Brazil, and other developing countries require that the United States employ a new, integrated and responsive strategy for identifying and ensuring, on a continual basis, an adequate supply of strategic and critical materials required for U.S. security needs. In today's global economy, it is critical to ensure a strong domestic defense industrial base capable of meeting national security needs.

Accordingly, the NDS, through the efforts of an Office of the Secretary of Defense-led Working Group, the DoD Strategic and Critical Materials Working Group (WG or Working Group), has developed a plan for a comprehensive Strategic Materials Security Management System (SMSMS) that would identify, on an ongoing basis, those strategic and critical materials required for national security. The system would be founded on an interagency, collaborative approach, and bolstered by the use of experts and timely market research and intelligence. The system would also employ an integrated risk assessment construct, compare demand to supply by analyzing supply sources and risks of supply chain interruption, and identify mitigation strategies to ensure an adequate and timely supply of those materials. This system would be a joint effort by the Office of the Secretary of Defense, the Military Departments, the Defense Contract Management Agency (DCMA), and the Defense Logistics Agency (DLA), with representation and analysis provided by other government agencies such as the Department of Commerce (DOC) and the United States Geological Survey (USGS). The system could also involve other relevant organizations such as Defense research agencies, Federally-Funded Research and Development Centers or industrial associations and private consultants. The reshaped NDS, the SMSP, would continuously monitor global markets, establish supply chain commitments with producers/suppliers; monitor performance to ensure timely availability of materials, and store only limited amounts and types of materials.

The current policy to dispose of materials in the NDS could be modified to reflect the realities of today's global marketplace. Analysis by the Working Group and risk assessment modeling supported the NDS' action to temporarily suspend or limit the sale of 13 selected commodities in the NDS inventory. The analysis also indicated that 39 other materials should be monitored, studied and/or considered candidates for future mitigation strategies to ensure availability. Further, the Working Group concluded that 11 materials used in the largest quantities by the Department be addressed as potential candidates for strategic sourcing. If implemented, the reconfigured stockpile program would require a stable funding source to make strategic acquisitions, undertake other risk mitigation strategies and operate the stockpile program.

## **Industrial Capability Assessment of the DoD Helicopter Industrial Base (June 2009)**

The Deputy Under Secretary of Defense for Industrial Policy (DUSD(IP)) commissioned Defense Contract Management Agency (DCMA) Industrial Analysis Center (IAC) to perform an Industrial Capability Assessment of the DoD Helicopter Industrial Base. This request was a direct result of concerns expressed about potential increased risk that the helicopter industry as a whole may not be able to meet DoD programmatic requirements, which could result in program cancellations and shifting workloads within an already extended industrial base. The project included joint service participation with NAVAIR and PEO Army Aviation. The principal objective of the industrial base assessment was to identify company and industry core capabilities, workloads, throughput capacities, and risks/potential areas of concern and the ability of the industrial base to meet DoD requirements. The study population consists of five companies encompassing seven manufacturing and integration sites. Weapon system platforms included in the assessment are the CH-47, V-22 Tilt-rotor, H-60 Black/Naval Hawks, CH-53, UH/AH-1, OH-58, AH-64 Apache, Light Utility Helicopter and the new Presidential Helicopter VH-71.

The assessment established that the Helicopter Industrial Base, consisting of the prime contractors in the study population, has the requisite engineering and manufacturing skills to support DoD helicopters in current production and DoD requirements in the near future. It also concludes that the DoD Helicopter Industrial Base is healthy and viable from a business perspective, even with the terminations of ARH, VH-71 and CSAR-X. However, it determined that vendor and material management challenges and capacity utilization concerns exist, as some sites are close to maximum capacity. Capacity utilization is at high levels at four sites and nearing maximum at one site. Companies in the population reported they would invest \$1.6B in facilities/equipment over the next four years. Vendor- and material-management were identified as key challenges, which have been impacting deliveries of DoD helicopters.

## **Steel and Specialty Metals Trend Analyses (August 2009)**

The Office of the Deputy Under Secretary for Industrial Policy requested DCMA IAC to update a Steel and Specialty Metals report semi-annually. The purpose of the report is to provide trends and analyses to the DoD acquisition community, detailing the short, medium and long-term impacts of steel and specialty metals on the DoD Industrial Base.

The report is comprised of pricing, lead-time, capacity utilization and other industry factors that influence current and future conditions of the marketplace for steel, titanium, aluminum, copper, nickel, and stainless steel. The intent of trend analyses is to assist the 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.

As a result of the changing fundamentals in the global economy, metal prices will probably not go back to pre-2003 levels. Currently, they reflect 2005 levels. Resource-rich Brazil and Russia, coupled with the high demands of India and China, the “BRIC nations,” are now competing for ascendancy with Europe and North America for iron ore, scrap metals and other valuable feedstock required for the production of metal-based products. The BRIC nations are now a major driving force in the fundamentals of the metals and mining industries’ supply chain.

Regardless of the 20-25 months downturn in the American economy, a robust global growth in metals production and consumption is forecasted well into the next decade, possibly the next 20 years, and metal prices will remain relatively high. The world is in the initial phase of a prolonged bull market for steel and specialty metals, comparable to the post World War II economy.

The findings in the August 2009 Steel and Specialty Metals pricing trend analysis and industry assessment, did not alter much from the findings reported in January 2009. Metals pricing and capacity utilization commenced a downward trend in September 2008, and reached a bottoming phase beginning in February 2009. Economists and industry analysts are reporting that the U.S. economy started its fragile recovery period beginning late fall 2009, but the signs or economic indicators will not confirm a stable recovery until February 2010. If the U.S. economy should delay a fragile recovery beyond fall 2009 – *double dip recession* – signs of a stable recovery will not be noticed until summer 2010.

Once the U.S. economy begins a firm recovery, so will all six primary metals (aluminum, copper, nickel, titanium, stainless steel and carbon steel), however, not all at the same time. The copper and aluminum sectors will likely see a stronger recovery first, possibly in the summer of 2010, with the titanium, stainless steel and especially the carbon steel sectors lagging behind. More to the point, as late as the summer of 2009, those sectors were still shedding excess capacity.

The 2008 American Recovery and Reinvestment Act (ARRA), with a minimum of approximately \$77B for infrastructure projects, will likely show its full impact on the metals industry after the spring of 2010.

Despite the 2008-2009 contraction in production due to industry-wide apprehension to spend, coupled with the reduction in lending by the money center banks, the prospects of nearly \$3T in global public spending projects and lending guarantees by governments are likely to reverse the effects of slowing demand. Accordingly, forecasted production orders for steel and specialty metals were more optimistic for early 2010. In addition to global public spending projects, the commercial aerospace industry still has a projected 10-year backlog of more than 20,000 aircraft, valued more than \$2T. For instance, the 787 wide-body airplane has experienced



numerous delays which resulted in only a six percent cancellation rate. The 787 program still has a backlog of 850 planes representing more than \$150B.

The lessons learned from the pre-slowdown economy will concentrate a global push for fuel efficiency and finding substitutes for hydrocarbon fuel products. This will drive up the demand for specialty metals and super alloys that are closely associated to battery manufacturing. These metals are typically not mined or melted within the United States and the E.U. countries. Therefore, this will likely become a growing strategic concern for the United States as resources will have to be utilized to secure the free flowing access to the limited supply of super alloys and specialty metals products (i.e., chromium, cobalt, lithium, rare earth and platinum group metals).

### **Munitions Industry Capability and Surge Analysis (November 2009)**

DCMA IAC has a Memorandum of Agreement with the Joint Staff (J-4) to analyze industry's capacity and capability to surge 42 Munitions Programs and their variants on an annual basis. DCMA has provided annual updates to J-4 since 2001, to support contingency planning and preparation of munitions reports to the Chairman of the Joint Chiefs of Staff. The Deputy Under Secretary of Defense for Industrial Policy (DUSD-IP) also utilizes these reports for de-conflicting of demand for industrial resources. The study includes prime and critical subcontractor production capabilities, manufacturing capacity and lead times, minimum, current and maximum production rates with limiting factors; as well as vertical, horizontal and predictive analysis with DoD Program Budget Funding and Procurement Quantities.

Supplemental appropriations funding has been required since 2001 to replace battle loses, maintain adequate inventory, enhance military capabilities, and sustain the industrial base by accelerating production, repairing or replacing Precision Guided Munitions (PGM), missile, bomb, and rocket expenditures from Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). The munitions industrial base faces a number of significant, near-term challenges with numerous single qualified sources of supply, a growing dependence on foreign suppliers at the subsystem level, disruptive fluctuations in demand, excess capacity and aging infrastructure in some areas; in other areas, the lack of surge/replenishment capacity within time/cost parameters, and declining R&D technology funding, reducing capability.

History indicates accelerated production of certain PGM's, missiles and rockets may be required to successfully prosecute future conflicts. However, due to added complexity, certain Standoff Tactical Missiles cannot be accelerated as quickly as kitted systems. Bottlenecks remain in the supplier base, with some critical component lead times that can exceed 12 months to reach maximum facilitated rates, to support complex subsystems (e.g. Guidance Systems, Rocket Motors, Gas Turbines etc.).

## **Platform Material Breakdown Study (December 2009)**

From 2004 through 2007, U.S. producers of metals and composite materials experienced sharp price increases and in some cases availability constraints driven by global demand growth. These market factors contributed to higher costs for major weapons programs such as the F-35. In another case, global demand for steel led to supply constraints that threatened the mine resistant ambush protected (MRAP) vehicle production plan. To better assess the Department's exposure to episodic materials price volatility, the Institute for Defense Analyses (IDA) gathered detailed information on the amounts of both raw product and final material forms of selected materials used on two representative weapons systems: the F-35 and its F135 engine and the MRAP. IDA also examined the implications of this content on the cost and success of the subject weapons system programs.

The F-35 and its engine contain materials like those of the F-22A and its F119 engine; however, the exact materials and amounts are proprietary. In general, it was found that given the total system cost of the aircraft relative to the cost of raw materials, even large metal price fluctuations have only a small effect on average procurement cost. Furthermore, while long term contracts with materials suppliers are good for ensuring supply and maintaining the production schedule, the government does not need to hedge the price of these metals. This finding is consistent in many ways with the findings of the Defense Business Board regarding DoD fuel hedging.

The MRAP is like many armored systems in that it uses conventional armor grade steel plate. The MRAP program alone, however, effectively surged armor demand between three and ten times the normal level. This increase still meant that armor was a relatively small fraction of the steel produced, but it was a dramatic increase in demand of a niche product during a time when global demand for steel was driving capacity utilization to levels not seen in many decades. OSD and the Army used several policy tools to enable contractors to get enough steel to meet the demand for MRAP vehicles. First it relaxed restrictions on using plate from steel melted outside the United States; second it used Defense Priorities and Allocation System (DPAS) to prioritize plate through the quench and temper facilities in the United States; and third the Army worked with the domestic steel industry to change military armor specifications for improved plate production efficiency without impairing the quality.

## **4.2 Army**

### **Ammunition Industrial Base Modernization of Government Owned Contractor Operated Army Ammunition Plants (September 2009)**

The Army manages conventional ammunition procurement for the Department of Defense. During 2009, the Army executed \$190.9M of FY09 funding in modernizing the Government Owned Contractor Operated (GOCO) Army Ammunition Plants (AAP) to support the operating contractors. This together with the \$184.9M Global War on Terrorism (GWOT) funding received late in fiscal year 2008 enabled us to initiate over 70 plus critical modernization projects across six Army GOCO AAPs. In order to assure prompt execution of the GWOT funding, the Project Management Office for Joint Services conducted a special Council of Colonels session to expedite the validation of industrial facility project requirements and to facilitate the release of funds from the Army Budget Office. This process significantly reduced the project approval time from the traditional average of seven months to less than three weeks. The receipt of \$184.9M GWOT funding added a healthy boost to this program. It allowed the acceleration of many modernization projects to correct the deficiencies across our GOCO industrial base.

In parallel, PEO AMMO completed a Six Sigma Black Belt project to streamline the Determination and Finding (D&F) process for validating the Industrial Facility Project requirements. As a result of this project, the Deputy Secretary of Defense delegated the approval authority to the Single Manager for Conventional Ammunition (SMCA) Executor for Industrial Facility Projects up to \$10M. For projects over \$10M, the approval process will remain the same, going through Headquarters Department of Army to the Office of the Secretary of Defense. The delegation of approval authority for projects up to \$10M to the SMCA executor has significantly reduced the processing time for approval of D&Fs. This facilitates prompt obligation of funding and expedites project execution to correct critical deficiencies at our GOCO plants.

Principal achievements during 2009 involved propellant and explosive production. For example, one of the major modernization projects current underway includes building of a new Nitric Acid Concentrator and Sulfuric Acid Concentrator (NAC/SAC) facility at Radford. Construction of this new NAC/SAC is currently underway with an anticipated commissioning date of June 2010. This project replaces a 30 year old, inadequately maintained acid plant with a modern facility with greatly enhanced energy efficiency, environmental benefits and improved product quality. Another major modernization project currently underway is the consolidation of the acid production facilities from Area A to Area B at Holston AAP. This project, with an anticipated completion date of FY14, will significantly reduce the safety hazard associated with the current operation and greatly enhance the operational efficiency.

## **Sky Warrior Unmanned Aerial System Industrial Capability Assessment (September 2009)**

The United States Army Unmanned Aerial System (Medium Altitude and Endurance) Office, Redstone Arsenal, Huntsville AL requested the Defense Contract Management Agency (DCMA) Industrial Analysis Center (IAC) perform an Industrial Capability Assessment (ICA) on the Sky Warrior Unmanned Aerial System (UAS). This assessment will be used by the Program Manager to support the Sky Warrior MQ-1C program Milestone C decision.

The U.S. Army is acquiring the Sky Warrior UAS system that will provide persistent surveillance, communication and reconnaissance capabilities with worldwide access. Initial estimates are for the U.S. Army to obtain 11 systems, with 12 unmanned aerial vehicles each and five control stations per system.

DCMA IAC performed analysis of the prime contractor and seven of its critical component suppliers utilizing established industrial and financial risk criteria, in accordance with DoD 5000.60H. The analysis concludes that the requisite Industrial Capabilities to produce Sky Warrior MQ-1C are considered high risk, since two critical components supplied to the prime contractor are considered unique, endangered and high risk; the Electro-Expulsive De-Icing System (EEDS), and the Heavy Fuel Engine.

DCMA IAC performed analysis of the prime contractor and seven of its critical component suppliers utilizing established industrial and financial risk criteria, in accordance with DoD 5000.60H. The initial analysis concluded that the requisite Industrial Capabilities to produce Sky Warrior MQ-1C are considered high risk, since two critical components supplied to the prime contractor are considered unique, endangered and high risk; the Electro-Expulsive De-Icing System (EEDS), and the Heavy Fuel Engine.

Army took corrective actions. Concerning the De-Ice system, the following risk mitigation strategy is in place. An escrow account gives the prime contractor access to all intellectual property should the EEDS manufacturer cease to exist. The escrow account is updated regularly and is inclusive of all software code, electrical schematics, hardware and assembly drawings. Current analysis shows that, should the EEDS manufacturer cease to exist, the time line to move production to the prime contractor would take three to four months. The prime contractor's lead times and inventories are adequate to absorb the three to four month impact. Therefore, the MAE product office concludes that this risk is low.

Concerning the foreign Heavy Fuel Engine (HFE) provider, the following risk mitigation strategy is in place. All government contracted engines are on site at the prime contractor's facilities. The prime contractor has initiated additional HFE orders, which the HFE provider has accepted. Current inventory and additional orders will support production and spares through FY12. Additionally, the prime contractor is

pursuing alternate HFE development with production cut-in capability by June 2011. Therefore, the MAE product office concludes that this risk is low.

### **Army C4ISR Annual Industrial Capability Report Summary (November 2009)**

Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) programs represent the backbone of the combat capability of our forces. Overall the Department procurement growth trends have been reflected in recent C4ISR program budgets. Thus, from a business health view point, the large majority of companies in the C4ISR sectors are in good to excellent shape fiscally. For example, in the Electro-Optics, Infrared/Thermal (EO-IR) Imaging Sector Study, which is comprised primarily of 19 contractors and relies heavily on defense program spending, we have seen that most of the companies in the sector have strong *Moody* and *Dunn & Bradstreet* financial ratings. The reliance on defense contracting, however, makes the health of this industrial base sector sensitive to fluctuation in the defense budget. Several current C4ISR Manufacturing Technology (ManTech) efforts are focused on improving manufacturing processes, production yield and cost reduction in the EO-IR technology area.

Other sector areas of the C4ISR Industrial Base seem to be similarly situated. Data collected related to the Information Technology (IT) area reflects similar status notwithstanding the 2008-2009 economic down turn impacting these companies much more so than those focused on EO-IR. There is however, well founded fact based concern with regard to the maintenance of sufficient DoD procurement funding in C4ISR programs to sustain essential C4ISR industrial capabilities where commercial application of the technology does not exist.

A current challenge is that our manufacturing centric workforce skills, knowledge and abilities are becoming scarce for many reasons, including an aging workforce, the decline in the number of industrial/manufacturing engineering degrees being granted in the United States, the amount of time required to become proficient in the required manufacturing/production-centric technical skills, focus on other relevant technical areas of expertise as a function of business element alignment, and the movement of the U.S. industrial base offshore to locations such as China and India. Part of the equation is a simple phenomenon: manufacturing moves to low cost locations and the technical expertise follows to the manufacturing locations - hence movement of manufacturing and preponderance of manufacturing/production-centric technical knowledge, skills, and abilities away from the U.S., and towards locations such as China and India.

Our software development workforce concerns reported in our last annual summary remain and continue to represent a challenge for all DoD programs, including C4ISR systems. The Defense Contracting Management Administration (DCMA) Industrial Analysis Center (IAC) completed a two-part Software Industrial Base Study (SIBS), in 2007, to assess the demand for software within the DoD and the industrial

base's ability to satisfy that demand. The demand for software developers continues to outpace the number of university degrees granted. As a result, software developer jobs are being filled with staff that are not formally trained in software engineering, computer science or computer engineering.

With respect to future actions, the recommended action for the maintenance of the health of the C4ISR industrial base is continued funding support for critical C4ISR programs. The present state of the C4ISR Industrial Base, especially with respect to technology areas such as radars, thermal imaging and night vision that have only limited non-military applications, has been achieved in large measure from robust funding support. Significant R&D and manufacturing technology (MANTECH) investment is continuing to occur in these areas. We judge it essential that related acquisition programs employing these technologies move forward with adequate funding to take advantage of the technology. These technologies, such as 3<sup>rd</sup> Generation Forward Looking Infrared and Software Defined Radios will provide critical tactical advantages to troops in the field. A healthy industrial base (derived from adequate procurement funding) is essential to the achievement and maintenance of technological dominance and consequent tactical, operational and strategic military dominance.

### **Army's Approach to Foreign Sourced Software (December 2009)**

There are supply chain risks as U.S. software developers move software development work offshore for economic reasons. For example, the potential security ramifications inherent in malicious code (e.g., Trojan horses, back doors, and time bombs) increase as more individuals and companies have access to the software coding. Maintaining the ability to leverage commercial markets while minimizing risk continues to be a focus area for the Department. Under the umbrella of the President's Cybersecurity Initiative, the Department is working with other federal agencies to develop standards, policy, and pilot projects to address this risk.

### **Army Brigade Combat Team Modernization (December 2009)**

The 2009 Future Combat Systems [now Brigade Combat Team Modernization (BCTM)] Early Infantry Brigade Combat Team (E-IBCT) Increment 1 Industrial Capability Assessment addresses industrial base capabilities and the underlying infrastructure and processes in preparation for a Milestone C decision in December 2009, which granted authority to proceed with Low Rate Initial Production (and is a required part of the BCTM program acquisition strategy).

The Increment 1 hardware is comprised of the following components: 1) the network integration kit, consisting of battle command software, an integrated computer system, a ground platform communication system and unattended ground sensors

[tactical and urban]; 2) the class I unmanned aerial vehicle; 3) the small unmanned ground vehicle; and 4) the complementary program Non-Line-of-Sight Launch System.

Army's Tank-Automotive Command (TACOM) Industrial Base staff visited over 20 prime and critical sub-tier suppliers for those components, in conjunction with PEO Integration and Boeing (prime contractor), to determine their capabilities to support E-IBCT Increment 1.

Overall, the industrial base for E-IBCT Increment 1 is capable of producing the necessary hardware and associated software solutions. There are some risks, however. Risks identified include: 1) the difficulty in obtaining certification and accreditation for the cross-domain solution for the integrated computer system; 2) the availability of government furnished equipment (e.g., GMR radio, HMMWVs); 3) obsolescence; 4) proprietary processes; and 5) design, software and testing maturity. Action taken: These risks will be monitored by Boeing, PEO Integration and the TACOM LCMC Industrial Base Management Office to mitigate any adverse effects on the overall program schedule.

### **4.3 Navy**

#### **Advanced Extended Echo Ranging System Industrial Capability Assessment (January 2009)**

The Navy's Program Executive Officer, Air Anti-Submarine Warfare Systems Program Office, (PMA-264), requested the Defense Contract Management Agency's Industrial Analysis Center to perform an analysis of the industrial base to support the Advanced Extended Echo Ranging (AEER) System ACAT IVT. The analysis supported the scheduled Milestone B Defense Acquisition Board (DAB) review of industrial capabilities to support acquisition of the AEER.

The DoD domestic sonobuoy manufacturing industrial base is limited due to a narrow market, required unique technical knowledge, and a small number of qualified manufacturers. The U.S. sonobuoy manufacturing industrial base consists of two prime contractors; the sonobuoy contracts awarded are produced through a joint venture agreement between the two contractors. It is vital to note this joint agreement provides the opportunity to maximize efficiencies in the design and development of the related sonobuoys, although both companies function independently and each maintains the ability to build the complete sonobuoy systems. Both companies identified a small number of common suppliers producing components which are considered low risk because of the relatively unsophisticated technologies required to produce their items and existence of multiple alternate sources.

The two companies are the only two U.S. based manufacturers of sonobuoys and are the only known sources with the requisite technical knowledge, experience, tooling, and industrial capabilities to produce AEER to DoD specifications. The industrial capabilities required to support AEER and total DoD sonobuoy requirements are considered low risk since both companies have a depth of sonobuoy manufacturing experience, and each facility possesses the requisite skills, facilities, processes and capacity, as demonstrated by the large number of complex units each has produced in the last two decades. Under the joint venture arrangement, manufacturing is shared and capacity utilization is increased and should continue to improve when these programs reach full production.

### **E-6B Modification Program (March 2009)**

NAVAIR (PMA 271) requested DCMA Industrial Analysis Center (IAC) to perform an Industrial Capability Assessment (ICA) on the E-6B Modification Program (ACAT II) to support the Milestone C decision. The DCMA team assessed the industrial capabilities and capacities; evaluated the financial conditions of the prime contractor, the principal subcontractor, and select key-suppliers supporting the Block I Program; examined associated labor concerns for the supplier base, potential ripple effects the economy could have on program delivery; and researched industry throughput capacity and essential capabilities in order to identify areas of concern to meet DoD requirements. The DCMA field representatives distributed a survey to companies in the Study Population and validated the provided information by performing on-site visits and meeting with company officials.

Based on the analysis of the Study Population, there were no high industrial capabilities or financial risks that could cause significant program impact. The industrial capabilities necessary to perform Block I Program modifications were considered a moderate risk, since the current prime contractor is the single qualified source for the secure product line components, and qualification time and cost of an alternate source would not meet program's schedule requirements. Also, it was noted that the Block I Open Systems Approach provides for future cost effective system enhancements.

### **F/A-18E/F Infra-Red Search and Track System Industrial Capability Assessment (April 2009)**

NAVAIR (PMA 265), requested DCMA Industrial Analysis Center (IAC) to perform an Industrial Capability Assessment (ICA) on the Infra-Red Search and Track (IRST) system to support the Milestone B decision for the program and prepare the IRST to enter the Engineering, Manufacturing and Development (EMD) phase of acquisition. The IRST prime contractor (sensor system integrator) and six key hardware suppliers, in addition to two F/A-18E/F aircraft ancillary system/component subcontractors, were assessed. The assessment supported the Navy's Milestone B Defense Acquisition Board (DAB) review.



The study determines and analyzes the industrial capabilities required in designing and producing the IRST system and its associated components. Overall, the industrial capabilities required to support the IRST system are considered a moderate risk.

The assessment establishes that the requisite industrial capabilities, to provide six of the nine F/A-18E/F IRST system components, are considered a 'moderate' risk and three are considered to be a 'low' risk to the program. The study described operational/performance concerns, such as; material lead-times, obsolescence, development and quality issues, and single/sole sourcing. In addition, five of the nine component contractors are considered a 'moderate' financial risk, while the remaining four are considered a 'low' financial risk.

It is recommended that all companies rated as 'moderate' financial risk be monitored on a continual basis to determine if any company's financial position deteriorates. It is also recommended that sole source and long-lead time items' production schedules be monitored closely to prevent any impact to the master build/assembly schedules of IRST subsystems/components, and to make certain that there is no impact to the F/A-18E/F IRST system program.

### **Surface Combatant SWAP (April 2009)**

As a result of extensive discussions with General Dynamics Corporation Bath Iron Works (BIW) and Northrop Grumman Shipbuilding, Inc. (NGSB) the Navy arrived at a plan that most affordably met the requirements for Navy surface combatants, commenced the transition to additional, improved missile defense capability in new DDG 51 Class construction, and provides significant stability for the industrial base.

The plan aligned construction responsibilities for DDG 1000, 1001, and 1002 at BIW with NGSB continuing participation in the program. This will help stabilize and minimize cost risk for the DDG 1000 Program. The plan also called for efficient restart of the DDG 51 program with DDG 113 and DDG 114 to be constructed at NGSB and DDG 115 to be constructed at BIW. The plan also provided for stable continued construction of the LPD 17 Class.

### **P-8A Poseidon Program (June 2009)**

In March 2009, Naval Air Systems Command, PMA-290 requested the Defense Contract Management Agency, Industrial Analysis Center (DCMA IAC) to perform an Industrial Capability Assessment (ICA) for the P-8A aircraft industrial base. The study was requested to support acquisition strategies for Milestone C requirements in accordance with DoD Instruction 5000.02. The scope of the study also included the request to evaluate potential program impacts from the current economic downturn on the financial condition of key suppliers.

The study assessed industrial capabilities, capacity, and risks. DCMA also conducted financial analysis on the prime contractor and key suppliers identified in collaboration with Naval Air Systems Command, PMA-290. The IAC looked at associated labor concerns for the supplier base and potential ripple effects the economy could have on program delivery. The IAC reviewed industry throughput capacity and core capabilities to identify areas of concern to meet DoD requirements. The methodology included distribution of a survey to companies in the study population. Survey results were validated by performing on-site visits, meetings with company officials and through the DCMA network of field offices.

Based on the analysis none of the companies in the study population present a high industrial base or financial risk that could cause significant program impact if managed properly. The P-8A is only a small part of the workload for these facilities and the companies have adequate workload to maintain the required industrial capability and capacity to meet the DoD requirements. The prime contractor did not provide insight into the commercial 737 aircraft supplier base partnerships due to the highly competitive business structure; however independent analysis of the aerospace industrial base indicates there are adequate industrial capabilities to meet P-8A program requirements. No specific actions resulted from the analysis..

### **Naval Aviation Industrial Maintenance Assessment (July 2009)**

The Industrial and Logistics Maintenance Planning/Sustaining Department (AIR-6.7) developed a document titled the Naval Aviation Industrial Maintenance Assessment. The purpose of this effort was to conduct an internal assessment of the Industrial maintenance sector in terms of four focus areas (Core Sustaining Capability, Logistics Transformation, Workforce Revitalization, and Capital Investment) established for the Services' Depot Maintenance strategic plan alignment with the requirements of the last Naval Aviation submission to the DoD Depot Maintenance Strategy (Naval Aviation Industrial Strategy, Version 1.0, dated 30 November 2007).

This assessment focused on Naval Aviation Industrial Maintenance which includes three sectors: Organic depot maintenance, Commercial depot maintenance, and Inter-service depot maintenance. It also serves to provide a common framework to link critical information and strategies from the different industrial maintenance sectors that can be used to eventually develop a requisite sustainment strategy, as well as respond to recurring higher level data calls and data reviews within the Navy and the Department.

## **Small Tactical Unmanned Air Systems / Tier II UAS Program (October 2009)**

Naval Air Systems Command (NAVAIR) requested DCMA IAC to perform an analysis of the industrial base supporting the Small Tactical Unmanned Aircraft System (STUAS) program. This analysis will support a scheduled review of industrial capabilities to support acquisition of the STUAS.

Currently, the Unmanned Aircraft System (UAS) industrial base consists of numerous contractors that possess the industrial capabilities required for research, design, development, test and evaluation, and maintenance for a STUAS type vehicle. DCMA IAC selected a sample population of six contractors, from small to large, based on discussions with NAVAIR and from DCMA IAC's experience working with the UAS industry. Emphasis was placed on assessing industrial capabilities required to successfully obtain products and services required for the Milestone B review. A survey was developed to include industrial capability, capacity, and business base information, and distributed to the targeted companies for input. Survey information was collected and validated by DCMA's IAC and Financial Analysis Branch (FAB) by performing on-site visits. DCMA IAC performed analysis utilizing established industrial and financial risk criteria, in accordance with DoD 5000.60H. For the purposes of this study, Industrial Capabilities are defined as the skills, processes, facilities and technologies necessary to research, develop, manufacture, test, and evaluate a STUAS.

The study concluded that the requisite Industrial Capabilities to produce STUAS for NAVAIR programs is considered Low Risk, since several companies currently possess the essential capabilities (i.e. skills, facilities, processes, technologies) to research, develop, manufacture, test, and evaluate STUASs. Each Contractor's current capacity utilization levels indicate that they can support additional workload at this time, and it is assumed that this capacity will be available to support future STUAS workload. It is anticipated that a follow-on Industrial Capability Assessment will be conducted to support the Milestone C decision.

## **4.4 Air Force**

### **Tin-Lead (SnPb) Solder Market Availability Analysis (April 2009)**

This study, requested by Air Force Materiel Command, assessed the degree to which more stringent environmental regulations and the market acceptance of lead-free solder pose a threat to the continued sustainability of legacy defense systems. Many of these systems were produced and originally fielded with SnPb solder and solderable connections. Because SnPb and lead-free solder are incompatible, and because lead-free solder does not currently meet many military requirements, the defense systems sustainment community is concerned about its continuing ability to use and buy SnPb solder.

Environmental regulations have resulted in decreased production of products that contain hazardous materials, such as lead. While these standards affect the vast majority of the electronics market, some high reliability components for defense and medical systems applications have been granted waivers to these standards until the middle of the decade. There are still multiple domestic suppliers or producers of SnPb solder. Most manufacturers produce both SnPb and lead-free solder and those surveyed forecasted sales of both for the foreseeable future. The total global consumption of lead-free solder has increased from 15 percent of the solder market in 2004 to over 60 percent in 2008.

Some manufacturers have forecasted that SnPb solder may increase in price as regulations become more stringent or demand lessens. The Department of Defense is investing in lead-free solder initiatives to support compliance with environmental standards, less on reliance on waivers and diminishing sources, and limit risk from material cost increases. It is recommended that the Department continue to monitor revisions to current regulations and standards, as well as the relative market shares of lead-free and SnPb solder.

Based on these findings, no immediate action or intervention should be required to assure continued access to SnPb solder materials for the foreseeable future.

### **Radar Miniaturization Building Block Improvements Assessment (May 2009)**

This assessment, requested by Aeronautical Systems Center and Air Force Research Laboratory (AFRL), evaluated that segment of the avionics industrial base that designs and manufactures small-scale radars for Department of Defense missile, helicopter, or Unmanned Aircraft System (UAS) applications. The study identified multiple domestic companies whose current capabilities could support projects that would extend the application of Synthetic Aperture Radar (SAR) and Active Electronically Steered Array (AESA) radar technology, through miniaturization, to pressing Air Force mission requirements. In addition to characterizing the companies in terms of product technologies, market share and financial health, the assessment evaluated specific recommendations aimed at yielding significant reductions in radar size, weight, power, and production cost.

While three large defense contractors dominate the defense market for radar systems, sixteen domestic companies with relevant experience and capabilities were identified within this industry segment. The companies ranged from those supporting the full spectrum of radar design and manufacturing to firms with niche expertise in selected functional and component technologies. This segment is financially healthy.

Several design and manufacturing alternatives were identified where producibility and affordability constraints could be mitigated in order to pursue system miniaturization. In some cases, use of existing state-of-the-art capabilities were

leveraged while other recommendations require further research in terms of materials and integration technologies. A decision model was developed to assess and prioritize each recommended solution based on technology maturity, availability in the industrial base, and the customer's window of opportunity.

This assessment supports investment planning within the Air Force and broader Department of Defense research and development communities. The prioritized projects are incorporated into annual planning documents within the Air Force Manufacturing Technology (ManTech) program.

### **Military Aircraft Transparencies Industrial Base Assessment (October 2009)**

This report, requested by the Program Executive Office for Fighter Aircraft and AFRL, assesses the industrial base capacity to design, manufacture, and maintain aircraft transparencies, which includes windshields, windscreens, windows, light covers, and canopies. Transparencies for advanced fighter aircraft face demanding speed and optics requirements, including a need to complement low-observable characteristics. Due to complex production processes and extensive investments in equipment and fixtures, this assessment focused on canopies for the F-22 Raptor and the F-35 Joint Strike Fighter.

There is adequate competition and capability in the industry. After-market sales account for the majority of current production volume. The Department of Defense has worked aggressively to dual source most transparencies to both improve quality and lower cost. On average, the industry is operating at about 60-80 percent of capacity, but constraints have been identified that will require additional infrastructure to support ramp-up for F-35 canopy production. With four domestic and several foreign manufacturers, the industry may need to consolidate should either military or commercial demand decrease.

Common issues cut across the industry. There is a systemic inability among most manufacturers to implement, control, and sustain process yields as they launch new products. The industry readily adopts new materials and technologies, but has struggled with control of process variability. Forming processes are a common challenge across the transparency industry. Transparency coatings for advanced fighter aircraft are becoming more complex and difficult to apply with costly consequences for errors and rework. Some manufacturers are working to integrate Lean Production and Six Sigma techniques.

AFRL is coordinating the results of the study with both the F-22 and F-35 System Program Offices and the Defense Contract Management Agency. In addition to manufacturing process investment programs, the stakeholders are supporting the adoption and application of Manufacturing Readiness Levels to monitor transparency manufacturer capability against planned rate increases for new product introductions.

## **North American Gas Turbine Engine Market Analysis (October 2009)**

This assessment requested by Air Force Materiel Command (AFMC) and AFRL, evaluated aircraft engine production value forecasts for rotary and fixed wing aircraft and major unmanned air vehicles for the North American military and commercial markets. Production forecasts include the North American contribution to consortium, joint venture, or association sales. The assessment also included maintenance, repair, and overhaul (MRO) data since engine manufacturers generate a significant amount of revenue from MRO activity. In addition, scenarios were included to show how the market could be affected by changes in selected military aircraft procurements.

During the period 2009 to 2018, the forecast for the total North American engine market is \$295B. This includes both new production and MRO for military and commercial engines. The majority of sales are new production of commercial engines, which account for 55 percent of the total market value. New military engine production accounts for 11 percent of total forecasted sales and the remaining sales, approximately 34 percent, are from MRO business. The commercial market is expected to be flat through 2011, at \$12 to \$13B per year with moderate annual growth beyond the 2012 timeframe. The military new engine market, both for the U.S. military and foreign military customers, is expected to average \$3.0B per year through the forecast period.

The report analyzed sensitivity in the domestic engine manufacturing base based on potential changes to four large Air Force procurements: the C-17; F-22; F-35; and KC-X programs. Pratt & Whitney has the most volatile potential swing in sales over the forecast period (\$3B) due to their heavy involvement in fighter aircraft engines and uncertainty associated with the C-17 program. General Electric's military production could also be impacted, but is offset by maintaining a significant majority of commercial engine market share. Both manufacturers have research programs that contribute to future competitiveness in both military and commercial markets.

The Air Force will continue to monitor this critical industry as individual decisions are made regarding procurements, as well as overall market conditions impacting commercial production operations.

## **Ceramic Packaging Industrial Base Assessment (November 2009)**

This study, requested by the Under Secretary of the Air Force (SAF/US), the Space and Missile Center (SMC), and AFRL, had two purposes: 1) characterize the industrial base for ceramic packaging; and 2) determine the scope of available suppliers. Electronics components with ceramic packages are used in a variety of high temperature, high reliability military and aerospace applications. The processes involved in producing ceramic packaged integrated circuits (ICs) include package manufacturing, IC fabrication, assembly, and test. As the semiconductor industry

continues to move production capability off-shore, there is concern regarding supply chain vulnerabilities associated with ceramic packaged ICs.

There are three materials used for electronics packages: Plastic; Ceramic; and Metal. Plastics account for 97 percent of the worldwide commercial chip-encapsulation market. Ceramic packaging is widely used for space applications, although other hermetic, high-reliability package options exist. Besides space, other applications for ceramic packaged chips include down-hole oil drilling and unpressurized environments (missiles and aircraft). There are 13 domestic, qualified companies offering relevant assembly services for ceramic packaging. However, there are only two manufacturers of the ceramic packages qualified for military use, both Japanese owned, with one domestic production facility. Several smaller domestic manufacturers currently produce ceramic packaging for a small non-military aerospace market.

Conventional single chip packaging is moving to more compact formats such as wafer level packaging and system level integration in the package. Next generation technology trends include more layers, more electrical functionality in the substrate itself, and higher frequencies. The trend toward outsourcing test and assembly operations is increasing. All of this further complicates qualification and system assurance processes. The current time required to qualify a new supplier is typically one to two years for non-space certification and then another one to two years for space level certification.

The Defense Supply Center Columbus (DSCC) is responsible for a significant amount of the Department of Defense's semiconductor procurements. DSCC believes that there is enough demand to maintain a competitive domestic base for ceramic package manufacturing, but that the industry will require periodic monitoring.

### **Glass & Quartz Fiber Used in Aerospace Structural Composites (November 2009)**

This study, requested by AFRL, examined the capabilities and health of the industrial base that produces glass and quartz fibers used by the Air Force in its aerospace systems. Glass and quartz fibers are a major subset of inorganic fibers; they compete with and complement organic carbon fibers, the dominant fibers in aerospace composite structures. Among the varieties of glass fibers, the commodity E glass and the high performance S glasses are the source of glass fibers used in aerospace structures. The Department of Defense uses R glass in ballistics and armor; it may also have application for aerospace structures in the near future.

The firms that provide fibers to the military aerospace composites industry also supply the market for commercial applications. Department of Defense especially Air Force demand for these fibers in aircraft is expected to grow along with the use of glass fiber composites in ballistic armor protection for vehicles. Glass fibers are available from multiple domestic and foreign sources. For quartz fiber, the Department is dependent on a single foreign-owned, U.S. plant. Mined quartz is melted and formed

into rods in France. The rods are then shipped to the United States, to be processed into quartz fiber. Fiber is sold to companies that make it into fabric. In the case of quartz, 95 percent of the quartz fabric used by the Department is supplied by a single domestic source. This single-sole source situation for quartz fiber products has existed for decades and has resulted in no supply disruption in the last five years.

Glass fiber manufacturers have limited access up the supply chain to expose new fiber technologies to prime contractors and the Department of Defense. Fiber manufacturers find themselves constrained by obsolete process standards and the need to meet old formulation specifications. This lack of communication limits innovation and adoption of new materials. To minimize or eliminate the use of potential pollutants, manufacturers are striving to reduce the amount of boron used in glass production (boron is used to lower the melting point of glass, resulting in lower energy costs). Military specifications, however, give suppliers no incentive to reduce boron, treating boron-free glass the same as a borosilicate glass. The extrusion bushings that form glass fibers are made from a combination of platinum and rhodium. The United States is largely dependent on foreign sources for these two precious metals and the potential exists for shortages, supply disruptions, or price fluctuations.

The Air Force will continue to monitor the supply chain for quartz fiber products. The DoD Strategic Materials Protection Board (SMPB) has been evaluating material vulnerability concerns. As part of this effort, the SMPB and the Defense National Stockpile Center should continue to assess market conditions and stockpile requirements for both rhodium and platinum.

### **High Power Solid State Amplifier Industrial Base Assessment (November 2009)**

High-power amplifier technologies are used in satellite transponders, airborne fire-control radar systems, electronic warfare, and self-protection systems. There are primarily three forms of technology in use to provide radio frequency and microwave signal amplification. Traveling Wave Tube Amplifiers (TWTAs) are the legacy technology composed of an elongated vacuum tube with an electron gun at one end that has been integrated with a regulated power supply and protection circuits. Solid State Power Amplifiers (SSPAs) are next-generation amplification devices with no dependency on the electrical properties of a vacuum and have no mechanical action or moving parts. Microwave Power Modules (MPM) are a hybrid device leveraging the best engineering and design principals of both TWTA and SSPA technologies. This assessment, requested by SAF/US, SMC and, AFRL, characterizes the industrial base for SSPAs.

High power amplifier product lines are characterized primarily by the frequency bands they generate and their power output. While there is overlap among the three amplifier technologies in terms of performance characteristics, SSPAs and MPMs have not yet achieved the higher power output levels of TWTAs. Design and material improvements have steadily increased SSPA performance. The industry has significant



capability. The study identified nine domestic and four foreign SSPA suppliers and 11 domestic and five foreign TWTA suppliers. There is limited overlap between producers of TWTAs and SSPAs.

The high power amplifier industry while robust has several constraints. At specific frequency and power levels, there may only be a couple of qualified suppliers. For example, there is only one domestic and one foreign supplier that manufacture amplifiers for spacecraft. The companies themselves are a diverse mix that includes a few large defense manufacturers for whom amplifiers represent a small fraction of sales and a significant number of small privately held firms investing solely in new amplifier technologies. Most suppliers (or at least their parent companies) are financially viable, however, little data is available for small, private companies. In terms of technology, the trend is toward use of SSPAs where vacuum devices were previously utilized. SSPAs performance is improving as Gallium Arsenide (GaAs)-based amplifiers are likely to be replaced by Gallium Nitride (GaN)-based devices that are capable of using larger operational frequency bands, higher power, and higher power densities.

High power amplifiers continue to be a critical item in many military systems. This assessment supports investment planning within the Air Force and broader Department of Defense research and development communities. Continuing concerns over performance, quality, and reliability warrant further investment in both technology and process capabilities. In addition, monitoring of single source constraints will continue to occur on a periodic basis.

### **Trusted Foundry-Field Programmable Gate Arrays Industrial Base Assessment (November 2009)**

Security of integrated circuits procurement is of concern due to the critical functions they control in current defense systems. Increased reliance on off-shore manufacturing sources for integrated circuits and their constituent materials has resulted in concerns over risks associated with quality and intentional tampering. These global supply chains prompted the creation of Trusted Foundry/Trusted Suppliers for Application Specific Integrated Circuits (ASICs). Field Programmable Gate Array (FPGA) technology differs from that of ASICs in that it allows for programming after production. This assessment, requested by SAF/US, SMC, and AFRL, examined the New Systems Assurance policy requiring the development of specific guidance on the oversight of the supply chain associated with a variety of integrated circuits.

FPGAs are widely viewed as the next preferred IC to be utilized in defense and intelligence systems. The four dominant FPGA manufacturers predominantly use suppliers located in East Asia for fabrication, assembly, and test. The key processes in the manufacturing of FPGAs occur in overseas facilities. A small percentage of FPGAs are tested in the facilities of the FPGA designers. Tampering of the circuit or other malfeasance can occur in the design stage through final distribution.

FPGAs are currently not a secure substitute for ASICs because component manufacturers are not accredited. The capabilities and the manufacturing process of an FPGA warrant attention as its use increases in defense systems. Disruptions may occur unless programs are proactive in evaluating their supply chain risks. Establishing a rigid supply chain can help reduce risk in the system, but can also introduce other inefficiencies to the program.

Pilot programs are underway to assess the security of IC acquisitions applying supply chain risk management methods. A well developed and integrated risk management plan can provide greater security in the procurement of integrated circuits if the plan is developed with and adopted by the various suppliers. These processes will be further refined as the policy evolves.

## **4.5 Defense Contract Management Agency (DCMA)**

### **Aircraft Sector Economic Analysis (October 2009)**

The Defense Contract Management Agency (DCMA) Industrial Analysis Center (IAC) conducted an economic analysis of the Aircraft Sector for DCMA's Aerospace product division. The economic analysis consists of an assessment of macro-economic and federal budget trends, DoD budget trends, technology trends, production trends, and financial and other industry trends. The report outlines the outlook for three aircraft sectors: Fixed Wing, Helicopters and Unmanned Aircraft Systems.

The Aircraft Sector, unlike the rest of the defense industry, is not adversely impacted by the global economic crisis that began with the collapse of the U.S. housing market in 2007, and peaked with the stock market crash in 2008. Long-term commercial and military aircraft order book is healthy, with more than 20,000 aircraft representing more than \$2T. Currently, military aircraft procurement budget trend is projected to peak in 2010-2011, and decline two to three percent in 2012, stabilizing thereafter.

The overall defense budget is projected to decline about 21 percent over the next decade, according to Government Electronics Information Technology Association (GEIA-10/2008), because of concerns over the deficits and declining threat as the Iraq war winds down. The war in Afghanistan and aging equipment will provide a floor to the defense budget over the next decade.

One trend of concern to the Department of Defense is the potential atrophy of the design and development team capabilities for the next generation of military aircraft, as current programs reach their procurement completion phase.

## **Ground Systems Sector Economic Analysis (October 2009)**

The DCMA IAC conducted an economic analysis of the Ground Systems Sector for DCMA's Ground Systems Product Division. The economic analysis consists of an assessment of macro-economic and federal budget trends, DoD Budget trends, technology trends, production trends, and financial and other industry trends. The report outlined the outlook for three ground systems sectors: Ground Vehicles, Weapons and Munitions.

Unlike the rest of the defense industry, Ground Systems is not adversely impacted by the global economic crisis that began with the collapse of the U.S. housing market in 2007, and peaked with the stock market crash in 2008. Despite several program cuts and cancellations in recent years, the wars in Afghanistan and Iraq have sustained the industry. In fact, the overseas contingency operations have opened up the ground systems sector to non-traditional defense related companies, as the military seeks newer capabilities to combat evolving battlefield threats. After the peak in Ground Systems procurement funding of FY07, the budget will see a Compounded Annual Growth Rate of two percent through 2013. The approaching redeployment will likely sustain ground systems procurement budget before the sector's wind-down aligns with the rest of the defense industry beginning in 2014.

One ground system trend of concern to DoD, is the continued search for lightweight armor protection and the ability of the ground systems sector to develop capabilities to defeat the evolving improvised explosive device/ambush threat.

## **Shipbuilding Sector Economic Analysis (October 2009)**

The DCMA IAC conducted an economic analysis of the Shipbuilding Sector for DCMA's Shipbuilding Product Division. The economic analysis consists of an assessment of macro-economic and budget trends, DoD Budget trends, technology trends, production trends, and financial and other industry trends.

The shipbuilding industry, along with the rest of the defense industry, is impacted by a global economic crisis that began with the collapse of the U.S. housing market in 2007, and peaked with the stock market crash in 2008. The U.S. Government responded with the Troubled Asset Relief Program (TARP) and other bailout programs for large banks and other large companies. As a result, the long-term deficit is projected to be close to \$9.2T over the next 10 years, with Publicly Held Debt as a percentage of Gross Domestic Product (GDP) reaching 82 percent.

After years of being a bill payer, the shipbuilding budget is projected to rise over the next decade by 48 percent in real terms. Most of the increases in the Shipbuilding budget are from upcoming new submarine construction (raising SSN procurement from one to two a year and a new SSBN program) and investment in Surface combatants (Littoral Combat Ship LCS, DDX, and restarted DDG-51 programs). The new

administration has accelerated the SSBNX program and delayed the CGX program for technology reasons. Because of increased budgets, both the number and value of ship production are forecasted to increase over the next decade.

The increase in ship procurements is driven by aging ships and declining ship inventories. The U.S. Navy, in terms of battle force ships, stands at about 280 ships, the smallest force since prior to World War I. DoD has growing concerns about China's naval build-up. If current trends continue, China's Navy will surpass the U.S. Navy in number of ships in the 2016-2020 time period. According to U.S. Navy's 30 year Shipbuilding plan (12/2008), the U.S. is committing itself to achieving a 313 ship navy by 2025.

The Shipbuilding Industrial Base for the Department consists of two large companies owning the six largest shipyards that can produce every class of ship in the U.S. Navy. These contractors are financially stable and dominate the shipbuilding industry in the United States. There a number of smaller shipyards that produce small ships, such as patrol craft and surveillance vessels, for Navy from time to time. However, these yards rely on commercial workload for most of their business. Owing to the size of the LCS program, two foreign yards have risen in importance in the Shipbuilding Industrial Base. However, because of cost growth, the LCS program is scheduled to down-select to a single design in 2010; this could lead to one yard getting the majority of all new build ships for the remainder of the LCS program.

Despite a growing budget, Shipbuilding as a sector is most concerned with controlling costs. Cost overruns have led to curtailments of numerous shipbuilding programs over the past decade. Consolidation of the shipbuilding industrial base, at both the prime and subcontractor levels, has reduced capacity and increased cost as a result of the lack of price competition for key systems and components. Changing technologies and aging workforce have been factors in rising costs within the shipbuilding industry. Another factor weighing in on costs is the small domestic commercial shipbuilding base' ability to carry the overhead costs generated by U.S. Navy shipbuilding contracts (the United States has only about one percent of the global shipbuilding markets).

### **Space and Missile Industry Sector Economic Analysis (October 2009)**

The DCMA IAC conducted an economic analysis of the Space and Missile Industry Sector for DCMA's Space and Missiles Product Division. The economic analysis consists of an assessment of macro-economic and budget trends, DoD Budget trends, technology trends, production trends, and financial and other industry trends.

The Space and Missile Industries, along with the rest of the defense industry, is impacted by the global economic crisis that began with the collapse of the U.S. housing market in 2007, and peaked with the stock market crash in 2008. The U.S. Government responded with the Troubled Asset Relief Program (TARP) and other bailout programs

for large banks and other large companies. As a result, the long-term deficit is projected to be close to \$9.2T over the next 10 years, with Publicly Held Debt as a percentage of Gross Domestic Product (GDP) reaching 82 percent.

Like the overall defense budget, budgets are currently at or near peaks and are projected to decline over the next decade. Missiles and ordnance declines result from the winding down of the war in Iraq and program cancellation/consolidation. The DoD Space Budget is declining based on recent program cancellations, consolidations, and stretch-outs. Production forecasts for all key space and missiles markets are stable at best, to trending downward reflecting the declining U.S. defense budget.

NASA budget is projected to be stable (GEIA 10/2008) as the agency phases out the Space Shuttle by 2010 and shifts resources to developing the Constellation Program vehicles, such as the Orion Crew Exploration Vehicle (CEV). A gap of four years (2010-2014) is likely, where the United States will have no manned space vehicle available to move personnel and cargo to the International Space Station. The current manned space programs are currently being reviewed by an independent commission for the administration. There could be significant opportunities for the industrial base as priorities shift.

After consolidating in the 1990s, the Space and Missile industrial base is facing difficult issues. Aging work force and facilities continue to be a challenge. The companies in the Space and Missile Industrial base have and will continue to shift production facilities from aging facilities in the North East and California, to the South, attracted by lower labor costs and talent. Lack of long-term demand for many space and missile systems has caused consolidation to the point that many key capabilities, such as solid rocket motors, only have one or two providers and limited capacity.

## **4.6 Defense Logistics Agency (DLA)**

### **Acrylic Sand Bags (October 2009)**

An industrial base study was completed for acrylic sand bags in 2008. The study indicated that the acrylic sandbag supply chain has significant bottlenecks that impact wartime readiness, primarily in the availability of domestically produced acrylic fabric. The study was part of the information supporting a Domestic Non-Availability Determination allowing use of non-domestic acrylic fabric, which was approved in late 2008.

A new contract is being solicited with an estimated award date of third quarter FY10. Upon award of the contract, the new contractor's capability vs. requirements will be re-evaluated and findings of the previous study will be adjusted accordingly.

## **AM2 Landing Mat (October 2009)**

DLA completed a Lean manufacturing and Value Stream Analysis (VSA) study of the sole source provider's production facilities in 2009. The study resulted in various investment strategies based upon required production outputs, material requirements, and availability of funds.

DSCP exercised a strategy from the VSA study to improve wartime surge production output by pre-positioning components for the AM2 Pallet and Mat Assembly. The following components will be Government-owned inventory but will be maintained by the contractor:

- a) 14,400 Unfinished Mat Extrusions (Equivalent to 800 pallets)
- b) 3,000 Finished End Frames (2 per pallet, equivalent to 1,500 pallets)
- c) 416,000 Finished Inserts (520 per pallet, equivalent to 800 pallets)
- d) 32,000 Finished Connectors (40 per pallet, equivalent to 800 pallets)

## **Body Armor (October 2009)**

The Defense Logistics Agency conducted an industrial assessment of the DoD domestic body armor industrial base as input into the DoD Report to Congress on the acquisition strategy for Body Armor. The study included both hard body armor (ceramic plate manufacturing) and soft body armor (ballistic outerwear garments and carriers).

While the industry currently has the capacity to meet surge requirements, the DoD body armor industrial base has expanded significantly due to increased wartime requirements. As these requirements eventually decrease, it is critical to maintain the industrial base's ability to rapidly field new body armor systems during wartime. Several segments of this industry are at risk, including manufacturers of ceramic plates, high performance polyethylene (HPPE), and aramid fiber.

DLA is working closely with the military services to address the industry's long-term maintenance requirements.

## **Government Furnished Equipment for Unitized Group Rations (October 2009)**

A study was commissioned to identify in detail the bottlenecks in the production process of Unitized Group Rations (UGR). The focus was on identifying investments required to increase surge production capacity. Capacity of three current and potential UGR vendors to meet surge requirements was studied, resulting in three investment options. The recommended option was for the government to invest \$1.8M to procure retort machines (these units cook the food in the pouch), two Tray Sealer units (these units seal the pouches), and associated support items, including spare parts kits,

manuals, and retort racks. Awards were made in September 2009 to two firms with delivery expected within six to nine months.

Once an award for this ration is made in 2010, an assessment will be conducted at the vendor's facility to decide how much of the Government Furnished Equipment (GFE) will be positioned at the facility to support surge requirements. Utilization of this GFE for surge production will result in an additional 288,000 rations per month, which significantly closes the gap between production capacity and requirements. It should be noted that this GFE can also be used to augment production for the Meals Ready-to-Eat (MRE).

In addition, Defense Supply Center Philadelphia (DSCP) assumed ownership of two critical pieces of equipment, at no cost, from the Combat Ration Advanced Manufacturability Network (CORANET). One piece of equipment, a Raque-brand Fill and Seal machine, will be refurbished and positioned at a UGR vendor. The use of this machine will result in an additional 15 percent increase in UGR production, and it can also be used for testing and training purposes during peacetime.

DSCP has also initiated the purchase of additional retort racks to be used during a surge event. One of the bottlenecks in the production of UGRs as well as MREs is the shortage of racks. The racks being purchased will be a new design and made of a new material to allow for greater heat penetration and transfer.

### **Industrial Base Extension Follow-on (October 2009)**

The Industrial Base Extension (IBex) Program provides Outside the Continental United States (OCONUS) and Continental U.S. (CONUS) asset visibility of inventory and global logistics capability available to support U.S. military operations and relief efforts following natural disasters with possible access to these capabilities if required. The IBex program is a government/industry partnership with multiple global logistics providers that develops an overlapping global network of information on inventory, manufacturing, logistics, storage, transportation, humanitarian support, and base camp construction and maintenance. DLA has formed strategic partnerships with industry experts allowing government planners access to commercial sector expertise. These strategic supplier relationships transcend purchasing transactions and enhance DLA's ability to develop improvement opportunities that facilitate the sharing of information.

Interest in this program by a wide diversity of DLA offices has resulted in a request to expand IBex from a planning tool to a value-added contingency contracting mechanism for supplies and services. A feasibility study (IBex2) was conducted to determine the benefits to the DLA mission and its customers should an expansion project be implemented. The results of the contractor study are being reviewed for further action and possible follow-on in FY10.

## **Joint Service Lightweight Integrated Suit Technology (October 2009)**

Although customer requirements have steadily declined for the last several years, FY09 and FY10 demand has stabilized at or near the minimum sustaining rate for the sole source filter liner fabric producer.

However, requirements beyond FY10 are considered vulnerable and an issue paper has been forwarded for Program Budget Review 11 to discuss future industrial base funding to maintain the critical portion of the Joint Service Lightweight Integrated Suit Technology (JSLIST) supply chain. Recommendations from the issue paper were not funded, but the expected result of the issue paper process will be funding to study alternative courses of action to maintain key portions of the JSLIST industrial base.

DLA continues to work with the Joint Program Office and Service representatives to obtain the best forecast for acquisition planning. DLA also works closely with the industrial base to develop an acquisition strategy that will maintain both production and surge capability for this critical item.

## **Meals Ready-to-Eat (October 2009)**

Significant requirements for Meals Ready-to-Eat (MRE) have continued in support of operations in Southwest Asia. The Federal Emergency Management Agency (FEMA) has also had substantial requirements resulting from ice storms, earthquakes, tsunamis, fires and hurricanes that have required DLA's support this year. Industrial Specialists continue to monitor the MRE vendors and have noted that the current commercial industrial base has been more than capable of handling the added surge.

A five million case stockage objective of MREs has been achieved. The MRE vendors are in continuous production.

Using Lean Six Sigma, an analysis was conducted with one of our MRE/Unitized Group Ration (UGR) vendors, and another is in process to identify areas where readiness and surge may be improved. The analysis will focus on quality improvements that will decrease inspections, rework, and lead times, while increasing industry's capability to support both peacetime and wartime demands.

## **Nomex<sup>®</sup> Supply Chain (October 2009)**

Nomex<sup>®</sup> is the registered brand name of a flame retardant aramid fiber and is a sole source product from DuPont Advanced Fiber Systems. Material made from this fiber is heat and flame resistant and provides significant protection from fire. Nomex<sup>®</sup> material is required for several military clothing items including coveralls, gloves, and jackets. These items were traditionally worn by the aviation and combat vehicle communities; however, due to increasing threats from improvised explosive devices and



resulting burn casualties, the need for flame protection spread to non-traditional users including wheeled vehicle operators and ground troops.

Based on increasing requirements for Nomex<sup>®</sup> items during wartime, it was determined that the supply chain had some inherent constraints limiting its ability to meet surges. The typical production lead time for end items with Nomex<sup>®</sup> material is six months to include the production of fiber, spinning the fiber into yarn, weaving the yarn into fabric, finishing the fabric, and the production of the end item.

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

### **Rapid Assembly Program Follow-on (October 2009)**

The Rapid Assembly Program (RAP) allows for increased surge capability for UGRs. It features flexible unitization capability via self-contained mobile production line assembly modules capable of being deployed to government depots, commercial ration assemblers, or through DLA's Subsistence Prime Vendor program. Use of these assembly modules will significantly shorten lead times of finished UGRs to theater by obviating the need to assemble and transport completed rations from the United States. The implementation of this program will also free up critical transportation assets. The two additional assembly modules purchased during FY06 are being specially configured for OCONUS use and will include voltage converters and air compressors. DSCP allocated \$25K for FY10 to review, modify, and upgrade two of the four units. As funding is received, these upgrades will be scheduled at industrial facilities. Completed units will be deployed to the Subsistence Prime Vendor in Hawaii and to a yet to be determined site in Europe.

### **Rapid Wall, Force Protection Barriers (October 2009)**

DLA invoked the surge provision in order to release pre-positioned raw materials in its long-term contract for pre-fabricated barriers to meet spikes in demand for these critical force protection items.

The Services' demand for these barriers outstripped previous wartime usage estimates in both volume and breadth of product type. Increases in troop levels for Operation Iraqi Freedom and Operation Enduring Freedom in Afghanistan as well as changes in operating procedures (increased use of Forward Operating Bases) led to a surge in orders from the Army.

## **Tents and Shelter Systems (October 2009)**

Based on a Minimum Sustaining Rate (MSR) study completed in 2007, DLA maintains an Industrial Base Support Initiative for the current MIL-SPEC tent and shelter manufacturers. Initial awards of MSR contracts in 2007 totaled \$23.5M and included both directed and competitive contracts. In both 2008 and 2009, requirements, inventory levels, and production levels were again analyzed, and an additional \$23.5M of Warstopper funding was obligated each year to continue the MSR contracts.

Additionally, the TENTNET program continues to explore ways to improve surge capabilities for military tent requirements through the collaboration of DLA/DSCP, industry, government, and academia to ensure the availability of tentage and shelters. Through this collaboration, efforts to enhance the supply chain focus on improving surge capability, reducing production lead-times, improving availability, and providing tents and shelters that possess similar or improved quality and cost.

## **Tray Pack Ration Readiness (October 2009)**

Tray pack rations are a member of the family of DoD field combat rations. They are used to sustain groups of military personnel in highly mobile field situations. The component items are thermally processed, shelf-stable foods packaged in hermetically sealed, steam table-sized poly tray containers. DoD contingency requirements for tray pack rations have greatly exceeded peacetime requirements.

Lean Six Sigma was also used to conduct an analysis with one of our MRE/UGR vendors to identify areas where readiness and surge may be improved. The findings of the value stream mapping were reviewed by the vendor and DLA. As a result, the vendor is implementing improvement actions or has action plans, when surge activity warrants, to remove pacing internal constraints. DLA has taken action to procure retort machines and tray sealer units and upgrade and increase retort manufacturing capabilities.

## **Unitized Group Ration - Express (October 2009)**

Late in FY07, a compact, self-contained module that provides a complete hot meal for each group of 18 Warfighters was introduced. The Unitized Group Ration - Express (UGR-E) uses a simple pull-tab to heat food in just 30-45 minutes and is served in trays to provide a hot meal to our Warfighters. Heater modifications continue to be researched for future release.

The evolution of this ration has spawned a continuing dialog as early high demand challenged the new supply chain. Subsistence Industrial Specialists continue to research component alternatives and additional suppliers, due to design

modifications and newer production techniques. They are also visiting and evaluating 22 vendors that currently provide components for this ration, to ensure continued support in the face of economic conditions that have negatively impacted many small businesses.

The UGR-E shares poly tray production lines for its entrees with the UGR Heat & Serve and was part of the Lean Six Sigma analysis conducted during FY09. The findings and actions taken by the vendor and DLA will benefit the UGR-E as well as the UGR Heat & Serve.

### **Petroleum, Oil, and Lubricants (December 2009)**

DLA's Defense Energy Support Center (DESC) continues to support the DoD and commercial satellite industry with uninterrupted delivery of the two liquid propellants critical to the U.S. space program, specifically, hydrazine (N<sub>2</sub>H<sub>4</sub>) and dinitrogen tetroxide (N<sub>2</sub>O<sub>4</sub>). Both products have a limited domestic industrial base from a production perspective but are supported under a long-term contract (10-year plus two 5-year options) with reliable suppliers. There were no interruptions of supply during FY09 or the first quarter of FY10, for either product. In addition to the commodity supply, DESC manages the transportation component of the supply chain for both products. DESC delivered 100 percent of its hydrazine and N<sub>2</sub>O<sub>4</sub> shipments to customers without incident.

Previously, DESC had awarded three contracts in support of the Air Force's Aviation Synthetic Fuel (synfuel) Certification Program. DESC awarded the first synfuel contract to Shell Oil Products in June 2007 for 315,000 gallons and this contract has been fully performed. In FY08, DESC awarded two synfuel contracts to Sasol Oil (Proprietary) Limited (Sasol). One contract was for 60,000 gallons of synthetic fuel, which specifically required coal as the feedstock, for delivery to Wright-Patterson Air Force Base (AFB), Dayton, Ohio, and Edwards AFB, Lancaster, California. The second contract was for 335,000 gallons, with no restrictions on the feedstock.

In FY09, DESC awarded five alternative fuel contracts in support of the Air Force and Navy's testing/certification programs and alternative fuel goals. Two contracts were awarded for Hydro-treated Renewable Jet (HRJ) -8 using camelina and tallow as feedstock. The contracts had a base quantity of 100,000 gallons each, with options for an additional 100,000 gallons per contract. Delivery will be at Wright-Patterson AFB, Arnold Engineering Development Center (Arnold AFB, Tennessee), and Edwards AFB. The third contract was for 40,000 gallons of HRJ-5 using camelina feedstock, with an option for an additional 150,000 gallons, with delivery to Naval Air Station, Patuxent River, Maryland, and General Electric Aircraft Engines, Evandale, Ohio. The fourth contract was for 1,500 gallons of algae-derived JP-5, with delivery to Naval Air Station (NAS) Patuxent River. The fifth contract was for 20,000 gallons of Fischer-Tropsch F-76, produced from natural gas feedstock, for delivery to an Office of Naval Research contractor. Additionally, the DLA Contracting Support Office awarded an alternative fuel

from organic sources research and development contract on behalf of DESC that includes the delivery of 20,055 gallons of algae-derived F-76, with delivery to NAS Patuxent River. Initial fuel deliveries have been made in accordance with contract schedule delivery requirements.

DESC continues to support the Air Force by supplying Turbine Fuel, Aviation, Thermally Stable (JPTS) for use in its highflying U-2 aircraft. DESC currently has only two suppliers for JPTS; one in CONUS and one OCONUS. AGE Refining Inc. (San Antonio, TX) 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. AGE delivers fuel on a free on board (f.o.b.) destination basis via railcar to Beale AFB, California, and Seabrook, Texas. The AGE 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. DESC encounters difficulties in securing suppliers of JPTS due to the extensive qualification process required to be a certified supplier.

#### **4.7 Missile Defense Agency (MDA)**

During FY09, DCMA with the support of The Missile Defense Agency (MDA), conducted a study of the Inertial Measurement Unit (IMU) and Light Detection and Ranging(LIDAR)/ LAsER Detection and Ranging(LADAR) industrial base, as part of its effort to update the baseline assessments of missile defense industrial and technology capabilities. MDA will use the findings and recommendations of this study to implement its evolutionary strategy for missile defense systems, by capitalizing on technology advances as appropriate.

The IMU and LIDAR/LADAR industrial base was surveyed and assessed to determine the industrial capability and viability to meet future military requirements. The study sought to identify sole/single sources, foreign sources/dependencies, business and financial risks at developers and component manufacturers.

In addition, MDA Ground Missile Defense Program Manager requested DCMA support to a Ground Based Interceptor (GBI) Manufacturing Break Assessment. The MDA GBI Assessment involved surveying and assessing 68 supporting prime and sub-tier Solid Rocket Motor (SRM) and electronic suppliers.

## **Inertial Measurement Unit Industrial Capability Assessment (May 2009)**

Three types of IMUs were evaluated: Ring Laser Gyros (RLG); Fiber Optic Gyros (FOG); and Micro Electro Mechanical Systems (MEMS).

The study concludes: 1) there are numerous foreign and domestic IMU integrators and producers; 2) most RLG and FOG IMU's are expensive commercial or Military/Space applications; commercial applications support aviation/shipboard navigation; 3) there are numerous sole source IMU subtier suppliers; and 4) RLG and FOG technology is mature. MEMS technology represents the greatest potential for DoD investments.

The recommendations were to: 1) closely monitor the numerous sole source suppliers identified for RLG, FOG, and MEM production; 2) MDA work on characterizing the effects of radiation on MEMS devices; and 3) consider a Broad Area Announcement to identify technologies which may be applicable as a common IMU standard interface.

## **LIDAR/LADAR Industrial Capability Assessment (September 2009)**

The Department of Defense and Government systems use LIDAR/LADAR applications for autonomous navigation, 3D cameras, terrain, and cloud mapping, underwater detection and Homeland Defense facial recognition. Space based applications are predominately used for National Aeronautics and Space Administration (NASA) planetary mapping climate change purposes. MDA related high power Space based emerging technology is based on Linear Mode Single Photon Counting Avalanche Photodiodes (SPAD), with benefits to include a lower target false alarm rate, stronger reflected signals and dark current rejection.

The study concludes: 1) all LADAR systems supporting DoD/MDA programs are rated 'low' industrial or financial risk as there are multiple alternate sources; 2) numerous LADAR suppliers exist within the industrial base; 3) there are limited laser and supporting electronic developers for high power applications for MDA/DoD/NASA; 4) foreign suppliers provide some niche electronic parts, alternate domestic sources do exist; 5) MDA is investing in LADAR R&D using the Small Business Innovation Research (SBIR) program. The SBIR program presents investment opportunities for MDA in Space Based IR and ground and sea based radar system enhancements; 6) a limited number of companies, laboratories, and universities are developing advanced LADAR modeling software and algorithms for Space based long range high power systems; 7) LADAR provides significant performance improvement over the full engagement during stressing conditions. Emerging MDA related technology will focus on LADAR system applications for long range Space based detection, with reasonable laser power. To sustain current MDA LIDAR/LADAR products, there is a need to develop LADAR sources in new wavelengths and higher power.

Findings and recommendations are to 1) continue to work on advancing LADAR target recognition capabilities; 2) develop a LADAR system for flight test applications and assess applicability for systems such as Space Tracking and Surveillance System (STSS), Exo-Atmospheric Kill Vehicle (EKV) and Standard Missile-3 (SM-3) detector and camera enhancements; 3) continue DoD, MDA and NASA investments in order to get increased range and power. Invest in the development and demonstration of new techniques for modeling LADAR at long ranges over a variety of LADAR options [coherent vs. direct detection, various wavelengths, etc.]; 4) continue to work with Defense Advanced Research Projects Agency and AFRL on LADAR unmanned ground vehicle and unmanned aircraft systems that allow autonomous perception capability. Inertial Measurement Units that are developed using MEMS technology may allow for a smaller and lower cost package providing a geospatial mapping capability not previously available; 5) have commercial companies continue working commercial LADAR applications which will allow for a more distributed order book. Homeland Defense applications and the increased use of LADAR movie cameras and projectors will dominate this business area along with underground and undersea mapping to include oil deposit locations. The application of LIDAR for wake turbulence research and wind shear measurement is being demonstrated by the FAA before making any long-term buy decisions. Systems are currently predominately sold for overseas applications.

### **Ground Based Interceptor Manufacturing Break Assessment (September 2009)**

DCMA IAC was tasked by the MDA, Ground Missile Defense (GMD), Program Manager to assess a manufacturing break associated with the Ground Based Interceptor (GBI) contract. MDA uses GBI's to defend against hostile missile launches. A total of 68 prime and supporting GBI suppliers were analyzed regarding the following GBI subsystems: Exo-atmospheric Kill vehicle (EKV), Booster Avionics Module (BAM) and the Orion Boost Vehicle (OBV). A resulting report and briefing was provided by DCMA IAC to the Director DCMA and Director MDA to include members of his executive staff. The report and briefing prioritized by high risk those GBI suppliers and or components affected by either a degraded financial viability and or associated loss of capabilities due to a GBI manufacturing break. Both in the report and during the briefing, risk mitigation options were identified based on potential overall effect to the Ballistic Missile Defense Office (BMDO). As part of the report findings, proposed GBI supplier manufacturing break mitigation actions and/or investment options were identified so that potential Executive level MDA decisions could be addressed.

The study concludes: 1) the GBI Solid Rocket Motor (SRM) and associated propellant industry is declining and an overarching DoD/NASA analysis may be required; and 2) GBI electronic suppliers are limited due to their custom capabilities and associated GBI operating environment.

Recommendations are: 1) convene an Industrial Policy sponsored SRM industry analysis to determine potential investment options (underway); and 2) DCMA to apply

GBI Manufacturing Break Assessment recommendations on associated MDA new contract Request For Proposals (RFP) and or Source Selection Evaluation Board participation.

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## 5. Industrial Sector Summaries

Industry segment-level baseline assessments (aircraft; C4/ICT; ground vehicles; missiles; services; ships; and space) are summarized in the following section of this report. Several of the conclusions are highlighted below and are seen throughout industrial sectors:

Workforce concerns are evident in several defense sectors. The military aircraft and rotary-wing design and development workload is at a historic low with significant skill and experience loss expected as the aging research and development (R&D) workforce retires thereby increasing the execution risk for new programs in this sector. Preserving and developing unique and highly creative talent, labor skills, and technology is vital to the industrial base's ability to continue to produce world-class aviation and rotary-wing products. The reduction in RDT&E funding does not bode well for the sectors' design and development capability without long-term production programs. There is significant concern for the potential loss of essential military unique design and engineering capabilities due to multiple systems production shutdowns.

Science Technology Engineering and Mathematics (STEM) education is necessary to ensure that the nation has a workforce capable of understanding in detail both the environment and processes of the Department as well as leading edge technologies brought to bear upon them. After spiking during the internet boom, enrollments in university STEM programs have reverted to previous historical levels and there is growing concern with expanding information and communications technology (ICT) usage in defense, that a sufficient supply of qualified graduates will not be available to meet industrial base needs. The Department is addressing STEM education issues with the National Science Foundation under the umbrella of the president's Networking and Information Technology Research and Development Program (NITRD).

Although capabilities within the industrial base supporting defense generally are sufficient to meet current and projected DoD requirements, the Department has been faced with industry segment capacity concerns centered on difficulties associated with rapidly increasing production of "important" (based on unique evolving operational scenarios) items. There always have been certain low peacetime demand, defense-unique, niche product areas where industrial capabilities are limited. These issues are even more striking when the Department endeavors to accelerate production of such an item. Problems (for example, bottlenecks) do not necessarily arise at the prime contractor level, but most often arise at the subtier supplier level. For the purpose of monitoring important subtier suppliers, the Department defines "important components"<sup>2</sup> as any item that:

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<sup>2</sup> In an October 2008 report entitled "Department Of Defense: A Department-wide Framework to Identify and Report Gaps in the Defense Supplier Base is Needed," the GAO recommended that the Department take action to leverage and fully apply the criteria used by the ODUSD(IP) to guide the identification and monitoring of supplier base

- Is produced by a single or sole source;
- Is used by three or more programs;
- Represents an obsolete, enabling, or emerging technology;
- Requires 12 months or more to manufacture; or
- Has limited surge production capability.

In defense-unique markets, there sometimes is little competition at the subsystem/component level. Accordingly, the Department must use many single/sole source suppliers—suppliers for which there may be minimal innovation incentive. Further, defense-unique industry segments may not be sufficiently profitable and suppliers within those segments may have an insufficient business case to justify continuing in the market.

## 5.1 Aircraft Sector Industrial Summary

The aircraft industrial base produces fighter/attack aircraft, vertical lift aircraft, transport/cargo aircraft, large fixed wing aircraft (i.e., aerial refueling tanker, Intelligence, Surveillance, and Reconnaissance (ISR), and multi-mission aircraft), trainers, and unmanned aerial systems. This sector is projected to remain in good shape despite ongoing market pressures. The vast majority of DoD aviation production programs continue to be supported near term in the budget process. Lockheed Martin and Sikorsky even have production programs projected for the next 20+ years. However, the impact of top line budget constraints on future procurement and Research, Development, Test and Engineering (RDT&E) funding levels and on future industry design and development capabilities has yet to be determined.

By and large, U.S. defense and aerospace companies have maintained their financial health with relatively low debt and large free cash flow throughout the recent economic downturn. For the primes, these trends may not last forever with the sales of aircraft reducing and the cost of pension plans rising. Existing large backlogs have decreased but continue to provide a reasonable buffer. Boeing for example announced that its backlog now stands at \$320B, nearly five times their current annual revenue.<sup>3</sup> Even with substantial backlogs many companies are still aggressively managing infrastructure costs and investments in an effort to remain competitive coming out of the economic downturn. Bell, with the loss of the Advanced Reconnaissance Helicopter (ARH) on top of the economic downturn, has cancelled some planned facilities growth in an effort to align orders more closely with capacity. Correspondingly, the Department has not seen any failures from critical 2<sup>nd</sup> or 3<sup>rd</sup> tier aviation suppliers. However, some lagging supplier health indicators have shown increased cost and schedule variances that have proven manageable so far. The length of the continuing economic downturn

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<sup>3</sup> Boeing Company 3<sup>rd</sup> Quarter 2009 Earnings report. October 2009.

and depth of subsequent budget cuts will determine further impacts on DoD programs originating from the supplier base.

IP has been tracking the industrial base impact of cancelled programs such as CSAR-X combat search and rescue aircraft (Boeing) and VH-71 Presidential helicopter (Lockheed Martin). While these cancellations themselves do not appear to impact DoD's ability to meet its immediate vertical lift requirements, the helicopter industrial base as a whole has been identified as an area of continued concern. IP has been working closely with the newly created Vertical Lift Consortium to identify capabilities required to ensure future vertical lift requirements continue to be met.

The Department of Defense continues to progress in its recapitalization effort with the demand for new or upgraded aircraft remaining strong. The impact of airframe corrosion and aging aircraft subsystems on mission readiness has become increasingly problematic for the Services. Our military aviation equipment is being used faster and harder than envisioned. Sustaining legacy aircraft has become progressively more expensive and time consuming for maintainers with many aircraft types operating beyond their original design life. Maintaining and upgrading these aircraft is proving to be far less cost-effective in the long-term than buying replacement aircraft with increased capabilities.

While procurement funding levels are strong, there is a continuing trend to accelerate programs into production to speed the overall recapitalization effort over the need to pay for new development and innovation. Procurement funding shows a steady increase through 2013. Five major prime contractors have procurement orders from the Department of Defense for the next ten years. Lockheed Martin and Sikorsky have programs identified today that will carry production for the next 20 years.

In contrast to increases in procurement, aviation has seen significant reductions in RDT&E funding. RDT&E funding for aircraft programs is projected to continue to decrease across the Future Year Defense Plan (FYDP). A major driver for this is the reduction of F-35 (Joint Strike Fighter (JSF)/Lightning II) RDT&E funding as the program transitions from the System Development and Demonstration (SDD) phase and into production. Additionally, more vertical lift programs are now using non-developmental airframes that install military-unique subsystems to meet their mission requirements avoiding the obligation of large amounts of RDT&E funds. The reduction in RDT&E funding does not bode well for companies and their subcontractors without long-term production programs. The lower-tier supplier industrial base continues to consolidate as the number of military programs reduces over time. Suppliers not associated with future production programs (for example, suppliers not participating in the F-35 or UH-60M) will be impacted the most. These suppliers will be forced to either exit the business or find new non-DoD programs for their products.

One area that seems resistant to the lack of substantial RDT&E funding is the unmanned aircraft market. This area is seeing continued sustained growth. Unmanned Aircraft Systems (UAS) have proven themselves an effective new tool for

the 21<sup>st</sup> century warfighter. Interest in UASs has grown dramatically since the start of the conflicts in Afghanistan and Iraq. Demand for the capabilities they bring has far exceeded the supply. Predator and Global Hawk provide constant imagery and are now virtually indispensable to Combatant Commanders in theater. Over the last decade, business development of UASs had been left to smaller, start up companies.<sup>4</sup> Large aerospace primes saw little profit in the typically small, inexpensive, and short production UASs produced at the time. The early UAS industrial base was made up of a number of small, independent, newly-formed companies vying for work in this new and highly competitive market. While things have changed somewhat, the industry still thrives based on the innovation brought to it by these small independent firms. In order to move their ideas into reality, these firms eventually enter into strategic alliances with a larger prime integrator or are bought out. Working through a prime integrator allows the smaller companies to continue to do the innovation and creativity that they do best without the problems associated with learning how to build and develop a fully integrated system. By 2007, U.S. firms controlled more than 60 percent of the UAS market.<sup>5</sup> The leading firms are Northrop Grumman and General Atomics that produce the Global Hawk and Predator/Reaper UASs respectively. Mergers and acquisitions continue in this very active field and further consolidation within the UAS industry is expected as the UAS demand continues to expand and larger programs develop. Still the UAS industrial base is large and robust driven by the ever expanding unmanned system demand.

In general terms, today's aviation industrial base's greatest risk is not consolidation, it is atrophy and the potential for loss of key design and development capabilities. Military aircraft design and development workload is at a historic low and RDT&E funding is expected to continue to decrease across the FYDP. Another issue faced by the aviation industry includes an aging workforce and decreased likelihood that a younger engineering workforce will remain in the industry due to the lack of new challenges and interesting things to do. Adequate funding must be identified to encourage innovation and to mitigate risk-taking through company-sponsored independent R&D activities. There is also a growing need to address shortages in specific critical skill sets such as structural analysis, systems integration and other critical military-unique skills. This is necessary to ensure a full range of competencies will continue to exist to design, develop, prototype, produce and sustain new platforms and systems needed to explore new concepts and innovate.

### **Issues:**

- The military aircraft and rotary-wing design and development workload is at a historic low with significant skill and experience loss expected as the aging research and development (R&D) workforce retires thereby increasing the execution risk for new programs in this sector. Preserving and developing unique and highly creative talent, labor skills, and technology is vital to the industrial base's ability to continue to produce world-class aviation and rotary-

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<sup>4</sup> [www.uavforum.com/vendors/vendors.htm](http://www.uavforum.com/vendors/vendors.htm); October 2009

<sup>5</sup> "Unmanned Vehicles Forecast." Forecast International. October 2007.

wing products.<sup>6</sup> The reduction in RDT&E funding does not bode well for the sectors design and development capability without long-term production programs. With the shutting down of the F-22 and soon the F/A-18E/F/G production, there is significant concern for the potential loss of essential military unique design and engineering capabilities. Examples of military unique design skills at risk include hypersonic, canopy and cockpit design and integration, stores management and weapons separation, loads, stress and aerodynamics.

- The U.S. vertical lift industrial base continues to be impacted by the government and industry response to the Nunn-McCurdy cost breaches of the past decade and by the lack of any new real innovative development. The Department's budget-driven remanufacture strategy has produced a series of sole-sourced relationships, leaving few real competitive opportunities among the helicopter prime contractors to force technology refresh cycles. With limited competition, few new platform contracts, and declining government technology investments, industry has been left with little incentive to invest in independent research. Widespread lack of innovation in the rotorcraft industry could jeopardize the Department's plan to modernize the fleet leaving us on a path of the status quo exacerbating the critical skill loss in the rotorcraft sector.
- The Aircraft sector relies on an extensive network of suppliers, teaming relationships, and partnerships that are heavily integrated with the global commercial aircraft market. The overall outlook for the industry is stable with increases in U.S. defense procurement spending, but challenges still remain with respect to foreign competition, foreign outsourcing, changing defense requirements and missions, declining research and development, an aging workforce, and infrastructure consolidation and modernization. Over the next few years, multiple military aircraft production lines will terminate leading to a new round of consolidation in order to reduce infrastructure costs. Many of the issues faced by the military aircraft sector involve budgetary and re-capitalization trade-offs. Suppliers not associated with future production programs (for example, suppliers not participating in the F-35 or UH-60M) will be impacted the most. These suppliers will be forced to either exit the business or find new non-DoD programs for their products.
- Global partnerships continue increasing as many European contractors have either formed an alliance or established domestic subsidiaries in the United States in order to better compete for U.S. defense-related programs. While U.S. defense spending had enjoyed increases in recent years, European and other international defense spending has not increased. This, combined with the downturn in the civilian aviation market, has increased European interest in the U.S. defense market.<sup>7</sup> Today, the majority of aerospace suppliers supporting DoD programs are still U.S. suppliers; however, participation from global

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<sup>6</sup> "The Unseen Cost: Industrial Base Consequences of Defense Strategy Choices." Aerospace Industries Association. June 2009.

<sup>7</sup> Aboulafia, Richard. "World Military & Civil Aircraft." Teal Group Corporation. Dec 2008, pg 6.

contractors is increasing and so are the number of foreign subcontractors supporting the primes, further diluting future procurement and RDT&E funding.

## **5.2 Command, Control, Communication, Computers, and Information and Communications Technology (C4/ICT) Sector Industrial Summary**

In the decades immediately following WWII, military requirements drove information and communications technology (ICT) development and led development in the commercial world. In later decades, coincident with the internet revolution, the drivers reversed and commercial forces now drive ICT development with the commercial world leading military development. Military C4/ICT products are now heavily dependent upon commercial technology. This dependency is not expected to change in the foreseeable future. Nevertheless, given simultaneous military operational requirements for high-mobility, high-security, and high-bandwidth, often in areas with no infrastructure, there will still be some defense-specific products. The new paradigm, however, for these defense products is less about technology or advances in science or engineering but rather meta-technology or the application, software development, and systems integration of existing commercial technology into defense products.

ICT is obviously pervasive across the spectrum of defense activities. In addition to command, control, and communications products used by operational forces, ICT is used in the development and sustainment of those products as well in DoD business functions such as personnel, finance, training, and management. In these areas, there is much less need for defense specific products and commercial, or even commercial-off-the-shelf (COTS), products are more and more the rule.

This dependence upon commercial technology and COTS products has both advantages and disadvantages. The Department represents less than two percent of the global ICT market. Assuming proportionate research and development (R&D) investment, more than ninety-eight percent of the world's ICT R&D is focused on commercial products. The advantage is that the Department leverages this vast commercial R&D investment by focusing more on meta-technology than on advances in science. The disadvantage is that enemies, potential enemies, and competitors to the U.S. have the same technology and have potential to exploit the Department's supply chain. The DoD strategy to cost-effectively meet strategic objectives is to maximize the use of commercial technology while emphasizing risk mitigation in design, sourcing, and operation.

Although often described as a network, in very simple terms, the C4/ICT industrial base can be thought of in four tiers: tier I system integrators; tier II specialized subsystem suppliers; tier III device, component, and piece part suppliers; and tier IV design and production tool suppliers. Tier I suppliers are often well known major

defense contractors. Sometimes, tier I suppliers do their own tier II work in house and sometimes subcontract to lesser known and/or more specialized suppliers. A core skill for a tier I supplier is successfully operating in the government contracting environment. The focus of tier II suppliers is meta-technology with detailed knowledge of both the customer's environment and state-of-the-art technology. Tier II suppliers are often more of a mix of traditional and non-traditional suppliers and there are many more companies operating at this level than at tier I, perhaps hundreds. Tier III suppliers in the C4/ICT industry are often focused on the more than 98 percent of the global ICT market that is commercial and may not even be aware that they are DoD suppliers. In a highly-innovative global market, there are thousands of tier III suppliers. The state-of-the-art is frequently developed and defined at tier III. At tier IV, the number of suppliers narrows down dramatically. For example, nearly all of the world's integrated circuits are designed with software tools (Electronic Design Automation) supplied by only four companies.

Integration of civil and military suppliers at tier I is frequently an issue of a potential supplier's willingness to adopt the government contractor business model. Integration of civil and military suppliers is nearly absolute at tier IV with almost no identifiable defense-specific suppliers. At tier II and tier III, there are a number of specialties with requirements related to DoD's needs. Aerospace and its applicable reliability standards, notably the Federal Aviation Administration's DO-254, Design Assurance Guidance for Airborne Electronic Hardware, is an obvious example. The automotive industry has requirements for high reliability ICT in harsh environments, though with less functional complexity, and uses ISO 16949 as a standard. Even the oil and gas exploration industry has requirements for high reliability in harsh environments with electronics packages found in drill bits more than a mile below the earth's surface. The medical and communications industries have very high reliability requirements with some medical devices having a 6-nines or 99.9999 percent reliability requirement. In the area of cyber-security, there are businesses where the use of ICT is universal and the stakes are in the hundreds of billions of dollars: banking, finance, e-commerce, and gaming.

A keystone relationship in the C4/ICT industry is the trade between hardware and software. In contemporary electronics, a large portion of hardware is either programmable or requires instructions. During design, a choice can usually be made to develop features in either hardware or software (or firmware).<sup>8</sup> Factors in the trade space include speed, power consumption, production quantity, adaptability, security, and standardization with some favoring hardware and others favoring software. In general though, particularly given the high costs of small quantities of custom hardware, it would not be surprising to see DoD products using more rather than less software.

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<sup>8</sup> Firmware - a microprogram stored in ROM, designed to implement a function that had previously been provided in software.

## **Issues:**

- Cyber-security is likely to be a major issue for the foreseeable future. Threats can come from anywhere including individuals, organized crime and nation states. The targets include both the Department and its suppliers. Because the adversaries are dynamic, cyber-security must be dynamic and continuously reassessed. Rote compliance with certification programs is not by itself effective and even detrimental when it provides a false sense of security. There is growing discussion that boundary protection is not an effective strategy and that design and operation for risk and consequence mitigation with behavioral monitoring is more realistic. The Department is aggressively addressing cyber-security for itself and its suppliers on a number of fronts.
- Supply Chain Risk Management is related to cyber-security. The Department is preparing another Report to Congress on this issue entitled “Trusted Defense Systems” in response to the 2009 National Defense Authorization Act, Section 254. With thousands of tier III suppliers and a large proportion of tier III and tier IV work moving offshore, this is a serious area of concern. For example, a survey of OEMs, subcontractors and distributors by the Department of Commerce documented nearly 10,000 cases of counterfeit parts in 2008.<sup>9</sup> These components not only have increased likelihood of failure but also the potential to house malware.
- Science, Technology, Engineering, and Mathematics (STEM) education is necessary to ensure that the nation has a workforce capable of understanding in detail both the environment and processes of the Department as well as leading edge technologies brought to bear upon them. After spiking during the internet boom, enrollments in university STEM programs have reverted to previous historical levels and there is growing concern with expanding ICT usage in defense, that a sufficient supply of qualified graduates will not be available to meet industrial base needs. The Department is addressing STEM education issues with the National Science Foundation under the umbrella of the president’s Networking and Information Technology Research and Development Program (NITRD).
- Because the pace of innovation in the commercial world is so rapid and the pace of traditional defense acquisition relatively slow, defense systems can be fielded that are technologically far behind the current state of practice. In 2010, the Department expects to address development of a new acquisition process for IT.

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<sup>9</sup> “Counterfeits and the US Industrial Base,” Mark H. Crawford, Office of Technology Evaluation, US Department of Commerce, [http://www.ncix.gov/comm\\_workforce\\_dev/Crawford-CounterfeitBriefing-General-September2009.pdf](http://www.ncix.gov/comm_workforce_dev/Crawford-CounterfeitBriefing-General-September2009.pdf).



### **5.3 Ground Vehicles Sector Industrial Summary**

Ground Vehicles are categorized as either wheeled or tracked. The Mine Resistant Ambush Protected (MRAP) and the MRAP All-Terrain Vehicle (M-ATV) are examples of wheeled vehicles, where as the M-1 Abrams and Bradley are examples of tracked vehicles. The distinctions between tactical and combat vehicles have blurred as a result of the lessons learned in Iraq and Afghanistan. There is increased importance accorded to arming and armoring both types of vehicles to protect against constant and difficult to detect threats in urban and rural environments.

The majority of vehicle suppliers have responded extremely well to significantly increased requirements in support of ongoing contingency operations. The Army, USMC and Joint Service ground vehicle research-development and procurement budgets for tactical and combat vehicles are \$15B in FY09, \$17B in FY10 and \$11B in the FY11 President's budget. These figures include programmed and supplemental funding and are in then-year dollars. Supplemental appropriations represent almost 40 percent of this funding. The largest vehicle programs over the three fiscal years are MRAP and M-ATV at \$13.3B, High Mobility Multipurpose Wheeled Vehicle (HMMWV) at \$6.3B, and Family of Heavy Tactical Vehicles (FHTV) at \$4.2B.

In addition to new acquisitions, the Department has increased overhaul and repair of the vehicle fleet due to the severe service experienced in Iraq and Afghanistan. The cost is estimated at \$17B to \$19B annually for the next several years as compared to \$2.5B to \$3B per year prior to the war. This work is extremely important for preserving tracked vehicle industrial capability, especially given the cancellation in 2009 of the Manned Ground Vehicle (MGV) portion of the Future Combat System.

The major vehicle production programs tracked in the Defense Acquisition Management Information Retrieval (DAMIR) system have not experienced significant delivery issues. For the most part, program schedule requirements are within the industry's capacity to achieve. The earlier MRAP and now the M-ATV program variant had extremely short and steep production ramp up schedules. Nevertheless, in 2007 and 2008 MRAP successfully transitioned from low to full-rate production and then post production in 2009. In June 2009 the MRAP Joint Program Office awarded its first delivery order for 5,244 M-ATV.

Wheeled vehicle component manufacturers are continuing to benefit from the operational requirements of Iraq and Afghanistan. Full-rate production of 1,000 M-ATVs per month, a continued demand for spare parts for fielded vehicles and increased rates of overhaul and maintenance enable the beneficiaries of this work to remain profitable. For the most part, combat and tactical vehicle manufacturers are meeting financial obligations, and reinvesting in their businesses through research and development, acquisitions and capital expenditures. Continued production and spare part demand is also helping subcontractors that support the heavy trucking industry to weather the depressed economic environment.

The significant drawdown of defense budgets in the 1990s reduced the number of major tracked vehicle prime contractors to just two; General Dynamics Land Systems (GDLS) and British Aerospace Engineering (BAE) Ground Systems Division. With the exception of the GDLS Marine Corp Expeditionary Fighting Vehicle (EFV), there are no major tracked vehicle programs under development or in production. However, both companies perform a significant amount of tracked vehicle overhaul work in partnership with military depots. In addition they, along with Navistar, AM General and Lockheed Martin, have received development contracts for the Joint Light Tactical Vehicle (JLTV). In addition, GDLS has production work for the Stryker, reset work for the Abrams, and continues to develop the Expeditionary Fighting Vehicle for the Marine Corp. BAE has MRAP, family of medium tactical vehicles, and a significant amount of reset and upgrade work for Bradley Fighting Vehicle. It also had a small quantity of Future Combat System (FCS) Non-Line-Of-Sight Cannon work, which was terminated in Dec 2009 as a result of the Secretary's FCS Manned Ground Vehicle cancellation.

There are “important” component suppliers for the vehicle industry. Examples include tracked vehicle transmissions, armament and military unique forgings, castings; and metallic and composite materials used to make armor.

**Issues:**

- Continued overhaul, maintenance and repair of vehicle fleet
- Consolidation of tracked vehicle design and manufacturing supplier base
- Increased survivability and mobility (protection + lighter/stronger armor)
- Impact of future MGV and JLTV requirements and ability of industry to adapt

## **5.4 Missile Sector Industrial Summary**

Missiles are classified into four segments—tactical missiles, strategic missiles, missile defense systems, and smart munitions. Generally, missile subsystems are categorized in four main areas – propulsion; armament; airframe; and navigation, guidance, and control (NGC). Smart munitions do not have a propulsion subsystem.

For roughly the last decade, missile programs and their associated funding profiles have remained fairly stable. However, this trend has recently started to change in the strategic and missile defense segments. For the strategic missile segment, procurement funding is declining. The funding is declining with the conclusion of the Minuteman III Guidance Replacement Program and the Propulsion Replacement Program. The Minuteman III Propulsion Replacement Program came to an end in August 2009 leaving the Navy D5 as the remaining strategic production program. The Air Force is developing a Minuteman III warm-line program to support the solid rocket

motor industrial subsector. In the missile defense segment, the Department cancelled the Kinetic Energy Interceptor program and reduced the Ground-based Interceptor program. This appears to reflect a departure from higher risk research and development programs towards the procurement of missile upgrades and modifications to proven programs like the Standard Missile-3. The procurement funding for missile defense programs has remained stable in part, due to increased foreign military sales. The procurement funding in the missile defense sector is for the PAC-3 and Standard Missile programs. The remaining missile defense funding is in the research & development line. Tactical and smart munitions funding has also remained fairly stable again with increased foreign military sales.

Research, Development, Test and Evaluation (RDT&E) funding is declining. Most of the research and development funding in the missile sector is associated with legacy program upgrades or modifications. Cancelling the Kinetic Energy Interceptor program further decreases the missile defense research and development funding. This lack of new missile program development limits our ability to fully exercise the industrial capabilities necessary in the missile industrial base – from design concept, system development, and production – to meet our current and future national security needs. Many industrial sectors that support our national security requirements are also supported by the commercial markets. Unlike those industrial sectors, the missile industrial sector is mostly defense unique.

Projections and forecasts for DoD investments in missile programs are subject to the results from the Nuclear Posture Review, the Ballistic Missile Defense Review, and the Quadrennial Defense Review. As constrained DoD budgets become more strained by higher priority programs, investments in missile research & development and procurement may be more challenged.

The significant drawdown of defense budgets during the 1990's reduced the number of missile prime contractors from more than twelve to six. However, the prime contractors are not necessarily equal in industrial capabilities. With the cancellation of the Kinetic Energy Interceptor program, four of the primes only operate in one of the missile segments (Boeing – Smart Munitions, General Dynamics – Tactical Missiles, ATK – Tactical Missiles, and Northrop Grumman – Strategic Missiles). Northrop Grumman, ATK and General Dynamics are prime contractors on only one program – Northrop Grumman the MM III program, ATK the AARGM program and General Dynamics the 2.75" rockets (Hydra rockets).

Lockheed Martin and Raytheon account for roughly 85 percent of the Department's missile procurement funding. This indicates that while there is competition in this sector, it appears mostly limited to two contractors. As one might expect, Raytheon and Lockheed Martin are the prime contractors on the majority of our missile programs and both have a mix of missile segment programs (tactical, ballistic missile defense, etc.).

The Department's missile prime contractors are profitable, able to meet their financial obligations, generally consistent in providing value to its shareholders, and willing to invest back into the company via research and development or capital expenditures. For the most part, our primes are able to meet our technical performance requirements.

"Important" components in the missile industry segment include thermal batteries, solid rocket motors (SRMs), jet engines, inertial measurement units (IMUs), GPS receivers, seekers, fuzes, and warheads. These components are considered "important" because they are used on multiple programs and some of these components require 12 months or more to manufacture.

Declining RDT&E funding, coupled with limited competitive opportunities projected in the near-term will make it difficult for the missile sector industry to attract and retain a workforce with the industrial capabilities to design, develop and produce future missile systems that will meet national security requirements.

**Issues:**

- The strategic missile segment funding is declining. With the MM III Guidance and Propulsion Replacement Programs ended, the Trident (D5) missile is the only remaining program. Congress has shown an interest in this defense unique segment and the FY10 National Defense Authorization Act has directed the Department to develop a solid rocket motor industrial base sustainment plan.
- RDT&E funding for missiles declines from FY07-FY13 with roughly a 50 percent decline in the strategic and tactical missiles and smart munitions segments over the same period.
- At this time, there is only one major missile program being competed – the Joint Air-to-Ground Missile (JAGM). The Department has established a Prompt Global Strike technology application program. This small number of new programs is an indication of limited opportunities for our industry to maintain their design teams.

## 5.5 Services Sector Industrial Summary

In FY08 50.5 percent of all DoD contract spending was classified as supplies, 38.2 percent classified as services, with 11.3 percent classified as RDT&E<sup>10</sup>. As the unescalated dollar value of overall contract spending has increased dramatically, 221 percent since 1998, the percentage of spending in each domain has exhibited noticeable trends undoubtedly related to spending on Middle East conflicts. The percentage of supplies increased from 43 percent to 50 percent, the percentage of services decreased from 40 percent to 38 percent and the percentage of RDT&E decreased from 17 percent to 11 percent. All DoD contract actions are classified by Federal Supply Class/Service Codes (FSCs) which map to 23 service categories. In order to identify strategic sourcing opportunities, the Office of Strategic Sourcing in the Defense Procurement and Acquisition Policy (DPAP) Directorate consolidated the 23 service categories into eight portfolio groups. Listed in order of largest to smallest total spend: Knowledge Based Services (KBS), Research and Development (R&D), Facilities Related (FR), Construction Related (CR), Equipment Related (ER), Electronics and Communications Services (ECS), Medical (Med) and Transportation (Trans).

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

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

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

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<sup>10</sup> After correcting for a \$13.9B data entry error in Construction Related Services.

Because two-thirds of DoD R&D costs consist of manufacturing development, advanced component development and advanced technology development for major weapons systems, it's arguable whether R&D should be considered a service or as a separate intermediate R&D category that's neither a supply nor a service. Regardless of preference, the R&D category has all the characteristics described above of Defense Industry Service sector members.

**Issues:**

- In-sourcing of services by DoD is an area of concern by industry. While many agree in principle with the notion that inherently governmental or close support to inherently governmental work should be in-sourced, there is concern that, in some cases, the government may be 'poaching' contractor employees or that quotas are driving functions to be in-sourced with little regard to being inherently governmental.
- Section 207 of the Weapons System Acquisition Reform Act directs the Secretary to revise the Defense Supplement to the Federal Acquisition Regulation to provide guidance and tighten existing requirements concerning organizational conflicts of interest by contractors in major defense acquisition programs. Some businesses have expressed concern that the government might over-react and prohibit some types of innocent horizontal business integration.
- Many competitively awarded contracts receive only a single offer. The reasons this can happen are not well documented; the Federal Procurement Data System (FPDS) data cannot collect information on offers that are not received. In some cases, potential competitors may not believe it cost effective to attempt unseating a well-performing incumbent. In the R&D sector, responses to Broad Agency Announcements are recorded as competed with a single offer when a single offer is all that's really expected for unique research project. Sometimes there is geographic specificity that works against identifying a large pool of competitors. Industrial Policy is preparing a report on the single offer phenomenon.

## 5.6 Shipbuilding Sector Industrial Summary

The shipyard facilities that make up the defense shipbuilding industrial base consist of two segments—first tier and mid tier shipyards that produce six functional product segments including –submarines, aircraft carriers, amphibious ships, surface combatants (cruiser, destroyer, littoral combat ship), sealift, and research/special vessels. Major ship subsystem providers can be categorized as system integrator, mission system integrator, armament, mission systems, propulsion or main engine, and yard/builder providers.

Six major U.S. shipyards build nearly all of the Navy's ships. Those shipyards are Newport News, Avondale, and Ingalls, which together comprise Northrop Grumman Shipbuilding (NGSB); and Electric Boat, Bath Iron Works, and National Steel and Shipbuilding Company (NASSCO), owned by General Dynamics (GD). Some of the first tier shipyards have unique capabilities that affect how the Navy and Congress have allocated new construction contracts.

U.S. commercial shipbuilding accounts for less than one percent of world commercial shipbuilding output and 80 percent of this comes from the mid tier sector. Of the six major shipyards, only NASSCO currently has a commercial shipbuilding program. With the lagging economy, the outlook for commercial Jones Act shipping orders does not support shipyards starting a commercial shipbuilding program for several more years.

While U.S. shipbuilders produce the most capable warships in the world, the number of U.S. Navy ships being built each year in U.S. shipyards is low when compared to the number of ships being produced each year by the leading international shipyards. A low volume of production makes it extremely difficult for U.S. shipyards to match the improvements in technology and productivity seen in the international shipyards. Serial production and a stable design are key elements that U.S. shipyards must have to increase productivity and reduce the cost of shipbuilding for the U.S. Navy. Two U.S. Navy shipbuilding programs in particular have shown how effective serial production and a stable design are at reducing the costs of shipbuilding – the VIRGINIA class submarine program and the T-AKE auxiliary program. Serial production allows lessons learned from one ship to be transferred to the next ship – significantly lowering the man-hours of labor required to build successive ships. A stable design allows the shipyards to optimize their facilities to build the ship – using jigs and fixtures for example – because the stable design eliminates the risk of having to constantly change their facilities from one ship to the next due to unique design requirements for each ship. Both the VIRGINIA and T-AKE program have seen significant cost reductions and production schedule improvements as a result of serial production and a stable design. The Littoral Combat Ship (LCS) program has recently shifted the acquisition strategy to incorporate both of these elements. By selecting a single design and awarding 10 ships to one shipyard, the LCS program will have both

serial production and stability in the design as key elements of the acquisition strategy. The Navy has shifted the construction of all three DDG-1000s to a single shipyard vice dividing the construction between two shipyards. By moving all three ships to a single prime shipyard, the shipbuilder will now have the ability to gain and apply lessons learned and optimize the production plan for their facility. These actions should result in both cost and schedule savings for the Navy. Both serial production and design stability were cited as industry best practices for the international shipyards by the Government Accountability Office in their study comparing best practices of international shipyards to those of U.S. shipyards.

**Issues:**

- The 30-year shipbuilding plan must be based on a funding level that is achievable throughout the entire 30-year span. Previous plans have required funding levels that were much higher than the historical average. In order for the shipbuilding plan to be a planning tool, thereby providing some stability in the industry and ability to plan workload and workforces, the plan must be executable and not change dramatically each year it is updated.
- Each shipbuilding program should be executed based on serial production and design stability. Examples exist in both U.S. Navy shipbuilding and commercial shipbuilding to demonstrate the benefits to both cost and schedule when these two elements are part of the foundation of a shipbuilding program. Recent examples also highlight the failures that occur when these elements are not adhered to in a shipbuilding program. In order to get to the 313 ship fleet in the current budget environment, the Navy must use serial production and design stability to ensure the highest savings possible in both cost and schedule are realized in all the shipbuilding programs.
- The total workload required to build the ships required for the U.S. Navy and the U.S. Coast Guard may not be enough to support all the shipyards currently doing business with the U.S. government. As the number of ships each shipyard builds reduces, the overhead associated with that shipyard is applied to fewer ships, causing the unit cost for each ship to rise. Low workloads cause peaks and valleys in workforce requirements for shipyards that in turn cause shipyards to lay-off and then re-hire workers. Without a stable workforce, it is harder to apply lessons learned from ship to ship and the cost savings associated with serial production decreases. Fewer healthy shipyards capable of attracting talent and capital investment will be able to provide a price and quality than more shipyards that are operating with excess capacity.



## 5.7 Space Sector Industrial Summary

The space industrial base supports three primary segments—spacecraft, launch systems, and control systems. Space systems support commercial, government, national security, and international markets. Spacecraft are used for a variety of purposes: communications, earth observation (imagery, environmental monitoring, and weather), intelligence, missile detection & tracking, research & experimentation, space surveillance, space exploration, and position, navigation, & timing (PNT).

A financial review of 15 of the top U.S. space companies concluded that the overall U.S. space industrial base is financially healthy. The companies were generally profitable at a five percent return on assets or better with all companies having positive gross profit margin. All but one of the companies had increased backlog from the previous year, indicating guaranteed work in the queue. While about half the companies had debt ratios above 60 percent (two of which appear to have high leverage and low liquidity), most were liquid with quick ratios close to or above one.

### **Issues:**

**Counterfeit Parts:** Increasing globalization and obsolescence of systems offer continuing and growing opportunities for introduction of inappropriate and counterfeit parts into spacecraft and launch systems as well as other Department of Defense (DoD) systems.<sup>11</sup> A counterfeit electronics survey of original equipment manufacturers' sub-contractors and distributors by the Department of Commerce documented over 9,000 cases of counterfeit parts in 2008. This is of particular concern to the space industrial base due to the need for reliable, radiation-hardened electronics in spacecraft. The incidents of counterfeit parts were almost equally divided between parts still in production and older parts that are out of production. The vast majority of counterfeit parts are suspected to originate in China.<sup>12</sup> In addition to chips and other parts, threats also arise from counterfeit routers, switches, and wide area network interface cards.<sup>13</sup> These components not only have increased likelihood of failure but also the potential to house malware.

**Critical Technologies & Components:** The National Security Space Office (NSSO) manages several forums designed to address space industrial base issues. These forums include: The Space Industrial Base Council (SIBC), which is composed of senior leadership from each of the major space agencies, the Space Supplier Council (SSC), which is composed of second and third-tier space supplier base contractors, and the Space Quality Improvement Council (SQIC), which is composed of space prime

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<sup>11</sup> Glow, Brian, Chi-Chu Tschang, Cliff Edwards, & Brian Burnsed, "Dangerous Fakes--How Counterfeit, Defective Computer Components from China are Getting into U.S. Warplanes and Ships," *Business Week*, October 2, 2008.

<sup>12</sup> Crawford, Mark H., "Counterfeits and the US Industrial Base," Briefing from the Office of Technology Evaluation, US Dept. of Commerce, September, 2009, [http://www.ncix.gov/comm\\_workforce\\_dev/Crawford-CounterfeitBriefing-General-September2009.pdf](http://www.ncix.gov/comm_workforce_dev/Crawford-CounterfeitBriefing-General-September2009.pdf).

<sup>13</sup> Krigsman, Michael, "FBI Counterfeit Cisco Routers Risk IT Subversion," ZD Net blog, 12 May 2008, <http://blogs.zdnet.com/projectfailures/?p=740>

contractors. Collectively, these organizations assess risks in the space industrial base, develop mitigation plans, and fund projects needed to ensure access to critical technologies and capabilities in the quality, quantity, and timeframe required to support U.S. Government space programs. Under the purview of the SIBC, the Critical Technologies Working Group (CTWG) is a forum for discussing technologies and components important to the U.S. space industrial base and their member agencies. By consensus, the CTWG prioritized the top seven technologies & components for 2009 as follows:

HgCdTe Detectors  
CdZnTe Substrates/Visible Sensors for Star Trackers  
Star Trackers Readout Integrated Circuits (ROICs)  
High Reliability Space Qualified Discrete Electronics (SQDE)  
Rayon

Export Controls: Born out of the Cold War in an attempt to restrict technology transfer to the former Soviet Union, export controls (ITAR—International Traffic in Arms Regulations) and the EAR – Export Administration Regulations) may adversely impact the U.S. national security space (NSS) industrial base today.<sup>14</sup> Some companies try to avoid the challenges of export controls by not bidding on military contracts (under the mistaken assumption that export controls do not apply to commercial products) or by not entering export controlled business segments altogether, thereby depriving the NSS industrial base of broader markets, innovation, new technology, and capital. Companies that do sell to the defense sector may sub-optimize their national security products in an attempt to protect their commercial market products. In the vacuum left by U.S. companies in international markets, foreign firms have been energized to fill the void and even create “ITAR-free” products that have no U.S. components that might prevent exporting to third countries. The cost and difficulty of export licensing becomes a competitive disadvantage to lower-tier U.S. firms with fewer financial resources.<sup>15</sup> Specific to the space industrial base, a 2008 study by the Center for Strategic & International Studies (CSIS) stated that the cost of ITAR compliance is about \$50M a year while approximately \$600M is lost annually in revenue due to licensing issues. This study also cited that export controls are the top barrier to foreign space markets for the U.S. space companies.<sup>16</sup> However, another study stated that there was little evidence to prove conclusively that export controls had decreased U.S. satellite industry competitiveness internationally.<sup>17</sup> There is renewed interest from both the U.S. Government executive and legislative branches to reexamine export controls, including controls on satellites. Changes to controls must balance U.S. space industry health and competitiveness with national security considerations. Less restrictive controls could be considered so long as they mitigate other lingering national security concerns. Exports

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<sup>14</sup> National Academy of Sciences, *Beyond "Fortress America" National Security Controls on Science and Technology in a Globalized World*, Washington, D.C.: National Academies Press, 2009.

<sup>15</sup> *Ibid.*

<sup>16</sup> Center for Strategic & International Studies, “Briefing of the Working Group on Health of the U.S. Space Industrial Base and the Impact of Export Controls,” February, 2008, slides 33 & 53.

<sup>17</sup> Van Atta, Richard, et al, “*Export Controls and the U.S. Defense Industrial Base*,” Institute for Defense Analyses, January 2007, pg 14.

that are not appropriately controlled may undermine national security priorities, such as maintaining the U.S. advantage on the battlefield or prolonging the life of U.S. national security investments in systems and know-how. The Department is participating in two major Export Control reform initiatives: an interagency task force review of the overall Export Control system in support of a Presidential Study Directive, and an assessment with the Department of State in response to PL 111-084, Fiscal Year 2010 National Defense Authorization Act (NDAA), Section 1248, "Risk Assessment of United States Export Control Policy.

NASA Disruptions to the Space Industrial Base: The retirement of NASA's Space Shuttle Program (SSP) and the proposed Presidential cancellation of the Constellation Program (CxP) could have the largest impact on NASA suppliers and workforce since the retirement of Apollo. This could result in a major loss to NASA in skills and capabilities as it ends an operational program (i.e., SSP) and ramps up a developmental program for exploration and scientific activities in place of CxP. Suppliers may shift to commercial space markets or exit the business. Considering that NASA alone had 25 percent of the entire 2008 U.S. Government space budget, a perturbation in NASA's supply base could have a significant outcome on the U.S. space industrial base.<sup>18</sup> In place of CxP, the proposed funding in NASA's budget for commercial space transportation could help to mitigate some negative effects. NASA is working with the Department of Commerce to assess the collective consequences of these two major events.

Increasing Global Competition: The U.S. is still the overall world leader in the space arena, but its dominance is eroding. Other countries have targeted space as a strategic industry and have provided government subsidies, resulting in intense international competition, possibly made worse for U.S. companies by export control impediments.<sup>19</sup> In 2008, Russia led the world in successful orbital launches; the U.S. was second with China ranking third. Russia has held this lead since 2004. Europe, Japan, India, & Israel also conducted successful orbital launches. The U.S. spacecraft manufacturing numbers for 2008 were less than half of what they were in 2000. For 2008, the U.S. and Europe were on par (30 versus 31, respectively) for number of spacecraft manufactured while Russia ranked third. China, Japan, India, Canada, Israel, Brazil, & South Korea made up the remainder of satellite production.<sup>20</sup> The trend is clear: global competition in the space sector from both traditional and non-traditional nations is increasing and is projected to continue.

Orbital Space Debris: Orbital space debris is an increasing concern as it may have direct impacts upon the space industrial base. Opinions vary on whether orbital debris has already reached a tipping point or whether it will continue to become a growing problem in the years to come. On the plus-side for industry, it could open up a new market for debris clean-up and mitigation. On the down-side, it has the potential to

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<sup>18</sup> "The Space Report," The Space Foundation, 2009, page 22.

<sup>19</sup> Taylor, Alan M., "Defense Industrial Base Assessment: U.S. Space Industry Final Report," Air Force Research Laboratory, 31 August 2007, pgs 13-16.

<sup>20</sup> Futron's 2009 Space Competitiveness Index: A Comparative Analysis of How Countries Invest In and Benefit from Space Industry, The Futron Corporation, 2009.

increase costs through collision avoidance (additional on-board satellite fuel), insurance premiums (insurance companies may determine some orbital slots have a higher probability of collision than others), and collision mitigation (shielding and component redundancy in the hopes that a small-scale collision might be survivable). Furthermore, portions of national space budgets that could be spent on new space infrastructure might instead be reallocated to deal with this problem.

Program Cancellations: The cancelling in April of 2009 of the Transformational Satellite Communications System (TSAT) should have a minimal impact on the U.S. space industrial base as a whole.<sup>21</sup> The FY09 TSAT Research, Development, Test, & Evaluation (RDT&E) budget accounted for over 20% of the FY09 RDT&E budgets for DoD major satellite programs, but this amount was only about 1% of the entire 2008 U.S. Government space budget.<sup>22</sup> Additional procurement of Advanced Extremely High Frequency (AEHF) and Wideband Global SATCOM (WGS) military communication satellites will help to buffer TSAT's absence along with the transplanting of TSAT technology developments into other programs.<sup>23</sup> On the civilian side, the world satellite industry has seen double-digit growth in revenue from 2005 to 2008, and the private sector rules the satellite communications market.<sup>24</sup> Based on a robust commercial satellite forecast, it appears the civilian communication satellite industrial base will remain healthy.<sup>25</sup> While the satellite communications market will remain financially viable, there is concern for specific skill-sets within the industrial base that are defense related. The military satellite community will have to carefully manage the sustainment of skill-sets related to protected military satellite communications.

Workforce Issues: Retirements from the U.S. Science, Technology, Engineering and Mathematics (STEM) workforce could significantly impact the aerospace sector in the coming decade.<sup>26</sup> For NSS programs, specialized skill sets (such as protected military satellite communications and intelligence payloads) make the issue of a declining STEM workforce even more of a concern for the military space industrial base. The combined factors of low demand, reduced military spending, workforce retirements, and reduced labor pool entrants could threaten specialized skills. If lost, it could take significant cost and time to rebuild these skills for the military space industrial base.

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<sup>21</sup> Brinton, Turner, "Pentagon Cancels TSAT, Trims Missile Defense," *Space News*, 6 April, <http://www.spacenews.com/military/pentagon-cancels-t-sat-program-trims-missile-defense.html>

<sup>22</sup> Derived from data at the OSD Comptroller Website, "RDT&E Programs (R-1)—DoD Budget FY10," May 2009, pgs F-3-5, <http://comptroller.defense.gov/Budget2010.html> and "The Space Report," The Space Foundation, 2009, pg 22

<sup>23</sup> Brinton, Turner, "T-Sat Demise Poses Bandwidth Challenge," *Space News*, 13 April 2009, Vol 20, Issue 15.

<sup>24</sup> "State of the Satellite Industry Report," Satellite Industries Association, June 2009, pg 5.

<sup>25</sup> "2009 Commercial Space Transportation Forecasts," FAA Commercial Space Transportation & the Commercial Space Transportation Committee, May 2009, pg 2.

<sup>26</sup> "A Special Report; Launching the 21<sup>st</sup> Century American Aerospace Workforce," Aerospace Industries Association, December 2008, pg 1.

## **6. Related Activities**

The Department of Defense's preferred approach to establishing and sustaining the defense technology and industrial base is to leverage its research, development, and acquisition processes and decisions to create a competitive environment that encourages industry to invest in technology development and make sound technology insertion and production capacity/facilitization decisions. When market forces are insufficient, however, the Department uses powerful Defense Production Act tools 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 Title III of the Defense Production Act**

The availability of domestic production capabilities for critical defense technologies is an essential element of national security. Title III of the Defense Production Act (50 U.S.C. App. 2061 *et seq.*) is a program specifically designed to create, maintain, modernize, protect, expand, or restore industrial capabilities required for national defense. 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 systems. To create the needed industrial capacity, Title III authorities provide for the use of financial incentives in the form of purchases, purchase commitments, the purchase or lease of advanced manufacturing equipment for installation in government or privately owned facilities, the development of substitutes, and loans or loan guarantees. Title III activities strengthen the economic and technological competitiveness of the U.S. defense industrial base and can reduce U.S. dependency on foreign sources of supply for critical materials and technologies.

In calendar year 2009, the Title III Program had 29 projects underway. Following are brief descriptions of each active project.

#### **ALON® and Spinel Optical Ceramics**

Military weapon platforms such as the C-17 and High-Mobility Multipurpose Wheeled Vehicle (Humvee) require lighter weight, higher performance, and lower cost optical materials. Aluminum oxynitride (ALON®) and magnesium aluminate spinel (spinel) are extremely durable optical ceramics with excellent ballistic and transmission capabilities that are used in military applications for transparent armor, missile domes, and infrared windows. ALON® and spinel components demonstrate optical, physical, and mechanical characteristics similar to today's standard sapphire; however, they are producible in larger sizes, higher quantities, more complex geometries, and ultimately at lower costs than are achievable with sapphire. Title III is supporting an initiative to establish an integrated, flexible manufacturing process capable of producing these two extremely durable, transparent 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.

### **Armor and Structures Transformation**

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.

### **Armstrong Titanium Production**

The Title III Program has begun a project to establish the domestic capacity to produce lower cost titanium powder using non-melt technology in the form of the patented Armstrong Process® technology. The Armstrong Process can produce commercially pure titanium powder directly from titanium tetrachloride by injecting it into a stream of liquid sodium. Alloyed titanium powders can be created in the same process by injecting chlorides of the alloying elements. The Armstrong Process is a disruptive technology in the titanium manufacturing market because of its ability to significantly reduce titanium parts manufacturing cost and lead times for both commercial and military manufacturers. With the Armstrong Process powder, manufacturers can use direct consolidation techniques to form near net shapes, sheets, plates, blocks, or pipe.

### **Atomic Layer Deposition (ALD) Hermetic Coatings Project**

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, reduced size, weight and protection cost as well as increase the operational life of the circuits. 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.

## **Beryllium Production**

When this project reaches completion, the United States and its allies will be assured of an uninterrupted supply of primary (high purity) beryllium metal for defense and civilian utilization. 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. Construction of the beryllium “Pebbles Plant” in Elmore, Ohio, is in full swing and continues to proceed smoothly. The final phase involves not only construction, but start-up, qualification and commissioning of the beryllium reduction facility. Plant construction officially began in July 2008, and completion is targeted for mid-March 2010. The contractor will introduce chemicals into the plant in April 2010, and initial production and process testing is planned to occur from April to June 2010. This cost share project with industry will create a new primary beryllium production facility and will ensure continuous availability of high purity beryllium metal.

## **Coal-Based Carbon Foam**

This material is an inexpensive, lightweight, fire-resistant, impact-absorbing material which can be fabricated in a variety of shapes, sizes and densities. It replaces conventional materials which 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 DoD needs for blast mitigation, hot structure applications, and low-cost tooling.

## **Extremely Large Domestic Expendable and Reusable Structures**

Current domestic large-scale composites production capacity is constrained by processing limitations and does not support the manufacture of structures at envisioned rates of production with diameters in excess of nine meters. This Title III initiative will scale-up domestic composites manufacturing and processing capacity and support facilities to directly support the DoD warfighter and NASA, as well as the U.S. commercial space industrial base. This technology is critical to enabling key space

programs currently being funded, such as the Constellation Program, which is replacing the aging space shuttle. The Constellation Program includes the Ares V “heavy lifter” cargo launch vehicle, which possesses a 10-meter diameter. The project includes evaluation and modification of current production facilities, as well as procurement, installation, qualification, and establishment of automated composite production equipment.

### **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% open porosity often called “frozen smoke.” The nano-scale 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.

### **Gallium Nitride (GaN) X-Band Monolithic Microwave Integrated Circuits (MMICs)**

The objective of this project is to assess, refine, and validate a domestic production ready process for X-Band (8 GHz to 12 GHz) GaN MMICs, thereby creating a domestic source of supply for GaN MMICs. GaN technology significantly enhances the warfighters’ capabilities by increasing radar ranges, sensitivity, and search capabilities. GaN transistors are more robust, 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. 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 efficiencies. Defense applications include communication systems, radar applications, electronic warfare, imaging, and sensor systems.

### **High Homogeneity Optical Glass**

Large format, High Homogeneity Optical Glass (HHOG) blanks are clear, homogeneous glass discs or plates processed into high precision optical lens products. HHOG blanks, characterized as possessing a maximum refractive index variation across the entire optic of  $\pm 1.0 \times 10^{-6}$  (industry equivalent of grade H4) or better, are critical elements of high precision optical lens systems. These lens systems are key technology enablers for defense and national security related applications and are employed by a broad mix of governmental agencies for aerial, satellite and other space



surveillance equipment. This Title III effort will focus on increasing yields by improving manufacturing processes. This will be achieved by improving production yields from the current cost prohibitive levels of less than 20 percent to yields approaching 70 percent.

### **Integrated Advanced Composite Fiber Placement**

Current process/production rates for large aerospace composite products are slow and time consuming in comparison to expected demand. Significant aerospace industry growth and inadequate manufacturing capabilities could jeopardize the assembly demands required by the Department of Defense. This project will expand the domestic supply base for automated composite technologies, maximize processing/cost benefit ratios, and provide cost efficient fiber placement composite processing technologies for military and commercial aircraft structures. The project aims to increase commercially viable production efficiency and make the process enhancements generally available to the commercial composite production market.

### **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 an ultra-high strength, polymer material. Ammunition casings produced with this material provide significant advantages over traditional brass casings such as decreased combat carrying weight, increased muzzle velocities, improved weapons accuracy, better corrosion-resistance, lower cost and increased savings from production synergies as well as lower deployment and transportation cost.

### **Lithium Ion Battery Production**

The Title III Program is supporting the development of a U.S.-owned domestic source for prismatic lithium-ion cells and batteries 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/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 when compared to other battery types for overall weapon systems performance.

## **Low Cost Military Global Positioning System (GPS)**

Military GPS receivers are a vital piece of equipment for soldiers on the battlefield. GPS receivers allow the Warfighter to perform both strategic and tactical maneuvers with a high degree of confidence of success. Without 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 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.

## **Methanol Fuel Cell Components**

As weaponry and armaments continue to become more sophisticated, employing larger quantities of power-consuming technology, soldiers are becoming overburdened by the need to carry more and more batteries. Military operations in Iraq and Afghanistan have highlighted the importance of reliable electrical power in mounted and dismounted soldier operations. Replacing batteries with methanol fuel cells as the power source of choice for the soldier has significant impacts on several key operations parameters. Unfortunately, due to low production volumes, manufacturing costs for methanol fuel cell membrane electrode assemblies remain high. This Title III project has developed low rate initial production capability, supporting increasing demand levels and reducing cost through increased production efficiencies.

## **Military Lens System Fabrication & Assembly**

The 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 the Warfighter to carry fewer pieces of equipment, improved 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.

## **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 Ordnance 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.

### **Photovoltaic (PV) Solar Cell Encapsulant**

Photovoltaic Solar Cell Encapsulants are used to protect delicate PV modules and solar cells from natural elements while insulating the embedded electrical circuits. There has been insufficient domestic production capability for Ethylene Vinyl Acetate (EVA)-based PV solar cell encapsulant material to meet defense needs for military photovoltaic equipment applications. Key military applications using EVA-based encapsulant include portable power pack batteries, power for electronic and propulsion systems on high altitude airships and Unmanned Aircraft Systems, power lighting and battery recharging shelters, and PV systems on military installations to reduce energy consumption. The Title III Program expanded domestic production of PV solar cell encapsulant material to meet DoD requirements and support commercial applications.

### **Polycrystalline Laser Gain Materials (PLGM)**

Polycrystalline Laser Gain Materials (PLGM) are high-strength, optically transparent materials with good thermal properties, which are shaped and polished to yield high-power laser line emission at a variety of infrared wavelengths. PLGM is the primary laser amplification medium currently utilized in U.S. DoD high-energy solid-state laser (HEL) weapon applications. The DoD is placing increasing priority on Directed Energy (DE) weapon systems, and HEL technology is a critical element in DE-related programs for national defense and security. Currently there is no cost effective domestic supplier capable of manufacturing PLGM for DoD HEL weapon system programs. The primary goal of this Title III project is to establish integrated domestic production capabilities from nanopowders to finished slabs, to meet current and future DoD requirements. This project has broad DoD application spill-over to include: Army, Navy, Air Force, MDA and DHS for solid –state and liquid laser HEL weapon systems.

### **Polyhedral Oligomeric Silsesquioxanes (POSS™) Nanotechnology**

This project is scaling up production of Polyhedral Oligomeric Silsesquioxanes (POSS®), a nano-sized material that, when used as a chemical additive, can greatly enhance the performance of polymers for a variety of DoD and commercial applications. POSS® has been demonstrated as useful in applications such as radiation shielding for

space-based microelectronics, coatings that prevent growth of tin whiskers on lead-free solder, photoresist material for semiconductor manufacturing, automotive fuel filters, food packaging, optical lenses, and aircraft tires.

### **Radiation Hardened Cryogenic Readout Integrated Circuits (ROICs)**

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) ROICs. ROIC 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.

### **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.

### **Silicon Carbide Monolithic Microwave Integrated Circuit Devices**

The goal of the MMIC project is to establish a domestic supplier of low cost, high performance silicon carbide (SiC) monolithic microwave integrated circuits (MMICs) that can satisfy military requirements for advanced radar systems. The project is demonstrating improvements in the characteristics of 100mm SiC substrate and epitaxial materials and processes to enable high yield, high performance and reliable SiC MMICs that can be produced at an affordable cost. The project is developing and demonstrating substrates and epitaxial structures with defect densities commensurate with high yield production of high performance, reliable SiC MMICs. SiC MMICs can significantly enhance the information gathering capabilities of next generation military radar systems.

## **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 and air vehicles, armor for naval ships, lightweight armor for helicopters and other aircraft, and lightweight body armor. This Title III project is increasing the domestic production capacity for both submicron alpha SiC powder and SiC ceramic armor.

## **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 incentivizing a domestic company for production scale up and capacity expansion efforts. 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.

## **Thin Silicon-on-Insulator (SOI) Wafers**

This project has established a domestic full-scale production capability for thin silicon-on-insulator (SOI) wafers. Thin Film SOI electronic wafers are critical materials that enable the fabrication of radiation-hard, ultra large scale digital devices such as microprocessors, application-specific integrated circuits, and static random access memories. These radiation hard circuits fabricated with SOI materials are essential to defense systems, such as surveillance, communication and navigation satellites, ballistic missiles, surveillance systems, and inertial navigation systems. They provide a superior technology for sensitive ultra-low power space, and battery- powered applications due to reduced power requirements, increased device density, and faster device performance over circuits fabricated in bulk substrate technologies.

## **Titanium Metal Matrix Composites (TiMMCs)**

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.

### **Traveling Wave Tube Amplifiers for Space**

This Title III venture is focusing on leveraging proven manufacturing processes to produce K-band Traveling Wave Tube Amplifiers (TWTAs) of high quality with improved manufacturing yield at reduced cost for DoD applications. A TWTA is a vacuum electronic device whose function is to amplify a radio-frequency signal. K-band TWTAs provide superior signal strength and larger bandwidth compared to today's satellite communications. Currently only a single foreign source for K-band TWTAs exists. Advancements in the domestic production capability for K-band TWTAs will support existing and future military and commercial requirements. DoD satellites using K-band TWTAs will support the growing need for real-time information and controls among deployed assets.

### **Vacuum Induction Melting, Vacuum Arc Remelting Furnace Capacity**

Low alloy Vacuum Induction Melting, Vacuum Arc Remelting (VIM/VAR) steel is a highly refined steel that is processed through multiple melts under vacuum in order 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 initiative to increase VIM/VAR capacity is reducing the order lead times and ensuring a domestic supply of clean alloy steels for critical military components.

## **6.2 Defense Priorities and Allocations System and Special Priorities Assistance**

Title I of the Defense Production Act provides the President the authority to require preferential performance on contracts and orders, as necessary, to meet national defense and emergency preparedness program requirements. Executive Order 12919 delegates these authorities to various federal departments and agencies.

The Secretary of Commerce is delegated the authority to manage industrial resources. To implement its authority, the Department of Commerce (DOC) administers the DPAS. The DOC has further delegated authority to the Department of Defense under the DPAS to: 1) apply priority ratings to contracts and orders supporting national defense programs; and 2) request the DOC provide Special Priorities Assistance (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 United States when such authorization furthers U.S. national interests.

The Office of the Deputy Under Secretary of Defense for Acquisition, Directorate of Industrial Policy convenes and chairs a Priority Allocation of Industrial Resources (PAIR) task force to quickly resolve industry constraints that interfere with military operations and Warfighter readiness. The task force ensures industrial resources are allocated to DoD programs in accordance with operational priorities when emergent requirements create competing demands among acquisition programs. It works closely with the DOC to ensure effective prioritization of materials, and to expedite delivery of urgently needed defense materials and services.

PAIR activity in 2009 resulted in SPA being provided to DOD buying components, foreign governments, and the State Department, and the formal issuance of 12 DOC industry directives. The Director of Industrial Policy performed 14 SPA actions in support of Operation Enduring Freedom (OEF) as depicted in the following table. Four of these were to accommodate the needs of U.S. forces, and the remaining ten addressed the needs of the State Department and foreign nation coalition partners.

For example, the Directorate of Industrial Policy engaged with industry to address numerous delivery issues on behalf of an OSD Task Force expediting the fielding of Intelligence, Surveillance, and Reconnaissance (ISR) systems in Iraq and Afghanistan. It also completed an Industrial Capability Assessment to determine industry's ability to deliver these systems quickly. The assessment provided insight into industry constraints and enabled the task force to prioritize delivery requirements and effectively employ DPAS priority rating authority across competing Service programs.

**DEFENSE PRIORITIES AND ALLOCATIONS SYSTEM /  
SPECIAL PRIORITIES ASSISTANCE CASES – 2009**

<b>Date(s)</b>	<b>Item</b>	<b>Assistance for</b>	<b>Summary</b>
01/09, 10/09, 11/09	Helicopter Ammunition and Parts	OEF Coalition Partner	Provided rating authority to ensure supply of helicopter equipment for deploying forces
03/09, 04/09, 05/09, 08/09, 11/09, 12/09	Night Vision and Image Intensification Equipment	U.S. Navy, U.S. State Dept, and OEF Coalition Forces	Organized allocation and provided rating authority to ensure supply of night vision equipment for deploying U.S. and coalition partners
05/09	Weapon Sight	OEF Coalition Partner	Provided rating authority to ensure timely repair of weapon targeting devices for a coalition partner
05/09	Inertial Measurement Unit	DARPA	Reallocated delivery to accelerate receipt of prototype device to theater
05/09	Targeting System	OEF Coalition Partner	Provided rating authority to ensure supply of needed equipment to deploying forces
11/09, 12/09	Ordinance	USAF	Reallocated delivery to accelerate production and fielding of new weapon



### 6.3 DoD Manufacturing Technology Program

For over 50 years, the DoD Manufacturing Technology (DoD ManTech) Program has demonstrated its value through process technologies that make new products possible and through manufacturing process improvements that get at the heart of defense system affordability challenges. The individual (Army, Navy, Air Force, Defense Logistics Agency, and Missile Defense Agency) ManTech Programs focus primarily on production issues specific to each component.



A recent addition to the DoD ManTech Program resource base is the Defense-Wide Manufacturing Science and Technology (DMS&T) Program. Recommended by Congress in 2006, the DMS&T funding line was established in FY08 to identify and transition advanced manufacturing processes and technologies for achieving significant productivity and efficiency gains in the defense manufacturing base. The DMS&T Program addresses cross-cutting, game changing initiatives that are beyond the scope of any one Service or Agency. DMS&T also complements the component ManTech programs by focusing on multi-service DoD priorities.

Identifying production issues early and providing timely solutions, the DoD ManTech Program reduces risk and positively impacts system affordability by providing solutions to manufacturing problems, often times before they occur. Ensuring that technology is affordable and producible remains imperative to make our forces more agile, deployable, sustainable, lethal, and dominant, anywhere in the world.

DoD ManTech provides the crucial links from technology invention to production of defense-critical needs that are in areas beyond the normal investment risk of industry. DoD ManTech investments enable industry to develop and provide defense-essential, affordable, low-risk manufacturing processes that effectively transition technology into new and existing equipment for the warfighter. ManTech improvements generally translate into affordability improvements or cycle time reduction. However, investments also focus on developing “new” capabilities that actually may result in a more expensive component, but will provide dividends in system performance or life cycle cost that far outweigh the initial cost.

The office of the Deputy Under Secretary of Defense for Advanced Component Development & Prototypes (ODUSD (AD&P)) exercises OSD-level oversight of the component ManTech Programs and manages the DMS&T portion of ManTech. The individual programs collaborate and coordinate their efforts through the Joint Defense Manufacturing Technology Panel (JDMTP), whose Principals are the directors of the component ManTech Programs.

## **ManTech's use of MRL improves a Knowledge Based Approach to Manufacturing Risk Management**

Manufacturing Readiness Levels (MRLs) are designed to be measures used to assess the maturity of a given technology, component or system from a manufacturing perspective. The purpose is to provide decision makers with a common understanding of the relative maturity and risks associated with manufacturing technologies, techniques, products and processes being considered. Manufacturing risk identification and management must begin at the earliest stages of technology development and continue vigorously throughout each stage of a program's life-cycle.

Manufacturing Readiness Level definitions were developed by a joint DoD/industry working group under the sponsorship of the Joint Defense Manufacturing Technology Panel (JDMTP). The intent was to create a measurement scale that would serve the same purpose for manufacturing readiness as Technology Readiness Levels (TRL) serve for technology readiness – to provide a common metric and vocabulary for assessing and discussing manufacturing maturity, risks and readiness. MRLs were designed with a numbering system to be roughly congruent with comparable levels of TRLs for synergy and ease of understanding and use.

MRLs are being used today throughout the technology and industrial base by some U.S. government agencies and many of the world's major companies. The MRL body of knowledge has been incorporated into the latest version of the DoDI 5000.02, and the Defense Acquisition Guidebook. Manufacturing readiness reporting is now required as part of the Analysis of Alternatives; the Technology Development Strategy; the Acquisition Strategy Report; and the Industrial Capabilities Assessment processes. It is also used in technical reviews of acquisition programs.

## **DoD ManTech responds to ARRA Stimulus and Fuel Cell Needs**

Modern military operations rely on an increasing array of power-hungry electronic devices. Warfighters often spend days in the field, far from supply depots. During these missions, they need continual access to high-power portable electronics, such as satellite communication radios, laser designators, and laptops. These devices require up to 70 pounds of batteries. As a result, warfighters and forward air controllers can go to the battlefield with insufficient battery power, thereby decreasing tactical superiority.

The Department of Defense has an immediate need for reliable, lightweight, and ruggedized fuel cells, capable of increased power without logistical problems. Specifically, the requirement is to provide for simple augmentation to the capabilities of the standard rechargeable batteries and extend their operating times by providing light weight, simple recharging in the field. These fuel cells also need to be more affordable through manufacturing maturation efforts. Finally, a strong domestic production base is required for fuel cells to thrive both commercially and in military applications.

To that end, the DOD MS&T program secured \$18.4M in American Recovery and Reinvestment Act stimulus funding to sufficiently ruggedize and mature both a 300W and 50W fuel cell soldier power battery recharging system. The 300W program has a platoon and squad level recharging requirement for the Army's Ground Soldier System, slated for fielding to Infantry Brigade Combat Teams in 2012. The 50W system is necessary for Special Operations personnel in each service, and will be part of an Air Force Advanced Technology Demonstration. Both efforts are overseen by a joint service team. Domestic industrial base growth in this emerging disruptive technology will also be achieved by this effort, as it is the single largest investment in tactical fuel cells ever made. Low Rate Initial Production (LRIP) quantities will be produced by these efforts and two or three design iterations with DoD user feedback will be incorporated to increase the probability of user acceptance. The end result is expected to be significant weight savings for missions exceeding 48 hours and the realization of affordable tactical fuel cells that are domestically produced. Multiple awards in both thrust areas are anticipated in December 2009.

### **Office of the Secretary of Defense – Creates Manufacturing Process Data File (MPDF): a Prototype Integration Facility for M2 Machine Gun**

The M2 Machine Gun is a 1930's designed weapon system that continues to serve the armed forces. The procurement of spare parts over the years has included two dimensional paper drawing designs along with manual machining centers. These processes caused conflicts and a burden on the legacy methods of replacement part procurement.

The Manufacturing Science and Technology program utilized the ManTech's capabilities to successfully develop a comprehensive facility that integrates Computer-Aided-Design (CAD) systems, Computer-Numerically-Controlled (CNC) machining centers, and Coordinate Measuring Machine (CMM) programs- processes required to meet the replacement part demands. By developing three dimensional CAD files to augment the 2D drawings, the Manufacturing Process Data File permits the process router to define the manufacturing and special processing requirements, which allows suppliers to input work-in-process status to an internet portal that provides the procurement activity with real-time progress status.

The Manufacturing Process Data File, created by Picatinny Arsenal, has improved 'startup through first-article-inspection' production completion times by 46 percent and consolidated three industrial base sources. Gun Barrel Extension MPDF creation costs have a Return on Investment with the purchase of the 2<sup>nd</sup> lot, and each 1000 piece Gun Barrel Extension purchase realizes more than \$11K in savings. This MRL advancement and stability is based on qualified process for future purchases and establishes configured vendor networks to make spares available in organic and commercial base for future needs.

## **Defense-Wide Manufacturing Science and Technology (DMS&T) – Ceramic Matrix Composites Manufacturing Initiative**

*Decreasing costs by over \$3B*

### The Problem:

Advanced turbine engine designs using composite materials provide lighter weight, durability, and cost savings for next generation aircraft such as the F-35. However, composites have been limited to the "cold section" of jet engines (e.g., fan blades, fan cases, etc).

### ManTech Response:

- Defense-Wide Manufacturing Science and Technology (DMS&T) and Air Force ManTech invested \$30.3M and leveraged Small Business Innovation Research (SBIR) and other sources to introduce heat resistant, lightweight composite components into the "hot section" of a jet engine
- The GE General Electric Rolls-Royce Fighter Engine team developed and implemented third-stage, low-pressure turbine vanes made from ceramic matrix composites (CMCs)

### Impacts:

- Enables jet engines to run at higher thrust due to less cooling required of the heat resistant composites
- Increased range, speed, acceleration, fuel efficiency and loiter due to engine improvements and weight savings
- Enabled advanced upgrades to current gas turbine engines, which will result in millions of gallons of fuel savings

This program is projected to decrease production and maintenance costs by over \$3B for the F135, F136 and T700 turbine engines.

Program participants included: Defense-wide Manufacturing Science & Technology, Air Force ManTech, NAVAIR, Army, Pratt & Whitney, General Electric, Rolls Royce, University of Dayton Research Institute, General Dynamics Information Technology, plus 25 other partners.

## **Army – ManTech Improves Warfighter Protection**

*Improved Ballistic Helmet Materials by leveraging innovations from Small Business Innovation Research (SBIR) Program and the North American Technology and Industrial Base Organization (NATIBO); Implemented by PEO Soldier in FY09 through a production decision for over 200,000 helmets.*

### The Problem:

The current U.S. headgear manufacturing processes are inadequate for a new generation of improved helmet ballistic materials.

### ManTech Response:

- Army ManTech invested \$5.7M and leveraged the Small Business Innovation Research (SBIR) Program and the North American Technology and Industrial Base Organization (NATIBO) to demonstrate high-pressure molding, preforming and thermoforming techniques not currently available in the helmet industrial base
- Implemented cost effective processes to manufacture enhanced thermoplastic-based, ballistic fiber reinforced helmets with increased ballistic performance and uniformity
- This ManTech program was cited by Army and Marines as one of two key enablers for the development of the new Enhanced Combat Helmet (ECH)

### Impacts:

- Increased ballistic fragmentation protection by over 30 percent (from 9mm frag protection)
- Reduced the amount of manual labor for assembly from 30 percent to 10 percent by automation
- Reduced tooling time from 15 minutes to 5 minutes
- Reduced scrap/waste of expensive ballistic fibers by over 60 percent
- Cost avoidance is estimated at \$83M

Program participants included: Army Research Lab, Natick Soldier Research, Development & Engineering Center, Armor Holdings, BAE Systems, GENTEX, and MSA, Inc.

### **Navy – ManTech Reduces Cost of T-Beam Stiffeners for DDG 1000 with Hybrid Laser Arc Welding**

Stronger materials of reduced thickness to save weight; reduction of structural cost of \$600K per ship

### The Problem:

T-Beam stiffeners, used extensively for decks, bulkheads, and other ship structures, are being manufactured with stronger materials of reduced thickness to save weight. Conventional welding of these thin materials results in significant distortion requiring extensive rework. Distortion accounts for an estimated 30 percent of the structural cost of a ship.

### ManTech Response:

- A Navy ManTech project team invested \$1.9M, with \$2M of industry cost share to develop and validate a hybrid laser arc welding (HLAW) process for fabricating HSLA-80 T-Beams with less distortion for DDG 1000 Class ships
- The HLAW process combines the deep penetration and high speed of laser welding with the gap tolerance of conventional gas metal arc welding

### Impacts:

- Better fit-up during shipyard construction, resulting in higher throughput
- 45 percent fabrication cost reduction due to higher weld speeds, less time required to set up the weld, and less labor required to straighten beams after welding
- Applicable to other platforms including the Littoral Combat Ship
- The HLAW process has been technically approved for HSLA-80 T-Beam fabrication for the DDG 1000 ship class

Program participants included: Navy Metalworking Center, PMS 500, NAVSEA, Naval Surface Warfare Center, Carderock Division, Bath Iron Works, Northrop Grumman Shipbuilding, Applied Thermal Sciences

### **Air Force – ManTech Reduces Cost of Components for Active Electronically Scanned Array**

*Cost avoidance of \$380M estimated over the life of the program*

### The Problem:

The Active Electronically Scanned Array (AESA) radar operates with an extremely fast scanning rate and much higher range providing a major battlefield advantage over conventional radar. Because of its complexity, an AESA radar is very costly and extremely difficult to build. Demand for these systems is high and projected to increase in the coming years.

### ManTech Response:

- Air Force ManTech invested \$19.4M to implement Lean Value Stream Mapping and used Integrated Product and Process Development to identify manufacturing cost drivers of current generation AESA radars
- Air Force worked with primes and sub-tier vendors to reduce costs by maturing the processes and manufacturability of AESA materials and components
- Implemented fully-automated 3D probing system to combine three tests (pre-seal, oscillation, and final electrical) into one test head

### Impacts:

- 50 percent reduction in associated touch labor for the radiator stick assembly by revising a connector masking process
- 85 percent reduction in RF manifold manufacturing process steps
- Eight percent increase in yield as the result of a circulator manufacturing process improvement
- Provides Warfighter with next generation radar technology with improved performance at a reduced cost

Program participants included: Air Force ManTech, Raytheon Company, and Northrop Grumman Corporation

### **Defense Logistics Agency (DLA) – ManTech Reduces Lead Time and Cost of Forging Dies**

*Overall cost benefits of this program exceed \$14.3M*

#### The Problem:

- Forging dies are used to produce high performance parts across multiple weapon systems.
- Conventional machining of die steels for forging tools is slow and expensive. Typically, lead-times for large, complex shapes are 15 weeks, with costs for some forgings exceeding \$40K.

#### ManTech Response:

- The DLA's Forgings R&D Program invested \$972K with industry cost share of \$988K to enable the implementation of a new paradigm for forging tooling known as Rapid Solidification Processing. Instead of removing metal to form the forging die, the process is additive, using spray technology to build the die around a form.
- Rapid Solidification Processing has produced dozens of forging dies for commercial and defense applications, making short run forgings feasible. This technology has advanced to Manufacturing Readiness Level 9

#### Impacts:

- Reduced production lead time of forging dies from 15 weeks to six days
- Reduced direct cost from \$2,000 to \$300 per die
- Reduced material cost from \$20,000 to \$6,000 per die
- Increased die size from 3" diameter to 9" diameter, allowing production of a greater variety of dies

Program participants included: DLA ManTech, RSP Tooling LLC, and Forging Defense Manufacturing Consortium

## **Missile Defense Agency (MDA) – ManTech Improves Production Process of Mission-Critical Batteries for Greater Reliability**

*Improved manufacturing processes assure reliable batteries for missile defense systems*

### The Problem:

Highly-specialized lithium batteries are used to power MDA kill vehicles. These batteries require hand assembly which is prone to errors and rework. These mission-critical batteries must perform reliably or else battery failure may cause catastrophic misfires and misguided missiles.

### ManTech Response:

- The MDA Producibility and Manufacturing Program invested \$2.3M to identify critical steps that improve assembly processes
- EaglePicher provided \$300K cost-share funding to modify and adapt an industry-standard computer aided manufacturing process documentation solution
- This effort resulted in the demonstration of a new automated traveler system with actual battery production

### Impacts:

- Reduced frequency of assembly errors and enhanced assembly instructions for battery fabrication processes
- Avoids rework and failure reviews associated with reliability problems
- Maintains personnel skill sets in lithium assembly process even during production gaps when expected attrition losses of skilled personnel can occur

Program participants included: MDA Producibility and Manufacturing, and EaglePicher Technologies



## 7. Programs and Actions to Sustain Capabilities

In 2009, the Department acquired and/or maintained facilities, equipment, or components, or took other actions needed to meet projected and actual military contingency requirements.

- DLA - Defense Supply Center Philadelphia (DSCP) currently has contracts in place that guarantee immediate availability of up to \$382M in medical materiel for Surge and Sustainment (S&S). This coverage increases to a total of \$746M, over a six month period, if all "refresh" options are exercised. The basis for medical contingency contracts is the Medical Contingency File (MCF) database that consolidates and aggregates the Services' time-phased wartime requirements. Once the requirements are known, DSCP will work to obtain contract coverage for contingency materiel to meet the response times and levels defined by the Services. The commercial coverage of \$746M represents the amount of the total requirement identified in the most recent MCF update that is owned or under contract by DSCP for the specific purpose of initial outfitting or re-supply upon deployment.
- DLA submitted an issue paper in response to the President's Budget Review 2011 to address the continued sustainment of the Joint Service Lightweight Integrated Suit Technology (JSLIST) critical industrial base. Another continuing action was the implementation of a DoD, industry, and academia forum called Tent Network for Technology Implementation (TENTNET). This forum encourages discussion on standardization and technical issues for tent and shelter systems. The third year of funding for tent Minimum Sustaining Rate (MSR) contracts was completed in 2009 with \$23.5M provided for contracts to help maintain the industry, with the resulting product used to build a war reserve.
- DLA invested \$8M during FY09 for an Industrial Base Maintenance Contract (IBMC) to Meridian Medical Technologies (MMT) to retain a capability to satisfy the Services' wartime 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 which 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.
- DLA commissioned a study to identify in detail the bottlenecks in the production process of Unitized Group Rations (UGRs). The focus was on identifying investments required to increase surge production capacity. Capacity of three current and potential UGR vendors to meet surge requirements was studied, resulting in three investment options. The recommended option was for the

government to invest \$1.8M to procure retort machines (these units cook the food in the pouch), two Tray Sealer units (these units seal the pouches), and associated support items, including spare parts kits, manuals, and retort racks. Once an award is made in 2010, an assessment will be conducted at the vendor's facility to decide how much of the GFE will be positioned at the facility to support surge requirements. Utilization of this GFE for surge production will result in an additional 288,000 rations per month, which significantly closes the gap between production capacity and requirements. It should be noted that this GFE can also be used to augment production for the MRE. In addition, DSCP assumed ownership of two critical pieces of equipment, at no cost, from the CORANET.. One piece of equipment, a Raque-brand Fill and Seal machine, will be refurbished and positioned at a UGR vendor. The use of this machine will result in an additional 15 percent increase in UGR production, and it can also be used for testing and training purposes during peacetime. DSCP has also initiated the purchase of additional retort racks to be used during a surge event. One of the bottlenecks in the production of UGRs as well as MREs is the shortage of racks. The racks being purchased will be a new design and made of a new material to allow for greater heat penetration and transfer.

- DLA's Industrial Base Extension (IBex) Program is a government/industry partnership with multiple global logistics providers that develops an overlapping global network of information on inventory, manufacturing, logistics, storage, transportation, humanitarian support, and base camp construction and maintenance. The IBex program provides OCONUS and CONUS asset visibility of inventory and global logistics capability available to support U.S. military operations and relief efforts following natural disasters with possible access to these capabilities if required. Strategic partnerships formed with industry experts allow supplier relationships to transcend purchasing transactions and enhance DLA's ability to develop improvement opportunities that facilitate the sharing of information. For the expenditure of \$200K per year, the government gains access and a better understanding of the global logistics networks and issues related to cultures, customs requirements/documentation, host nation knowledge, global constraints, and logistical nuances unique to any country or culture in areas of the world with limited U.S. resources.

During CY09, DLA's Warstopper Program completed four new strategic industrial investment projects. The projects include a vendor managed inventory of Nomex<sup>®</sup> for greater access to fire retardant raw material used in warfighter textiles, a vendor managed inventory of long lead time extrusions for the portable runway system commonly referred to as AM2 matting, Government Furnished Equipment (GFE) to increase the wartime availability of UGRs, and increased access to medical material used to treat the H1N1 influenza. In addition, DLA continued its work on the pilot strategic metal buffer project investment for 300M and M50 specialty steel.

- ❖ The H1N1 medical investment utilized \$300K to expand contract coverage for medical items necessary in the treatment and prevention of the H1N1 virus.

The increased coverage included: N95 Masks, syringes, needles, barrier clothing, isolation gowns, and gloves. This investment buys access to material by partnering with industry, rather than purchasing materiel for depot warehousing. To maximize overall access and coverage, the Corporate Exigency Contract (CEC) concept calls for making multiple contract awards in the same product line or product group. CEC thereby ensures the industrial base is prepared, prior to production ramp-up by the manufacturers, to respond to the Services' increased demands resulting from an H1N1 pandemic outbreak. Without these medical items, entire military units might be rendered unable to deploy.

- ❖ The UGR GFE investment utilized \$1.88M for the purchase of retorts and tray sealers. The GFE will allow the UGR contractors to meet and exceed the anticipated shortfall of 248,832 units per month during periods of surge.
- ❖ The AM2 matting investment utilized \$6.1M to award a readiness modification to an existing long-term contract to pre-position long lead-time components for AM2 matting. The pre-positioned materials eliminate the lead-time required for the vendor to order and receive materials (12-16 weeks) and begin mat assembly and painting. A two-year demand analysis and the strategic significance of this item during Overseas Contingency Operations made it a focus area for an industrial investment.
- ❖ The Nomex<sup>®</sup> buffer provides for 75,000 pounds of desert tan and 75,000 pounds of sage green material. The material is not Government Furnished Material but is a buffer of inventory for which DLA pays a management and holding fee to guarantee exclusive access. The stocks will be maintained on a first-in/first-out basis (to ensure freshness) for DoD contracts approved by DLA. Once the buffer material is in place, the lead-time to obtain end-items using the material will be shortened by as much as sixty days allowing Clothing & Textile manufacturers to respond that much quicker to demand for flame retardant items.
- DLA's Defense Energy Support Center (DESC) continues to support the DoD and commercial satellite industry with uninterrupted delivery of the two liquid propellants critical to the U.S. space program, specifically, hydrazine (N<sub>2</sub>H<sub>4</sub>) and dinitrogen tetroxide (N<sub>2</sub>O<sub>4</sub>). Both products have a limited domestic industrial base from a production perspective but are supported under a long-term contract (10-year plus two 5-year options) with reliable suppliers. There were no interruptions of supply during FY09 for either product. In addition to the commodity supply, DESC manages the transportation component of the supply chain for both products. DESC delivered 100 percent of its hydrazine and N<sub>2</sub>O<sub>4</sub> shipments to customers without incident. In FY09, DESC awarded five alternative fuel contracts in support of the Air Force and Navy's testing/certification programs and alternative fuel goals. Additionally, the DLA Contracting Support Office awarded an alternative fuel from organic sources research and development contract on behalf of DESC that includes

20,055 gallons of algae-derived F-76 (produced from natural gas feedstock). DESC continues to support the Air Force by supplying Turbine Fuel, Aviation, Thermally Stable (JPTS) for use in its highflying U-2 aircraft. DESC currently has only two suppliers for JPTS; one in CONUS and one OCONUS. DESC encounters difficulties in securing suppliers of JPTS due to the extensive qualification process required to be a certified supplier.

- DLA obtained “no charge” surge coverage on 523 contracts. This coverage represents a cost avoidance of \$194,742,590 that neither DLA nor the Services will have to expend for supplies to ensure that critical war/contingency items will be available.