

**Spring 2012
Industry Study**

**Final Report
*Manufacturing Industry***



The Industrial College of the Armed Forces
National Defense University
Fort McNair, Washington, D.C. 20319-5062

MANUFACTURING 2012

ABSTRACT: In the State of the Union address earlier this year, the President stressed the importance of rebuilding America's manufacturing base. Manufacturing remains critical to developing innovation and building wealth to further our nation's prosperity. Manufacturing associated with the defense industrial base accounts for a large portion of the advanced manufacturing conducted in the United States. Additionally, many commercial products are linked to defense products either in their means of production or use of technology. Maintaining a viable defense-manufacturing base during times of expected significant budget reductions including possible sequestration poses significant challenges and opportunities to the Department of Defense.

The defense industrial base would be significantly strengthened through the use of policies that improve the predictability and stability of the revenue streams for defense manufacturing firms. This report provides an overview of the status of defense manufacturing in the United States, analyzes the unique challenges within the defense industrial base, and provides recommendations for the Department of Defense to sustain the industrial base. These recommendations are focused in five general areas, which follow the theme of the paper. Specifically this will be achieved through: better government and industry partnering and communication, assisting firms in the defense industrial base commercialize products, improving the timing within the acquisition process, easing the restrictions that limit the sale and export of defense related equipment to allies and expanding the available pool of qualified employees. With the correct application of these recommendations, the Department of Defense will be able to significantly improve the viability of the defense industrial base.

Brig Gen Ali Algarni, International Fellow - Saudi Arabia

Mrs. Lisa Barr, DHS

COL Harold Buhl, U.S. Army

Mr. Robert Cameresi, NGA

Mr. Lance Carpenter, USTRANSCOM

LtCol Andre Harrell, U.S. Marine Corps

Mr. Christopher Hegadorn, DOS

Ms. Laura Howard, The Boeing Company

CDR Kevin Moller, U.S. Navy

LTC Rosemary Murphy, U.S. Army

Mr. James Remers, DIA

CDR Jerome White, U.S. Navy

COL Derrin Williams, U.S. Army

COL David Wilson, U.S. Army

CDR Gregory Zacharski, U.S. Navy

Dr. Nayantara Hensel, Faculty

COL Broc Perkuchin, U.S. Army, Faculty

Dr. Stephen Basile, Faculty Lead

MANUFACTURING 2012 SITE VISITS

DOMESTIC

National Capital Region

BAE Systems, Rosslyn

House Committee on Energy and Commerce

ICAF Seminar

The Boeing Company

Bureau of Labor Statistics

Center for Joint and Strategic Logistics, National Defense University

Center for Strategic and Budgetary Assistance

Congressional Research Service

High Road Strategies

Manufacturing & Industrial Base Policy, Department of Defense

Manufacturing Technology & News

MIT Washington Office

Oak Ridge National Laboratory

PEO Submarines

Y-12 National Security Complex

Johnson Controls Inc, Rosslyn

National Institute of Standards and Technology, Gaithersburg, MD

Renaissance of American Manufacturing Conference, National Press Club, Washington, DC

Safran USA, Inc.

Pennsylvania

Concurrent Technologies, Johnstown

Harley Davidson, York

Kennametal, Latrobe

Kongsberg Defense Corp, Johnstown

Latrobe Specialty Steel, Latrobe

L&S Machine Co, Latrobe

Letterkenny Army Depot, Chambersburg

National Center for Defense Manufacturing & Machining (APEX CNC Swiss, Kennametal Inc,

Pace Industries, Loyalhanna

Penn United Technologies Inc, H&W Global Industries Inc, Impact Technologies, National Tooling and Machining Assoc)

Maryland

ATK Aerospace Systems, Beltsville

North Carolina

Caterpillar Inc, Clayton

North Carolina State University, Raleigh

Semiconductor Research Corporation, Durham



Virginia

BAE Systems Space Systems & Electronics, Manassas

Micron Technology, Manassas

National Defense Industrial Association Hampton Roads Chapter, Virginia Beach

Tidewater Government-Industry Council, Virginia Beach

STIHL, Virginia Beach

INTERNATIONAL

London, England

AeroSpace, Defense and Security Group

Fuller, Smith and Turner PLC

UK Governmental Department for Business, Innovation & Skills, Manufacturing Policy

UK Ministry of Defence Industrial Policy

US Embassy, London, Office of Defense Cooperation

Paris, France

French Ministry of Defense, Director of General Armament, Industrial Affairs Department

Organization for Economic Cooperation and Development (OECD)

US Mission to OECD

Reims, France

Vranken Pommery Monopole

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CHAPTER I: INTRODUCTION

“We will not go back to an economy weakened by outsourcing, bad debt, and phony financial profits. Tonight, I want to speak about how we move forward, and lay out a blueprint for an economy that’s built to last -- an economy built on American manufacturing.”¹

President Barack Obama, 2012 State of the Union Address

The manufacturing sector in the United States, and more specifically – defense manufacturing – is a national strategic asset worthy of support and careful stewardship. As evidenced by new laws, policies, and the public discourse, it is clear there is growing support among those responsible for maintaining the U.S. economy and its defense industrial base to rethink the way we address manufacturing broadly. While jobs and factories continue to be outsourced, more and more Americans recognize the value of domestic industrial production as a source of well-paid jobs and economic vitality. In particular, the contributions of U.S. defense contractors is especially valued, given the significant contributions those firms make in terms of research and development, product commercialization, export earnings, and to the country’s basic defense.

The intent of this paper is to provide an assessment and make recommendations to improve the viability of defense-related manufacturing capabilities within the context of American manufacturing writ large. **In general, the efficiency and viability of the defense industrial base (DIB) would significantly improve by creating a more predictable and stable environment.** This paper will provide an overview of the manufacturing industry in the United States, discuss the uniqueness of the DIB, analyze the challenges the DIB is currently facing and provide recommendations to address and mitigate these challenges. The paper focuses on five major categories of recommendations; all follow the central theme to improve the predictability and stability for defense manufacturing firms in the DIB. First, improve the strategic alignment between defense manufacturing firms and the government through improved communications. Second, assist defense manufacturing firms to commercialize their products and technologies to open additional streams of revenue and to recognize economies of scale. Third, modify the acquisition process to stabilize resource changes and improve communication with industry. Fourth, make changes to trade controls affecting defense-manufacturing firms to ease the ability to export while protecting intellectual capital. Finally, leverage the technical nature of military training to expand the available pool of employees with STEM backgrounds.

This study attempts to present consensus problem definitions and recommendations. There are many challenges that the manufacturing industry confronts as a whole. They include but are not limited to a poor image, high corporate tax rates, non-permanent R&D tax credits, and others. This paper focuses on areas that uniquely affect the DIB where solutions can be implemented within the Department of Defense (DoD). Additionally, the recommendations and their associated analysis provide a context for further discussion and consideration but are not completely executable in their current form. Finally, this paper uses the term “defense industrial base” when discussing the industry as a whole. Firms within that industry that conduct manufacturing are referred to as defense manufacturers or defense manufacturing firms.

Manufacturing is a broad and complex sector of the global and U.S. economies. Even when the scope is reduced to consider only U.S. defense manufacturing, the complex and dynamic nature of the sector has multiple issues and solutions that cause reasoned people to disagree. This paper presents a solution set to the wicked problems that are affecting manufacturing based on visits with professionals in the industry both domestically and abroad, the course of study at the Industrial College of the Armed Forces, and personal experiences that members of the seminar have worked in their professional careers. This paper will begin with a discussion of the status of manufacturing in the United States and conclude with a set of recommendations to address specific challenges facing the DIB.

CHAPTER II: INDUSTRY ANALYSIS AND OVERVIEW

PORTER'S FIVE FORCES OF THE U.S. MANUFACTURING INDUSTRY

Understanding the near-term challenges and long-term sustainability of the broader manufacturing industry as a whole requires an analysis of the forces that shape industry structure and performance. Porter's Five Forces Model highlights current and future challenges in the industry.

Competition/Rivalry in the manufacturing industry is moderate to high and at times can be fierce. In a global marketplace of business without borders, international competition/rivalry is intense as cheaper and faster ways to introduce products (durable goods and services) to an international market continuously improve. Domestic competition is equally high as U.S. firms expand their global supply chains to capitalize on cost and innovation advantages. As a result, U.S. manufacturing has realized increased integration (horizontal and vertical), a high number of exits, and greater firm concentration.

Buyer Power in the manufacturing industry varies by segment. In concentrated manufacturing market segments with highly unique products buyers are concentrated and wield significant influence and buying power (e.g. DoD or NASA). In other segments influenced by competitive pricing, low switching costs, and producer influence, buying power is relatively weak (e.g. Apple - AT&T).

Supplier Power in the industry ranges from moderate to high. The degree of supplier power realized is dependent on the manufacturing segment/sector. In segments where the supplier possesses unique manufacturing capabilities (e.g., 3-D technology) and access to rare material (e.g., rare earth material) supplier power is very high.

Threat of New Entrants is moderate to high. The highly technical market segments tend to provide significant barriers to entry due to the high capital requirements, learning curves, and often government regulation.

Threat of Substitutes in the manufacturing industry is generally very high but varies by segment. A large percentage of manufactured products can be characterized as commodities. As such, substitution in the industry is potentially very high. Product substitution varies based on brand, application, etc. However, with improved manufacturing technology and techniques improving production costs, product substitution in the manufacturing industry is often driven by price.

INDUSTRY PERFORMANCE

Key indicators (number of firms, employment, revenue, profits and exports) provide insight into the performance of the industry.

- The **number of firms** in the manufacturing industry has gone down significantly over the past decade. In 2008 there were roughly 282,000 firms engaged in the mechanical, physical or chemical transformation of materials, substances or components into new products. This was down 11.6% from 1998.²
- **Employment** from manufacturing firms has also dropped. In 2010, there were nearly 10.5 million employees (-3.2% from 2009) with an annual payroll representing roughly \$540 billion (+1.8% from 2009).³
- Although manufacturing **sales** were significantly impacted during the recession in 2008, there have been recent improvements. According to a recent Industry Week report, the combined sales revenue (including global sales) of the top 500 U.S.-based manufacturing firms for 2011 was \$5.13 trillion, which was a 12.75% increase over 2010 sales of \$4.55 trillion.⁴
- Additionally, the after-tax **profits** outlook is hopeful. A March 2012 Census Bureau report noted manufacturing corporations' seasonally adjusted **after-tax profits** in the fourth quarter of 2011 totaled \$146.7 billion, down \$2 billion from the after-tax profits of \$148.8 billion recorded in the third quarter of 2011, but up \$13.1 billion from after-tax profits of \$133.5 billion recorded in the fourth quarter of 2010.⁵
- According to the U.S. Department of Commerce, manufacturing accounts for roughly 60% of U. S. **exports** but the United States has a significant trade deficit that continues to grow.

There have been significant declines in some areas (e.g., number of firms, employment, etc.) in comparison to the U.S. manufacturing industry of the past. However, most firms remaining in the industry are seeing a resurgence of business following the recent recession. The growing trade deficit and loss of jobs remain the largest concerns due to their ability to affect the economy as a whole.

CHAPTER III: DEFENSE MANUFACTURING AND INDUSTRIAL BASE

“Our future national security needs require a strong industrial base to provide technologically advanced weapons and equipment at affordable prices. This in turn requires a competitive defense marketplace with financially sound companies that are able to attract excellent technical and management talent.” –Defense Science Board.⁶

Since World War II, the DIB has been a critical part of America's economic and military instruments of power. The DoD has traditionally made decisions on its strategic postures regarding what kind of wars to prepare for and how to prepare for them in the belief that the defense industry would be able to support whatever needs it establishes.⁷

Unlike the mobilization of manufacturers that transpired during the two world wars, the current defense manufacturers that make up the DIB have held a steady place in enabling the United States to project force around the world in order to achieve its national interests. The DIB is a public and private sector industrial complex that has the capability and capacity to

deliver and maintain military weapon systems, subsystems, components, or repair parts that meet the requirements of the national security, defense, and military strategy documents.⁸

Defense manufacturers are at an intersection between the interests of shareholders and the interests of the U.S. military. It is at this intersection that the government makes it difficult for companies to thrive. In essence, DoD is both customer and regulator within the industrial base which creates turbulence among the companies that choose to do business in the defense sector. What makes this enterprise truly different is that the government has the political muscle to control the sale or use of commercially produced goods to other potential customers.⁹

Over the past 20 years, the defense manufacturing sector has grown ever more remote from being a “free market” in a traditional sense. It has become a monopsony and has evolved into a niche industry servicing a narrow and highly technical market defined as:¹⁰

- A market of one buyer that is also the regulator and a handful of major sellers that in many cases are required to collaborate with one another
- A market with many barriers to entry and little in the way of usable and timely information
- A market where a product considered as urgent “must have” requirements for one administration, one service chief, or one year’s budget request, can rapidly become an excessive and exquisite “nice to have” for another

The defense manufacturing sector is similar to a typical market in one important sense - firms seeking higher profits and more stable conditions can go elsewhere. Many already have, and more may yet follow. Other nations, including some of our closest allies, comprehend these realities and have adopted systematic, comprehensive policies to sustain what they consider to be strategic national assets.¹¹

The defense manufacturing sector is uniquely aligned to produce cutting edge equipment for the military. The DIB is distinguished by the customer it supports. The DIB is subdivided into segments and sub-segments that produce weapon system platforms, components, and expendables. This taxonomy is used throughout DoD to classify the contributions of particular DIB assets, as well as to analyze the criticality in each of these areas.¹² See Table 1 for a description of DIB segments and sub-segments.

Table 1: DIB Segments and Sub-segments¹³

Segments	Sub-segments	Segments	Sub-segments
Missile	<ul style="list-style-type: none"> • Tactical Missile • Torpedo • Strategic Missile 	Ammunition	<ul style="list-style-type: none"> • Bombs and Warheads • Cartridges & Fuses • Explosives
Aircraft	<ul style="list-style-type: none"> • Fixed Wing • Helicopter • Unmanned Aerial Vehical 	Weapons	<ul style="list-style-type: none"> • Small • Medium • Large
Troop Support	<ul style="list-style-type: none"> • Soldier Systems • Clothing & Textile • Subsistence/Medical • Smoke Obscurant • Nuclear, Biological, Chemical Systems 	Information Technology	<ul style="list-style-type: none"> • Command, Control, Computers, and Intelligence • Information Security • Trainers & Simulators • Computer Peripherals
Space	<ul style="list-style-type: none"> • Launch Vehicle • Satellite 	Shipbuilding	<ul style="list-style-type: none"> • Surface Ship • Subsurface
Combat Vehicle	<ul style="list-style-type: none"> • Tracked Vehicle • Tactical Vehicle 	Electronics	<ul style="list-style-type: none"> • Electronic Warfare • SONAR • RADAR

The industrial base and defense manufacturing are not on the verge of collapse. Still, the DIB has become constrained by the decreasing investment, culmination of conflicts, and the global economic downturn. In a Center for Strategic and Budgetary Assessments (CSBA) report, Barry D. Watts stated:

The US defense industrial base is not on the brink of imminent crisis or near collapse. The industry remains fairly innovative, relatively strong, and is capable of supplying American soldiers, sailors, marines, and airmen with world-class weapons and systems, even if they tend to reach the fielded forces later than expected and at increasingly higher cost than initially anticipated. Perhaps the most fundamental issue is the degree to which the American defense industry will, in decades ahead, continue to be an enduring source of strategic advantage.¹⁴

The DIB has emerged from the global economic downturn frail in some areas with its future strength being impacted by domestic government decisions as well as global market conditions. President Barack Obama stated, “The nation’s manufacturing base is the engine of growth and is critical to the economic recovery of the United States.”¹⁵ The President’s emphasis on manufacturing is warranted because the manufacturing industry is not just critical for the economic recovery of our country but serves as a critical underpinning of our national instruments of power.

The DIB is a national strategic asset that has provided the United States with a marked military advantage for more than six decades. It comprises and contributes significantly to many areas beyond just strictly defense needs, but the system is not perfect, there is room for improvement. As such, a main concern is whether the DIB is at risk of decaying to a point where it will not be able to provide the weapons systems this country needs in the future.

STRENGTHS, WEAKNESSES, OPPORTUNITIES, AND THREATS

The U.S. military services and the DIB underwent major changes during the past half-century, but not all of these changes have been for the better. If one had to choose an “industrial complex” that has stood above all others since the early 1940s, and continues to play a significant role in defense readiness, the American military-industrial complex would be the nation’s top choice.¹⁶ An analysis of the DIB reveals mixed results related to strengths, weaknesses, opportunities, and threats of the defense industrial and manufacturing sector. The

<p>Strengths</p> <ul style="list-style-type: none"> • Flexible, effective, and creative • Innovative • Robust and responsive • Enables rapid power projection • Rapid acquisition process 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Lack of supply chain visibility • Aging workforce • Misalignment of requirements revision and budget cycle • Lack of strategic alignment
<p>Opportunities</p> <ul style="list-style-type: none"> • Post war restructuring • Collaboration and partnering • Globalization introduces new markets, increases technological advances • Decrease/reduce regulations • COTS solution • Increase economies of scale • Political and public support for manufacturing 	<p>Threats</p> <ul style="list-style-type: none"> • Budget cuts • Loss of skills • Cyber attack, IPR theft, counterfeits • Export controls • Health of sub-tier value chain

following analysis focuses on those strengths, weaknesses, opportunities, and threats specific to the DIB for the purposes of this paper.

Strengths and Weaknesses: Internal Focus. Strengths and weaknesses primarily focus on those areas in which the DIB has control and the ability to fix without external influence. When discussing the strengths of the DIB, it is important to note America still has the largest defense budget in the world and the government can create stability and predictability through spending.¹⁷ When discussing the weaknesses, there are significant issues when it comes to supply chain visibility and alignment among government and industry efforts. The impacts of these weaknesses are further articulated in the Challenges section of this report.¹⁸

Opportunities and Threats: External Focus. Opportunities and threats primarily focus on those external areas that impact the DoD and may not be within the DoD control. With the drawdown of forces in both Iraq and Afghanistan, the peacetime environment presents an opportunity for the DIB to reinvent itself. Areas of opportunities highlighted in the table focus on increasing collaboration to create a stronger DIB by reducing inefficiencies and redundancies. The globalization of the DIB provides an opportunity to enable costs savings through increasing international market structures, introducing new technologies, and potentially achieving economies of scale. Threats addressed in the table focus on those areas that create uncertainty in the DIB. The challenges facing the DIB have the potential to influence the ability to meet America's national security interests and are discussed in more detail in the next chapter.

CHAPTER IV: CHALLENGES AND CONCERNS

In order to support America's national security interests in the 21st Century, it is imperative a robust DIB be maintained today, tomorrow, and into the future. There are several factors, which contribute to the growing unease of what may become of the DIB in the coming years. Challenges addressed in this section focus on the unpredictability and uncertainty the DIB faces when supporting the DoD. These include:

- A continued lack of coordination among government leadership, throughout federal agencies, and with private industry. While there are significant efforts focused in this area, more efforts are required. In an era of flattening and declining defense budgets, industry leaders receive little useful guidance that allows them to best target investments in people, facilities, and technology based on the military's future needs
- Unpredictable defense budget leads to increased risks on defense manufacturing firms, more costs passed onto government to offset the risks, as well as corporations shedding defense business components due to increased risk and declining returns on defense programs that are incompatible with industry fiduciary responsibilities
- A significant loss of industrial skill middle-class jobs without expansion in higher skilled knowledge and information sectors. This may result in a situation where a shift in the global security dynamic that requires the production of new weapons may have an industry that is unable to reconstitute much of its skilled work force and production capacity, resulting in higher cost related to time and resources.¹⁹
- An environment that places U.S. firms at a disadvantage due to difficulties from the export control processes and non-enforcement of intellectual property right protection.

Given the concerns above, the fiscal contraction facing the DoD, the politically charged environment of an election year, as well as the public up swell of support for growing manufacturing in the United States, it is more important now to address these issues. These challenges are not new to the DIB but the fact that these issues continue after years of awareness is significant and concerning.

STRATEGIC ALIGNMENT AND PARTNERING DEFICIENCIES

The DIB encompasses all assets and services used in the acquisition, production, support, maintenance, and sustainment of a weapons system or platform that is utilized by the U.S. military in training or combat. “References to the Defense Industrial Base that imply a monolithic entity are not [analytically] useful. There is a defense market serviced by a diverse selection of companies which span, and often reflect, the greater global economy for goods and services.”²⁰ Arguably, the only national policy that provides any strategic direction or alignment for the long-term sustainability of the DIB is provided (indirectly) from the National Security Strategy, National Defense Strategy, National Military Strategy, the Quadrennial Defense Review and most directly, the defense budget. The annual changes to these documents as well as a lack of prioritization contribute to the environment of instability and unpredictability.

Weaknesses <ul style="list-style-type: none">• Lack of supply chain visibility• Lack of strategic alignment
Threats <ul style="list-style-type: none">• Health of sub-tier value chain

A significant portion of this problem was illustrated by a July 2008 report by the Defense Business Board (DBB) Task Group on a strategic relationship model. They raised a concern regarding the industrial base, namely, that the level of communication between DoD and industry was inadequate.²¹ A clearly articulated view of the desired customer/supplier relationship and narrow legal interpretation of allowable communications between customer and supplier are two of the major contributors of the current condition. This is compounded by the fact that most dialogue is conducted with the major primes, while second and third tier companies and suppliers are left out.

“If I can't talk to people and I can't get basic information, what happens? You are then forced to recruit retiring military people because that is the only way you get to understand what is going on inside, which then raises the specter of the issue of what is going on, and so I tighten laws about that, and then I get even more and more removed every step of the way until the point where I can't talk to my basic customer in order to understand what is going on.”²²

Arguably, DoD and industry (as a whole) are not aligned based on the aforementioned conditions stated and the disconnected motives between private sector shareholder interests (profit margin) and the urgent operational readiness requirements of the military. DoD's unpredictability, acquisition complexity, and budgetary turbulence has further fractured this unique symbiotic relationship and forced the DIB to form diverse business strategies regarding consolidation, product differentiation (commercial and military) and globalization to remain competitive.

The lack of strategic alignment has a large impact on the viability of the DIB in that:

- Suppliers do not know where to invest their limited R&D dollars to best support the military and respond to demand requirements
- Industry’s role in shaping military capability requirements is more likely to lead to technical “overreach” on requirements
- It can result in cost, schedule, performance, and sustainment problems in acquisition programs²³

UNCERTAINTY IN DEFENSE BUDGETS AND SPENDING

As articulated in the SWOT analysis, there are significant challenges that create instability and uncertainty for defense manufacturing firms. This section highlights challenges with reductions in spending and a misalignment between budgeting and requirements.

Weaknesses

- Misalignment of requirements revision and budget cycle
- Lack of strategic alignment

Threats

- Budget cuts
- Loss of skills

Spending Reductions from FY13 Budget Request. As a result of the Budget Control Act, U.S. governmental leaders have focused on the DoD to help achieve budget and deficit reductions of \$1.2 trillion. The national defense budget, representing 19% of budget authority in FY2011, ranked among the top three government-spending areas; Medicare and Medicaid represented 22% and Social Security represented 20%. The Budget Control Act passed in 2011, requires a reduction in defense expenditures by approximately \$487 billion over the next decade and \$259 billion over the next five years with threats of additional \$600 billion in discretionary spending cuts by 2021. A significant burden has been placed on DoD to find ways to reduce spending while maintaining the capability and capacity to protect and defend America as well as support allies.

The FY2013 budget request submitted to Congress requests an increase in overall federal government funding support for research and development (R&D). Although there is an increase in total requested amount for R&D, the budget request for defense related R&D is being reduced from the FY2012 request. The R&D budget request is summarized below in Table 2.

Table 2: Summary of FY13 Budget Request for R&D (in millions of dollars)²⁴

FY13 Budget Request for R&D	FY13 Request	Change FY12-FY13	% Change
Total R&D	\$140, 820	\$1,951	1.4%
Defense R&D	\$75,895	- \$1,125	- 1.5%
NIST R&D	\$1,884	\$1,329	239.4%
Energy R&D	\$2,644	\$369	16.2%
NSF R&D	\$5,904	\$224	3.9%
Total Basic Research	\$30,627	\$449	1.5%
Defense Basic Research	\$2,116	\$5	0.2%
Total Applied Research	\$33,369	\$1,586	5.0%
Defense Applied Research	\$4,477	- \$260	- 5.8%

While funding for DoD related R&D is being reduced, the funding levels for the other key federal departments with programs driving innovation in manufacturing are all being increased. Given the significant reductions in applied R&D, defense manufacturing firms are at a disadvantage in developing marketable products and there will be less innovation in the DIB.

Sequestration. The DoD has submitted the FY2013 budget without planning for sequestration. The two issues with sequestration are the magnitude and mechanism of the budget cuts. It is mandated that the cuts are uniform across the department. If the sequestration cuts are taken, DoD will be one quarter into their fiscal year before the cuts are required. The President has the ability to fence off manpower so that personnel do not have any additional cuts in FY13. In order to achieve the budget cuts from sequestration, O&M, training and procurement will be impacted. The overall cost to the DoD is yet to be determined. However, there is no doubt these large cuts will have a significant impact on the defense manufacturing base due to the significant reductions in procurement.

In a joint treatise to the Secretary of Defense, Marion Blakey, President and CEO of the Aerospace Industries Association, Lawrence P. Farrell, Jr., President and CEO of the National Defense Industrial Association, and Stan Soloway, President and CEO of the Professional Services Council, documented their view of defense budget cuts.²⁵ They discussed the impacts of both the planned defense program cuts and the effects of sequestration, specifically:

- Uniquely skilled labor will be laid off
- Worker skills will be difficult to regenerate when needed
- Defense supply chains would be heavily impacted²⁶
- Suppliers would migrate away from DoD business
- Reduced competition
- Reduced capabilities²⁷

Acquisition Cycle Inconsistencies and Timing. The annual budget cycle for the nation is modified in the defense sector by a planning, programming and budgeting process²⁸ that is intended to provide predictability in procurement, research, and development. This predictability is reinforced in the multi-year authorization of money under categories such as RDT&E²⁹ and MILCON.³⁰ This intended predictability is subverted by Congressional and Executive branch changes within the cycle. Congress has absolute authority to authorize and appropriate money as they deem necessary within the cycle. The Executive branch also has authority--granted to it by Congress to make budgetary adjustments in cycle.³¹ In recent practice, both branches have favored budgetary turbulence over predictability.³² The annual DoD budget process makes it difficult for defense manufacturing firms to plan beyond one year.

This predictability is most critical to the DIB. The lack of predictability and stability in defense spending leads to defense firms being unwilling to commit to business decisions. This leads to:

- The inability to make business case analysis for investment decisions and work force stability
- Unwillingness to invest in R&D due to long lead time from results (typically 3+ years)

- Unwillingness to make capital investments due to large upfront cost and inability to determine a reasonable estimate at the break-even point
- Increased risk that leads to extra costs passed on to the government
- Failed procurement efforts due to an inability to respond to change within the 18-24 month schedule that must precede capability acquisition
- The industry migrating away from government work leading to loss of skills and technology development

By disciplining executive budgetary adjustments, the manufacturing base will have additional certainty they need to develop and deliver capability with reasonable and manageable risk.

WORKFORCE

As noted in a recent Commerce Department report on American competitiveness and innovative capacity³³, “increasingly, the specific skills embodied in science, technology, engineering, and mathematics (STEM) education fuel the innovative processes that are especially valuable to our economy.” While the STEM workforce is expanding, with growth in STEM jobs over the past decade growing three times faster as in non-STEM jobs, there are remaining concerns that the U.S. is not producing sufficient numbers of STEM graduates to adequately compete with other nations – predominantly in Europe and Asia – in high tech, cutting-edge manufacturing. According to *Aviation Week and Space Technology*, the average age of an aerospace and defense engineering worker is 45, with 22% of the work force under the age of 35, only 20% between 35-50, and the remaining 58% over 50 years of age. In fact, 13% of this workforce is eligible now for retirement.

Weaknesses

- Aging workforce

Threats

- Budget cuts
- Loss of skills

This workforce also suffers from a lack of diversity; women and minorities each make up barely a quarter of the workforce. Voluntary attrition in the more youthful segment of the workforce is extremely high: 14% annually as opposed to 10% for the overall industry.³⁴ Additionally, defense-manufacturing workers do not recommend the industry to their children. Innovation is restrained, as the industry ranks dead last in patents per employee. Security clearances are frequently required, further constraining the workforce; employees must be U.S. citizens and be able to meet the requirements of clearance processing.³⁵

In the U.S., fewer than 30% of U.S. high school students take physics and fewer than 25% take pre-calculus. The percentage of STEM graduates declined from 32% of all post-secondary degrees awarded in 1995 to 27% of all degrees awarded in 2004. While the number of graduate degrees awarded has remained stable, foreign students mostly make up the difference (i.e., not U.S. citizens and, hence, often not eligible for employment in the defense manufacturing sector).³⁶

The Washington Post notes that high-tech manufacturing has dropped by more than a quarter since the year 2000.³⁷ The Manufacturing Institute also reports that a shortage of 600,000 skilled workers exists in the manufacturing sector, presenting 82% of manufacturers with moderate to serious skilled labor shortages.³⁸ Younger workers often do not seek



manufacturing careers because many view manufacturing as a dying industry. At the same time, the “Baby Boom” manufacturing workforce is quickly reaching retirement age, and taking their skills and experience with them.

The National Strategic Plan for Advanced Manufacturing, published by the White House in 2012, attempts to address these demographic issues³⁹ in part by “expanding the number of workers who have skills needed by a growing advanced manufacturing sector and making the education and training system more responsive to the demand for skills.”⁴⁰ The plan recommends more money for STEM education in secondary schools and community colleges, new apprenticeship programs to give students hands-on experience, and a “Skills Certification System” advocated by the National Association of Manufacturers (NAM).⁴¹ Recognizing the significant contributions to U.S. manufacturing made by foreign students/graduates and temporary workers, the Administration seeks to continue/expand the H-1B visa program to allow U.S. companies to hire skilled foreign workers for manufacturing work.⁴² Such workers can perform non-classified work and backfill workers who can be utilized for defense-related jobs.⁴³

The DIB needs to have a viable workforce that can meet the national security needs of the United States in the decades to come. The current workforce faces distinct challenges: the average age of the workforce is higher than most other industries, the country faces an overall shortage of STEM high school and college graduates, and the available STEM graduates are in high demand by both the Department of Defense and corporate America. Fewer highly trained STEM workers will have significant impacts on the DIB, specifically resulting in:

- Reduced innovation
- Inability to meet DoD product demands
- Excessive product costs to reconstitute skills to meet product demands
- Larger competition for a limited pool of qualified workers resulting in additional costs

TRADE CONTROLS, TRADE PROMOTION, INTELLECTUAL PROPERTY

The Obama Administration is working to reform the export control system to promote U.S. defense manufacturing while protecting national security interests at home and abroad.

While certain controls will always remain in place, reforms are aimed at improving bureaucratic procedures to quicken application processing times, clarify jurisdictional boundaries, and improve coordination with key allies. To date, considerable progress has been achieved. Improving and streamlining the U.S. system of export controls will strengthen U.S. defense manufacturing through providing reliable markets that may offset the cyclical nature of U.S. defense spending.

Mercantilist policies and unfair trading practices of key industrial competitors, along with shrinking U.S. defense budgets, requires new thinking and new business approaches for preserving a robust American defense industrial base. Various policy changes as well as individual firms looking for every opportunity to increase foreign sales and servicing contracts is required to broaden the revenue base available to defense manufacturing firms. Small and medium-sized firms rely too much on the North American market without making the

Threats

- Export controls



investments required to acquire market share overseas. With U.S. defense spending on the decline, these firms will need to think internationally, partner with firms abroad, hire multi-lingual, multi-cultural staff, and create networks of offices and suppliers to help them win contracts and compete globally. Other countries are already working hard to support their domestic producers to export, especially in high-tech, advanced manufacturing sectors, which will prove vital for U.S. defense firms.

Areas of continued focus for the administration are International Traffic in Arms Regulations (ITAR) - administered by the Department of State and the Commercial Control List (CCL) - administered by the Department of Commerce. Additionally, intellectual property rights protection is a continued challenge given the need to broaden the defense-manufacturing base.

International Traffic in Arms Regulation. The Department of State (DoS) Directorate of Defense Trade Controls (DDTC) is responsible for the control of export and temporary import of defense articles and services covered by the U.S. Munitions List, in accordance with 22 U.S.C. 2778-2780 of the Arms Export Control Act (AECA) and the International Traffic in Arms Regulations (ITAR) (22 CFR, Parts 120-130).⁴⁴ Likewise, the Department of Commerce regulates exports of conventional weapons and systems. Among the items on the ITAR Munitions List are space and missile items, night vision goggles, certain aircraft and electronic systems, and certain small weapons and firearms. According to the DDTC website, 6,938 license applications were received in January 2012, 6,430 applications were closed, with an average processing time (calendar days) of 20 days.⁴⁵

On March 21, 2012, the DoS DDTC issued a final rule amending the ITAR to implement the Defense Trade Cooperation Treaty between the United States and the United Kingdom, signed in 2007 along with a similar treaty with Australia (not yet entered into force). The Senate gave its advice and consent to the U.S.-UK Treaty on September 2010, which entered into force in mid-April, 2012. This treaty, reflecting the strategic ties between two allied nations, is intended to improve inter-operability between the military services (a key goal of the most recent QDR). UK manufacturers and officials recognize the treaty's significance as a potential facilitator of trade and inter-operability yet question the large number of exempted defense articles and are withholding judgment for the time being. The DoS and DoD should consider expanding the list of allies with whom we have such agreements, and look to minimize the list of exempted items.

Drawing on the U.S. "Munitions List," ITAR applies to all items and information designed for military or intelligence purposes, while the CCL covers items and information considered "dual use" – that is, items or information with both military/strategic and commercial application. Among the biggest critics of such controls are defense manufacturers who feel their competitiveness in international markets is undermined by ITAR/CCL, and foreign firms whose freedom of action to re-transfer U.S. defense products is limited by U.S. laws.

Example: Commercial Satellites

The commercial satellite industry has suffered perhaps the most over the past decade from stringent export controls – applied in 1999 following a report of the Cox Commission, which reported on transfers of missile-related technology by U.S. firms to China's space

program. The controls put in place are responsible for significant damage to the U.S. commercial satellite industry (including the loss of 28,000 jobs per year, on average, between 1999 and 2008, along with \$21 billion in revenues) - according to the Aerospace Industries Association. Despite these losses, Congress has not changed the law governing licensing procedures or jurisdiction for communication satellites (comsats) – which remain the only USML items for which jurisdiction is mandated by law).

The commercial satellite example highlights how the DIB is impacted by the current export control regulations. Additionally, these regulations impact the industry through:

- Significant loss of foreign market share
- Inadequate interoperability with allies due to the U.S. being the sole purchaser of equipment
- Reduced economies of scale resulting in higher costs for the government
- Firms exiting the DIB to conduct business in an environment that does not have the same regulatory burdens
- Unwillingness for other countries to include U.S. controlled technologies due to restrictions with further marketing to third parties

Protection and Enforcement of Intellectual Property Rights. Intellectual property rights (IPR) protection is often cited as one of America’s major strengths for domestic manufacturers. However, IPR is threatened by foreign rivals that have been able to gain global market share from U.S. companies through outright theft, counterfeiting, and lax enforcement of global and domestic rules related to IPR. In particular, cyber theft has been a key method of massive theft of intellectual property from the U.S. by industrial competitors and foreign governments. This impacts defense manufacturing despite its extra layers of security and protections.

Advanced technologies are driven by innovation, for which effective IPR enforcement is critical. Recognizing this fact, the Obama Administration is strengthening IPR protections and enforcement. In testimony before the House Energy and Commerce Committee April 2012, Commerce Secretary John Bryson outlined the steps taken to benefit American manufacturers with respect to IPR protections.⁴⁶

As part of the America Invests Act of 2011, Bryson noted that patent applicants have the option of paying extra for a faster processing track – speed to market being a critical issue for advanced manufacturing technologies. Furthermore, the U.S. Patent Office has succeeded in significantly reducing its application backlog and is now implementing a new outreach program to educate American manufacturers about IP development and protection strategies. The America Invents Act also enhances the “prior user rights” defense to infringement actions, helping level the playing field for U.S. industries against foreign competition.⁴⁷

Intellectual property theft often takes place overseas, where laws may be lax and enforcement more difficult. Using the Internet, cyber thieves’ work to surreptitiously gain access to computer files across the globe, with high-tech and defense companies particularly attractive targets. Such theft costs U.S. businesses billions of dollars a year and robs the U.S. of high-paying manufacturing jobs and the tax revenues that accompany them. Recent examples of counterfeits impacting defense industries include: counterfeit transistors found on the Forward-

Looking Infrared System (FLIR) aboard the SH-60B helicopter and in the microchip market supplying the Missile Defense Agency (MDA). In the MDA case, 1,700 supposedly-new memory parts from an unauthorized distributor showed signs of previous use, prompting MDA to strip 800 parts from assembled units. In a stockroom sweep, 67 used frequency synthesizers were found to have been re-marked and falsely sold as new parts.”⁴⁸ These are just a sampling of the challenges faced in intellectual property rights and the counterfeiting of materials. It is readily apparent that these challenges will continue especially as technology advances, lack of attribution continues to remain an issue, and as long as the United States remains a treasure trove of information for competitors.

The concerns over IPR affect the DIB through:

- Increased costs due to infrastructure requirements to establish adequate protection
- Billions of dollars in lost revenue for firms and lost tax revenue for the government
- Reduced comparative advantage of innovation due to reduction in the timing for competitors to produce similar technologies
- Increased likelihood of counterfeit supplies being incorporated into defense products
- Reduced U.S. technological advantage over competitors and adversaries

CHAPTER V: RECOMMENDATIONS

To address the challenges occurring in this environment of contracting budgets, growing uncertainty and lack of predictability, the recommendations in this section capitalize on the opportunities to strengthen the viability of the DIB.

Opportunities

- Post war restructuring
- Collaboration and partnering
- Globalization introduces new markets, increases technological advances
- Decrease/reduce regulations
- COTS solution
- Increase economies of scale
- Political and public support for manufacturing

ROLE OF GOVERNMENT

When seeking to help and solve manufacturing problems, an assumption of policy elimination and de-regulation can be a strong incentive for innovation and investment. The emphasis for the government should be to improve the predictability and stability of funding for defense manufacturing firms through manufacturing policies to create an environment that fosters:

- A free and open market; allow for market forces to drive the shape of the industry
- Competition to encourage innovation and uniqueness in defense products
- Reduced barriers to entry for small and medium businesses to enable more firms to join the DIB and foster additional competition
- Not directly funding firms to maintain them when normal market forces would force them from the DIB
- R&D in areas that are not financially feasible for small and medium sized firms in the DIB

The following recommendations address the threats and weaknesses presented in the challenges section while maintaining the intent of an environment discussed above.

RECOMMENDATION 1: STRATEGIC ALIGNMENT

The DIB has always operated in an acquisition and business environment challenged with difficult communications due regulatory requirements and unpredictability. While there are

significant efforts underway to address more government and industry collaboration, DoD and industry must build a stronger structured approach to partnering that links the inputs and outputs of the private and public sector to the performance driven outcomes of defense readiness. This link must be formed by a policy and process that is collaborative and responsive. There are two approaches to improving this strategic alignment. Both address improving the communications and alignment between industry and government to allow firms to anticipate the needs of their customers better, allowing more long term planning capability.

Strategic alignment is not government control or intrusion into the free market. Communication (live, virtual, and through information architectures) to minimize uncertainty between government and industry—following applicable statute—as part of strategic alignment is intended to minimize uncertainty and allow for more informed business decisions. These business decisions, based on more confident data thus lower business risk, and result in better rates and lower costs to the government.

Recommendation 1-1. Improve leadership and stakeholder involvement and communication through teaming. Implementation of strategic alignment must first incorporate leadership buy-in (top-down) and resonate through operational execution (bottom-up). Policy formulation must be a collaborative process between DoD and industry and communicated vertically to everyone within the leadership chain. Horizontally, all stakeholders must be able to communicate to improve the processes and have increased visibility of others’ needs and weaknesses as well as have periodic access to senior leadership to discuss and improve on shortcomings in the process.

Within this construct, formal cross-functional and executive teams would be established with operational leads identified for every major weapon system or platform. The intent is to ensure the operational forces stay actively engaged with senior DoD and DIB leadership regarding readiness and to ensure problems can be communicated to both senior leadership and the people that can execute the solutions.

Recommendation 1-2. Develop an information system to improve transparency that links every element of the acquisition lifecycle to each stakeholder. Develop a system architecture based on one common DoD/DIB business language, which will link DoD and industry to have visibility on all relevant metrics to determine readiness. Gaps and disconnects would be eliminated based on structural collaborative data sharing and analysis predicated by operational readiness, predictability, and budget resource allocation and execution. The development of this system would be very challenging because it combines fundamental aspects of acquisition, sustainment and product support from two dynamically divergent informational and proprietary architectures (DoD and industry). However, if implemented, the benefits would be immeasurable. See Appendix A for additional detail on the data and connections within this system.

RECOMMENDATION 2: COMMERCIALIZATION OF DEFENSE RELATED PRODUCTS AND TECHNOLOGIES

Instability of funding streams due to the government budget cycle leads to unpredictability. Enabling commercialization of products and technologies designed for defense

and security will help open additional funding streams for defense manufacturing firms. Additional funding streams beyond those required for defense will provide a more fiscally stable environment that businesses and the government will benefit from. Businesses will benefit through stability and the government can realize cost reductions by firms having economies of scale in production.

Recommendation 2-1. Increase funding to ManTech and Defense Production Act programs that help defense manufacturing increase revenue streams and reduce costs.

There are several initiatives aimed at engaging private industry to fund R&D efforts. These current initiatives are successful due to their ability to create more defense revenue streams for industry, reduce costs for defense, develop technology that would be impractical for a small business to pursue, and create a bridge to commercial products improving economies of scale.

ManTech. The main focus of ManTech has been to bridge the gap between innovation and production to keep defense acquisition costs lower. These investment funds could be leveraged more to help improve the efficiency and operating margin for firms producing critical technologies. NDIA provides the following recommendation:

*The DoD ManTech program is underfunded. According to a 2006 Defense Science Board study, funding for ManTech should be approximately 1% of the defense R&D budget. Funding for ManTech should be about \$700M but is currently being funded at approximately \$200M. Historically, this program has saved the government billions of dollars in savings and cost avoidance. In these times of reduced budgets, additional spending towards ManTech could be significantly beneficial.*⁴⁹

Defense Production Act Title III Funding. Title III provides a set of unique economic authorities to incentivize the creation, expansion or preservation of domestic manufacturing capabilities for technologies, components and materials needed to meet national defense requirements.⁵⁰ The 2011 Annual Capabilities Report to Congress lists 29 projects being conducted under Title III requirements with government contributions totaling \$460.8 million.⁵¹ As an example of the benefits of this program, in FY10 a Title III funded program was completed with Cree Inc. to expand the production capabilities of Silicon Carbide Monolithic Microwave Integrated Circuit Devices for use in the Army's Joint Tactical Radio System (JTRS), Counter Radio-Controlled IED Electronic Warfare (CREW) program and high quality light emitting diodes (LEDs). The ability to expand production has significantly reduced the cost to the DoD through economies of scale.⁵²

Recommendation 2-2. Restore the defense-applied research funding levels to the same amount or higher as the FY12 budget request. Applied research funding has the most significant effect in supporting corporations turn innovative ideas into marketable products. As funding for procurement is reduced, the need for firms in the DIB to continue to develop products to ensure strong revenue streams will be critical. Removing funding from this area cripples the industry's ability to develop products.

RECOMMENDATION 3: ACQUISITION ALIGNMENT AND REFORM

The DIB is a manufacturing driver within the U.S. economy. This driver is fueled by the interaction three complementary systems--the Defense Acquisition System (DAS), the Planning, Programming, Budgeting, and Execution (PPBE) cycle, and the Joint Capability Integration and Development System (JCIDS). On top of these three systems is the Joint Staff and Service bureaucracy. Friction between these systems as they work through Joint and Service staffs is good. This friction forces substandard and low priority programs out of the Department. In an era of decreased resources however, this friction can also be bad. The waste generated in this friction is taxpayer money. Paying down risk, managing regulatory burden, and uncertainty are the tangible examples of this waster. More efficient linkages between these systems can reduce waste and improve the stability of the system.

Recommendation 3-1. Stabilize resource changes within the DoD using time and threshold limits at high decision levels. Changes to budgets across programs and within DoD provide flexibility, but add significant risk and cost to all programs. Limits on budgetary changes based on time and threshold is a reasonable initiative to balance flexibility and predictability within an acquisition. Examples include no budget changes within a 2-year appropriation unless there is a test failure or gross incompetence, no changes to efforts under \$10M in a 2-year appropriation, and all changes of more than 20% total value approved by Milestone Decision Authority.

Recommendation 3-2. Integrate Combatant Commands into the Capability Requirements Process. Services retain capability requirements approval short of the Joint Requirements Oversight Council (JROC). Change across requirements, resources, and management lack discipline following this approval. A disciplined change process must include the warfighting combatant commanders to assign prioritization of capability requirements within a program. This cooperation ensures that both force-driven and event-driven interests are communicated with the materiel developer to synchronize with resource and management systems, and increase predictability for DIB.

Recommendation 3-3. Supplement JCIDS with a cyclic Joint Warfighter Involvement Process (WIP). Following JCIDS approval of a new start program, that program each two years gets a requirements prioritization from the warfighter every two years. The Service and a sponsor Combatant Command cooperate with all stakeholders to provide the materiel developer more feedback. With these adjusted requirement priorities, the program manager enters a battle-rhythm to conduct analysis, systems engineering, program modification, and contracting to deliver on the adjusted priorities. Aligning WIP as a feeder for the PPBE process will lower friction, increase predictability, and enable DIB to manage risk more effectively—reducing government costs.

RECOMMENDATION 4: TRADE CONTROLS, TRADE PROMOTION AND INTELLECTUAL PROPERTY

In an era of a reduction in defense items procured from private sector manufacturers, the U.S. government should look at ways to strengthen systems in place aimed at controlling technologies, preventing proliferation, and protecting against intellectual property theft. In general, such steps would help ameliorate the expected reductions in domestic defense procurement that U.S. defense manufacturers are likely to face in the coming years and help

stabilize the DIB. To strengthen the likelihood of their survivability, federal policies can assist these firms to compete more aggressively for industrial market share outside North America, and can help level the playing field with respect to U.S. treatment of foreign firms operating and selling in the United States.

Recommendation 4-1. Review the International Traffic and Arms Regulation (ITAR) and the Commercial Control List (CCL) for currency and relevance now and on a regular and continuing basis. Remove items from restricted lists for which currently available public domain technologies exist or technologies that are more current have supplanted. Specifically, remove commercial satellites from the U.S. Munitions List (USML). Aggressively pursue reductions in bureaucratic processes that add no value.

Recommendation 4-2. Strengthen the U.S. – U.K. Defense Trade Cooperation Treaty by removing exemptions and pursue similar agreements with other key allies. Look to narrow the list of items exempted from that agreement. Using the U.S.-U.K. treaty as a template, consider additional agreements with key U.S. allies and other countries whose potential for expanded market share for U.S. defense manufacturers is greatest.

Recommendation 4-3. Level the playing field through enforcing current international rules and agreements. Continue efforts by USTR, State, Commerce, DoD, and others to level the international trade policy playing field by aggressively pursuing business opportunities for U.S. defense firms, insisting upon fair compliance and application of international trading rules, and assisting U.S. firms through existing tools and mechanisms such as export finance, trade support, and enforcement of IPR rules.

RECOMMENDATION 5: WORKFORCE RETENTION AND LINKAGES BETWEEN DOD & DIB

The ability to maintain a quality workforce plays a key role in establishing predictability and stability within the DIB. The DIB needs to have a viable workforce to produce items needed for ensuring the national security needs of the United States in the decades to come. The current workforce faces distinct challenges from aging workforce to an unfilled demand for qualified applicants. There are several national level efforts currently in progress to address shortcomings within the U.S. education system as well as improving immigration policies. These problems affect manufacturing in the nation as well as defense manufacturing firms.

One area where DoD can help overcome manufacturing's workforce-related challenges is through its recruitment, training, and post-service job placement efforts for non-career service members. In many countries, the military is a key source of workforce talent, especially in high-tech, cutting-edge industries related to modern defense. Israel and Singapore, for example (while having systems of compulsory national service) actively recruit talented men and women into elite units known for innovation and technical prowess. In Israel, graduates of such units are often highly sought by local employers, and are disproportionately represented among new, high-tech start-ups listed on major international exchanges.⁵³

DoD can do a better job of strengthening policies on recruitment, training, and post-service placement to strengthen the nation's defense industrial base. Particularly with the large

number of young veterans with combat experience in Iraq and Afghanistan, DoD can make valuable contributions by working more holistically to recruit talent, develop high-tech skills relevant to the defense industrial sector, and convince U.S. businesses of the value of hiring veterans with technical skills.

Recommendation 5-1. Seek to link military recruitment, in-service professional training, and military skill codes with after-service job placement in the military/defense manufacturing sector. The DoD can help incentivize those serving in the armed forces to enter the defense industrial workforce, particularly small and medium-sized firms and new high-tech start-ups working on innovative technologies and contemporary security threats. The DoD should do more to recruit those with engineering and technical skills. Likewise, DoD should do more to identify those serving with the highest technical aptitudes and steer them toward jobs – both during and after their military service – relevant to defense manufacturing.

CHAPTER VI: CONCLUSION

Defense manufacturers are already making changes in their medium and long-term plans to adjust to fewer federal dollars being spent on defense. Some are moving more toward commercial markets for their goods and services. Those firms that are not preparing will likely be at risk. Additionally, the uncertainty over future defense spending has forced many firms to cut back on R&D and capital investments. This paper proposes ways to address the challenges faced currently and in the coming decades for the DIB is to have the Administration, Congress and DoD improve predictability and stability for defense manufacturing firms. This predictability and stability reduces the risk to defense manufacturing firms, which in turn reduces costs to the DoD and the American public in meeting continued warfighter needs. This can be accomplished through a variety of short and long-term efforts summarized as follows:

- **Strategic Partnering and Communications** to achieve long term stability and predictability – aligning leadership buy-in (top-down) with operational execution (bottom-up) to better support warfighter needs, business requirements, and budget cycles.
- **Commercialization of defense related technologies and products** for more diversified funding streams – fund DARPA and ManTech programs that support R&D initiatives to reach commercial value for defense manufacturing firms.
- **Acquisition alignment and reform** for more predictable funding streams and requirements alignment – aligning the processes to reduce uncertainty and improve communication and coordination with defense manufacturing firms to better align requirements and production.
- **Trade Controls, Trade Promotion and Intellectual Property Rights** reform to ease the ability for defense manufacturing firms to export more while protecting intellectual property.
- **Workforce Retention and Linkages between DoD & DIB** will assist in increasing the available talent pool by leveraging the technical training and background of military member transitioning to the civilian workforce.

These steps take advantage of opportunities while addressing weaknesses, and threats from the SWOT analysis to help foster the stable and predictable environment that follows the primary theme of this paper. Fortunately, the White House is already investing heavily in dealing with the long slide of the national defense manufacturing sector, and has developed significant talent and experience in this subject matter. Industry is already well aware of these challenges. The opportunity presented from this continued national and public interest should be capitalized upon to continue to build more predictability and to support a more viable defense industrial base.

As President Obama articulated in his 2012 State of the Union address, manufacturing jobs are a critical asset to the country and needs to be treated as such by the government and public in general. The DIB is even more crucial since its output forms the basis of our country's ability to defend itself in times of crisis.

APPENDIX A: STRATEGIC ALIGNMENT IN THE DEFENSE INDUSTRIAL BASE

Sustainment is the most costly function of the acquisition lifecycle for any weapon system or platform in the U.S. military arsenal. Although there is significant room for improvement in the acquisition decision process regarding requirements generation, assessment, and product delivery, the most important element regarding life management and readiness will always be sustainment. The complexity and translucency of our current acquisition system does warrant inter-granular reform due to past challenges (A-12, Boeing, Trident, Joint Strike Fighter, Joint Direct Attack Munitions, Boeing, etc.) regarding cost overruns, schedule, delivery, ethics, and prudent management oversight. However, significant gains can be made in sustainment that meet both near and long term improvement goals if more emphasis was placed on accountability and performance.

DEPOT ACCOUNTABILITY AND PERFORMANCE

DoD operates 17 major depots employing more than 77 thousand personnel and expending more than 98 million in direct labor hours annually. By comparison, in 1987 DoD had 38 major depots that employed almost 160K personnel and performed approximately 200 million direct labor hours of maintenance. This reduction was mainly due to consolidation and force reductions from Base Realignment and Closure actions. Presently, property, plant, and equipment of public depots are valued at \$48B consisting of 5600 buildings and structures totaling 166 million square feet.⁵⁴

Given the role that U.S. defense depots provide for the armed services, several major concerns have surfaced which may lead to improved performance in the public sector. Currently, under U.S.C. Title 10 Section 2460 (Depot Maintenance) and 2464 (Core Logistics Capabilities), our public sector depots are not held accountable for materiel readiness or reporting to the Under Secretary of Defense Acquisition, Technology, & Logistics (USD AT&L), and Assistant Secretary of Defense Logistics, & Material Readiness (ASD L&MR). Both Title 10 sections only refer to workload labor hours regarding core capability accountability and a very nebulous definition of depot functions concerning maintenance, repair and overhaul. The current legislation fails to provide a standardized performance metric baseline to which every depot can be held accountable to cabinet and congressional level principals. A holistic approach to alignment within the public sector would require a "revision of the statutory framework of depot maintenance, a linking of acquisition and sustainment policies and outcomes with regard to depot maintenance, the strengthening of the core determination process, and an improvement in depot maintenance [and materiel] reporting."⁵⁵

At present, there is no reporting mechanism or requirement outside of each service's logistics and defense industry chain for depot material readiness. Public Depots are only measured by workload standard capability, labor hours and cost performance, which do not account for material availability and reliability (quality and on schedule removals). Establishing a standardized performance metric would hold each depot accountable, would highlight performance trends and provide transparency and visibility for all stakeholders. This initiative would also bring the power of ASD L&MR and USD AT&L to aid any depot having material, management, capability, or capacity issues. As an example, the following model could be used:

Level (Repair) Schedule Performance: All depots will be held to a performance metric range of 85-95% of their negotiated level schedule per quarter. Depots that perform less than 85% shall report their shortfalls, deficiencies, causal factors, and course of action recommendations to ASD L&MR for forwarding to USD AT&L. If three quarters of negative trend are reported, ASD L&MR will send an evaluation team to the Depot for further investigation. Depots performing higher than 95% for three quarters or more will provide and share best practice initiatives (if applicable) for the benefit of the public and private sector community.

Rationale: Currently every area of sustainment is measured by some performance metric that serves as a baseline requirement for readiness concerns regarding operational availability:

- DLA: 85% Supply material availability goal
- Operational Units: Each platform or weapons system has a readiness baseline based on utilization, training, funding, and sustainment. The readiness levels are set by each service based on their mission requirements for both peace and war time environments.
- OEMs: Measured by a firm fixed price, cost-plus, or a Performance Base Logistics contract (most ideal) to determine reliability, supply response time, availability, and engineering/maintenance support.

ROBUST INFORMATION SYSTEM

There is a significant benefit to the development of a product support management information system that would detail stakeholder information for anyone in the supply chain to monitor, take action, or review periodically. "Benefits include DoD-wide capacity and workforce utilization, the integration of management information and reporting systems, and the minimization of unplanned capability and capacity duplication."⁵⁶ This system would also provide strategic alignment and visibility for all stakeholders within any DoD community and access would be allowed to all Military/Federal employees with minor exceptions to industry. Such as system would provide the following information to all users:

- *Operational Readiness Metrics:* Readiness performance visibility for every platform by organizational tier (Wing, Group, Squadron, Battalion, Regiment, Division, etc.)
- *Total Asset Visibility:* Retail, wholesale, industry, and sub-tier value chain
- *Workflow Transaction Visibility:* Intermediate, depot and industry maintenance activity
- *Level schedule performance and quarterly scheduling:* Depot transparency
- *Demand and Cancellation Activity:* Total visibility of demand, cancellations and surplus vendor open purchases (DLA buy around) to mitigate stock outs
- *Forecasting:* Ability to make material forecast based on market share, failure projections, demand history, or projected operational commitments
- *Strategy and Policy Information:* List existing, new or recommended logistics and sustainment strategies for all stakeholders in order to maintain strategic alignment for public and private sectors
- *Budget Information:* Include Program, Planning, Budget and Execution, Defense Working Capital, supplementals, stock replenishment, and other related O&M funding that's managed and allocated to the operating forces and depots (public sector visibility only)
- *Cost Analysis:* Cost per hour, material usage/execution, fuel, contracts, and labor material cost

- *Engineering Data:* Mean time between failure, forced/unscheduled removals, engineering investigation results, technical publication updates, and new requirement initiatives
- *Supply Chain Information:* Retail and wholesale material availability, logistics response times, administration lead times, production lead times, stock/allowance visibility, backorders (high priority and stock), processing times, average ship times by vendor or distribution depot, stock outs, and non-availability material trends

Impact:

- Transparency and accountability of repair schedule performance to all stakeholders operating forces, program management, support agencies (i.e. DLA, AAMCOM, NAVSUP, etc.), engineering, and senior cabinet, congressional and military leadership
- Building better partnering relationships with supported commands, defense manufacturing, and industry as a whole
- Prioritizing workload efforts at depots based on communication and performance visibility
- Better management and allocation of resources (efficiency) based on actual demand notification vice reactive schedule fluctuations due to emerging requirements
- Identifying best practices and incorporating new procedures or processes based on proof of concept, analysis and documented research

The information system would have 5 Tiers that incorporate all levels of policy, strategy, accountability, planning, budget, performance, readiness, and sustainment. The following chart demonstrates a basic concept of how this robust system would function in creating strategic alignment throughout the DIB.

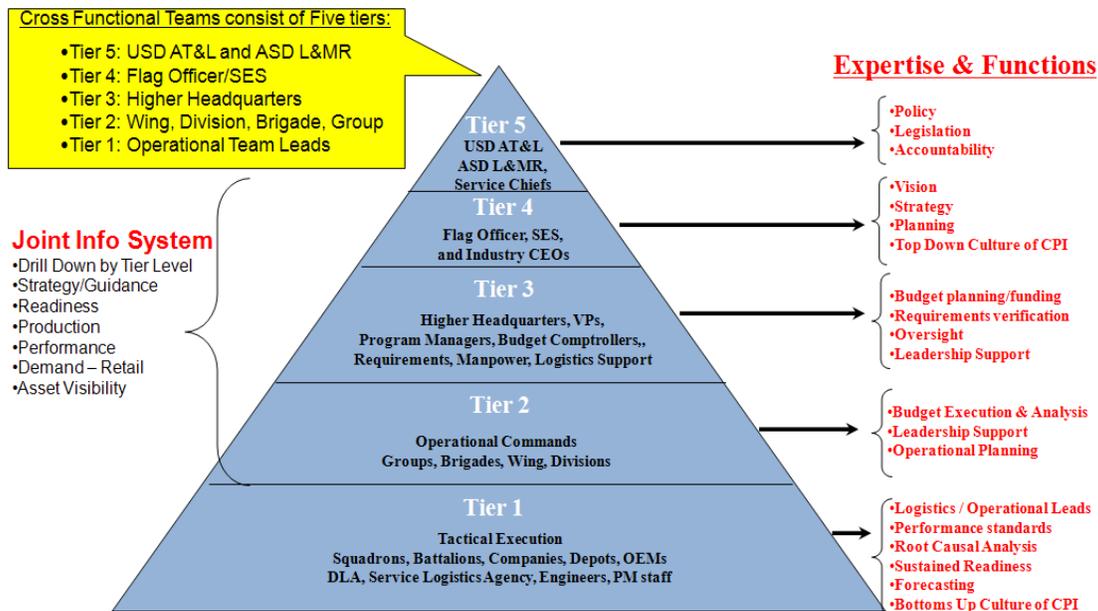


Figure 1: Information Systems Flow Structure

Key stakeholders must be involved throughout the DIB chain and each member/organization/agency must demonstrate a clear understanding of their roles and responsibilities regarding policy, planning, budget, execution, management, accountability, and reporting requirements. Table 3 provides an overview of the current system with recommended changes to support the new Product Support Management Information System construct; major changes are highlighted in red.

Table 3: Stakeholder Hierarchy

Policy Players Involved	Action	Emphasis
<u>Congress:</u> Depot Caucus (House) and Senate Depot Interest (no formal caucus)	Provides central policy guidance on sourcing depot maintenance for all systems taken together - e.g., 50/50 rule, Core depot maintenance, Core capability, and Public Private Partnership requirement will be reviewed annually to ensure max efficiency and productivity gains are realized. Waivers under 50/50 demarcation will be granted based on supportability, feasibility, affordability, and sustainability.	Resource preservation, Job Retention, Economy of Scale, effectiveness, long term viability and productivity
<u>High level DOD policy makers:</u> SECDEF, DEPSECDEF,USD (AT&L), ASD Logistics and Material Readiness (L&MR), DASD Maintenance Policy, Programs (MPP). JCS, Vice Chairman and Service Chiefs.	Provide central policy guidance on sourcing depot maintenance for specific systems (e.g., rules of competition, relevance of “Core capability,” implications of depot maintenance provision policy for addressing individual systems) . Establishing, monitoring, and enforcing, accountability for standardized performance goals where applicable.	Compliance; Efficiency assessment through reporting, business case analysis, and policy guidance
<u>Military Services:</u> Service Secretaries, Army Material Command, Air Force Material Command, Marine Corps Logistics Command, Chief of Naval Operations, Naval Sea and Air Systems Command.	Define concepts in central policy guidance (e.g., define “Core capability”)	Control, Compliance, Responsiveness
Logistics and Acquisition Commands within the Military Services; Private and Public-Sector Maintenance Activities	Managing expectations and actual performance parameters including cost, quality, and response time for maintenance provision of individual weapon systems. Ensuring visibility and tracking of sub-tier value chains to sustain materiel readiness and identify critical small and medium suppliers of defense weapon system components and end items.	Private Sector - Efficiency, cost. Public Sector - competency, job/skill retention. Linkage between shareholder profits to Materiel and Operational readiness sustainment
Acquisition Commands within the Military Services	Use analysis and competition to select sources for individual systems	Planning
Logistics Commands within the Military Services and Military Operating Commands	Use analysis or competition to allocate depot maintenance workload among existing sources for individual fielded systems	Mission Support
Office of the Secretary of Defense; Military Service Logistics Commands; Military Operating Commands	Set resource levels for actual depot maintenance activities: investment dollars, operating dollars, billets, training, etc.	Resourcing

VALUE CHAIN TRACKING AND VISIBILITY

Material and product providers have a difficult time of tracking inputs throughout the value chain. During periods of economic downturn or defense budget reductions, many mid to low sub-tier suppliers are affected because there is no formal linkage between the OEM and all its suppliers. Ultimately, this causes significant concern when a small company is the sole producer of an input for a weapons system and represents a single point of failure in the supply chain if the company cannot remain solvent due to budget reductions. Confirmation of this fact was reinforced when Mr. Brett B. Lambert (DASD, Manufacturing and Industrial Base Policy) stated that “some products and services sold by companies in the defense industrial base are unique to defense applications, while most have substantial levels of non-defense demand or are even sold exclusively on commercial terms such that the supplier may not even know that the product is used in military systems; and likewise, the military may not know it depends upon a primarily commercial component.”⁵⁷

Inputs (raw materials) from suppliers are critical to output, production, and manufacturing, which lead to availability, and operational effectiveness and readiness. Unfortunately, there is no legislative mandate that requires every defense contractor to identify and track suppliers within their sub-tier value chain. Having a uniform “top down” policy that forces each contractor to maintain visibility of all sub-tier suppliers would identify potential disruptions and critical sole source supply chain vulnerabilities. Additionally, this effort would act in concert with Sector-by-Sector, Tier-by-Tier data collection and analysis for determining immediate failure points within the existing value chains.

INCENTIVIZE VERTICAL SUPPLY CHAIN INTEGRATION FOR RARE EARTH ELEMENTS

Tracking and having total visibility of the supply chain will prove advantageous regarding long-term material availability and readiness. However, in order to avoid price volatility, inelasticity, and sensitivity from suppliers of raw materials, the government should establish incentives for companies that invest in backwards and upstream integration for key inputs that are mined, extracted (separated, refined, formed, manufactured) and owned by overseas companies. Dependency on any input that is identified as a strategic material by DLA’s Strategic Materials Branch increases U.S. vulnerability regarding shortages of imported raw materials during wartime conflict.⁵⁸ There are 17 Rare Earth Elements (REEs) that are extracted from the earth’s crust and they fall under two categories divided by atomic weight: Light REEs and Heavy REEs. Many of our commercial and defense systems (end use items) require REEs because of their high strength to weight ratio, quality, stiffness, and resistance to heat and corrosion. Examples are provided in Table 4.

Table 4: Rare Earth Element System Inputs

Commercial	Defense
Hybrid cars	Precision guided munitions
Wind power turbines	Lasers
Computer hard drives (Micron – DRAM, Flash)	Communication systems
Cell phones	Radar systems
Portable X-Ray units	Avionics
Fiber optics	Night vision equipment
Energy efficient light bulbs.	Satellites

There are limited or no substitutes for REEs and currently China produces 97% of the world’s demand and possesses 55% of the world’s reserves (55 million metric tons).⁵⁹ “The value of U.S. rare earth imports from China rose from \$42 million in 2005 to \$129 million in 2010, an increase of 207.1%. However, the quantity of rare earth imports from China fell from a high of 24,239 metric tons in 2006 to 13,907 metric tons in 2010, a 42.6% decline [due to export quotas. The United States was once self-reliant in domestically produced REEs, but over the past 15 years has become 100% reliant on imports because of low cost operations.”⁶⁰ There is new legislation being introduced to the 112th Congress to address our dependency and the monopoly of critical REEs from China (see Table 5)⁶¹.

Table 5: REE Existing Legislation Recommendations

Statute	Goal	Responsible Office/Agency
H.R. 1388, the Rare Earths Supply Chain Technology and Resources Transformation Act of 2011	Seeks to reestablish a competitive domestic rare earths supply chain within DOD’s Defense Logistics Agency .	Defense Logistics Agency
H.R. 1540, the National Defense Authorization Act for FY2012	Develops an inventory for rare earths materials to support defense requirements,	Defense Logistics Agency
S. 383, the Critical Minerals and Materials Promotion Act of 2011	Establishes a scientific research and analysis program to assess current and future critical mineral and materials supply chains, strengthen the domestic critical minerals and materials supply chain for clean energy technologies, strengthen education and training in mineral and material science and engineering for critical minerals and materials production, and establish a domestic policy to promote an adequate and stable supply of critical minerals and materials necessary to maintain national security, economic well-being, and industrial production with appropriate attention to a long-term balance between resource production, energy use, a healthy environment, natural resources conservation, and social needs.	Secretary of the Interior
H.R. 618, the Rare Earths and Critical Materials Revitalization Act of 2011	Provides for loan guarantees to revitalize domestic production of rare earths inthe United States.	

Statute	Goal	Responsible Office/Agency
S. 1113, the Critical Minerals Policy Act of 2011	<u>defines critical minerals.</u> Would require a <u>performance metric</u> for permitting mineral development and report on the timeline of each phase of the process. Would provide <u>forecasts</u> of domestic supply, <u>demand, and price</u> for up to ten years.	Secretary of the Interior establish a methodology (in consultation with the National Academy of Sciences, the National Academy of Engineering and various Department Secretaries)
H.R. 2011, the National Strategic and Critical Minerals Policy Act of 2011	Prepares a report on public lands that have been withdrawn or are otherwise unavailable for mineral exploration and development, mineral requirements of the United States, the nation's import reliance on those minerals, a <u>timeline for permitting mineral-related activities on public lands</u> , and the <u>impacts of litigation on issuing mineral permits</u>	Secretary of the Interior
H.R. 2090, the Energy Critical Elements Advancement Act of 2011	Improves assessments of "energy critical elements throughout the supply chain, supply, demand, disposal and recycling."	Secretary of the Interior and the Secretary of Energy
H.R. 2184, the Rare Earth Policy Task Force and Materials Act	Prepares a Materials Program Plan of R&D that would support and help ensure <u>long-term viability of a domestic rare earth industry.</u> Encourage expanding opportunities for <u>higher education to support the build-out of the rare earth supply chain.</u>	Department of Energy, Commerce, State, Defense, Agriculture, Office of Management and Budget, Council of Environmental Quality.

The United States should take the same approach to incentivize (tax cuts, subsidies, import restrictions/quotas) any firm that is willing to make the capital investment in mining raw materials or acquiring (i.e. consolidation, mergers and acquisition (CM&A)) overseas companies that already possess the capital resources (equipment, mining rights, knowledge, environmental certification) in order to make an immediate impact in the global market and reduce dependency. CM&A also avoids the 10-15 year average delay (return on investment) due to the high capital outlays and long-term process of mining, extracting, gaining permits, and complying with Federal or State/local environmental regulations. Eliminating dependency of critical raw material inputs from foreign suppliers will lower cost, reduce supplier power, improve supply chain controls, and provide better visibility or material distribution and inventory.

The United States would also need to make amendments to the General Mining Act of 1872, which states that mining can only establish claims on public land. The following is noted in the 2011 Strategic Materials Industry Report:

Today, roughly one third of the United States is public land, but half of those public lands are closed to mining and resource explorations. While the 139-year-old policy regime does not deter mining investment per se, it also does not incentivize exploration and development, nor does it capitalize on opportunities for the government to capture revenues accrued from the extraction of what is arguably a common resource to the public.⁶²

Congress must amend this legislation to expand mining exploration, and include language that allows companies to pursue mining operations on private lands if all environmental, safety, and reclamation standards are met.

To achieve long-term viability during periods of economic downturn, budgets reductions, or post war drawdowns, both public and private sectors can benefit from immediate policy changes. From the public sector, our depots should be held accountable for their repair schedule and quality performance by adhering to baseline/standardized performance metrics for MRO and Material Conditioning (Recapitalization, Reset, Reconstitution) requirements from USD AT&L. Other areas of product support sustainment for both supported and supporting commands are held accountable through performance goals that are tracked and monitored throughout DoD. This reporting requirement would be an easy transition for the defense depots and would allow USD AT&L and ASD L&MR to oversee the material readiness performance of the public sector. The resulting effects will lead to transparency, better collaboration, visibility, immediate action of negative trends, and recognition of lasting efficiencies gained from partnering, lateral support, best practice implementation, and real time prioritization. The implementation of a comprehensive product support management information system will also lead to improved material readiness, strategic alignment, transparent information flow, time management efficiency, and better root cause analysis. New legislation could mandate that all defense contractors and agencies track and maintain visibility of their mid-low sub-tier suppliers to gain total visibility of their value chain and identify single failure points or potential supply disruptions for critical inputs. Although the depot accountability initiative can be implemented immediately without additional funding, the long-term effects regarding improved sustainment will come from the development of a robust supply chain/product support information system.

APPENDIX B: TITLE 10 UNITED STATES CODE

While there is no formal strategy that impacts entities within the DIB, the sector is subject to positive and negative government influences. The government can provide incentives, subsidies and stimulus, but can also be restrictive with rules and regulations. Key congressional oversight of defense depot-level maintenance and repair activities is codified in Title 10, United States Code (Sections 2460, 2461, 2464, 2466, and 2474). A summary of each is provided below:

- **Section 2460** – defines depot-level maintenance and repair as “material maintenance or repair requiring the overhaul, upgrading, or rebuilding of parts, assemblies, or subassemblies, and the testing and reclamation of equipment...” The definition applies regardless of source of funds or location of maintenance, and explicitly includes all software maintenance as well as interim contractor or contractor logistics support.
- **Section 2461** – defines public private competition whereby no function of DoD performed by DoD employees may be converted to performance by a contractor unless the conversion is based on the results of a public private partnership. The results must compare cost of performance, include a most efficient organization plan, include issuance of solicitation, assess cost, reliability, quality, availability, and timeliness and compare cost of performance between government and contractor personnel.
- **Section 2464** – codifies the necessity of Government-owned and Government-operated (GOGO) depot-level maintenance and repair requirements. These core requirements are “essential for the national defense ... to ensure a ready and controlled source of technical competence and resources necessary to ensure effective and timely response to a mobilization, national defense contingency situations, and other emergency requirements”. Program Managers must identify these core requirements within four years of initial operational capability.
- **Section 2466** – requires that at least 50 percent of depot-level maintenance funds made available to a military department/defense agency be used for the performance of such work by employees of the DoD. In addition, the government cannot contract out more than 50 percent of funds to the private sector. The Secretary of Defense is required to submit a report to Congress identifying the percentage of public and private workload by service and defense agency.
- **Section 2474** – designation of military arsenals as Center of Industrial and Technical Excellence to reengineer industrial processes and adopt best business practices in connection with core competency requirements in order to lead and preserve the national technology and industrial base. Where applicable public private partnerships will be encouraged to maximize utilization, reduce cost of ownership and products, leverage private sector investment, and foster partnerships with DoD.

Acquisition and sustainment processes have matured in a resource-constrained environment, which has created challenges for DoD. Within these laws, a general framework is provided for services to make key acquisition, sustainment planning, and resource allocation decisions to meet operational objectives and characterize core capabilities. These laws however are subject to interpretation and are applied inconsistently. GAO has stated that clear guidance

must be established early in the acquisition process for any weapon system. Subsequently, program managers must identify a plan for core capability to address acquisition strategies for core requirements or program offices will not procure technical data to execute core capability.⁶³

Overall, the intent of the laws to sustain Government-Owned, Government-Operated (GOGO) core capabilities is sound. As Michael O’Hanlon noted, “Capabilities could be lost, and once lost, could be difficult, costly, and slow to replace if and when they are needed again.”⁶⁴ Specifically, Section 2464 enhances readiness by requiring a surge capacity, maintaining technical skills and abilities over the long term, and ensuring an enduring physical infrastructure. Ambiguity in the law enhances readiness by allowing the services flexibility on matters like location of repair and overhaul (Section 2460), ability to shift the 50/50 burden between weapons systems (Section 2466) and enlisting cost efficient best practices to support readiness requirements (Section 2461 and 2474).

There are however, significant seams between these laws, most notably between Sections 2464 and 2466. The 50/50 law should reinforce the core requirement, but the law is not linked to core capabilities in the statute. Since the 50/50 law is the only one requiring a report to Congress, the core capabilities accomplished in the depots are not easily found. The current wars have strained the services equipment allowing DoD to keep depots busy. As drawdown occurs and reconstitution is complete, the unused capacity will reduce the public side of the 50/50 ledger.⁶⁵ Additionally, newer acquisition programs incorporate depot-level maintenance as part of the contractor logistics support package under Performance Based Logistics (PBL) initiatives. This forces the services to become more reliant on legacy workload to balance meeting 50/50 requirements. Furthermore, as Avdellas noted, “Acquisition program managers are reluctant to make longer-term investments in depot maintenance capabilities, which need to be done early in a system’s life cycle in order to be effective because they have more immediate program needs.”⁶⁶ The Air Force faces challenges in meeting 50/50 and barely met legal standard in 2010 with a GOGO rate of 50.1%.⁶⁷ Ultimately, given the pressure to move to competitive sourcing, the seams create a legal loophole that unfortunately incentivizes the services toward a “mismatch of work selected to comply with 50/50 reporting, versus work that exercises core capabilities”.⁶⁸

Public-private partnerships (PPPs) have also come under increased scrutiny due to budget reductions and government inclinations to push for increased in sourcing of industrial base capabilities. However, evidence demonstrates that these relationships maintain and improve critical core capabilities. Commonly defined, “Public-private partnerships for depot-level maintenance are cooperative arrangements between a depot-level maintenance activity and one or more private sector entities to perform DoD or defense-related work, to utilize DOD depot facilities and equipment, or both.”⁶⁹ This definition can be broadened from maintenance activities to include sustainment activities, ammunition facilities, munitions centers, and manufacturing arsenals.⁷⁰ Furthermore, the types of partnerships “are diverse and flexible including: workshare, teaming, sales of parts and services, facility and equipment leasing, Centers for Industrial and Technological Excellence partnering, Armament Retooling and Manufacturing Support Programs (ARMS), Arsenal Support Program Initiatives (ASPI), and Cooperative Research and Development Agreements.”⁷¹ These partnerships illustrate potential

win-win situations for the depots, the warfighter, and commercial firms that provide measurable and realistic benefits.

In 1998 in order to facilitate partnerships, Congress added Section 2474 to 10 USC, which provided a statutory basis to establish partnerships. This also allowed depots to be designated as Centers for Industrial and Technological Excellence (CITEs) in their core competencies and allowed them to form public-private partnerships in these core competencies.⁷² A few years later, section 342 of the 2002 National Defense Authorization Act amended Section 2466 to 10 USC to exclude public-private partnerships performing at CITEs from the 50/50 limitation.⁷³ This evolution reflects an environment that is increasingly constrained by current costs that are crowding out spending on modernization.

A common theme in the literature on PPPs is the importance of conducting a thorough business case analysis (BCA). More fundamental to the discussion is some degree of consensus on what is inherently governmental work that must be preserved as a core capability, because existing laws provide incentives for services to enter PPPs in order to report 50/50 law compliance instead of a value-based decision. “Government has the responsibility of oversight. Government has the responsibility of management- they have to work with industry to do that in order to get the best results”.⁷⁴ Therefore, while it is true that DoD needs to enforce standardized BCAs with established baselines, performance requirements (readiness), true equivalent costs and metrics; BCAs are but one decision tool to aid determination of a sound PPP arrangement—the absence of which does not necessarily negate the value of the partnership. The culprit is the 50/50 law itself, which drives short term decisions to meet reporting requirements, yet is exempted at CITE locations in order to overcome its congressionally imposed constraints for apparently good reason. The need and acceptance of such exemptions are further evidence of the law’s arbitrary and archaic nature. The law is a valid reminder, however, that there will always be barriers to best value decisions due to congressional interest.

Additionally, standardization across DOD is required for reporting between services and private companies in order to measure progress. Furthermore, it is not inherently apparent that depots can be incentivized since they do not operate for profit. But, there is motivation to remain competitive and retain workload.⁷⁵ This problem is further aggravated by contracting practices that do not drive towards investing in long-term relationships through contracts that are five years or longer. While DoD has a difficult time defining and measuring core capabilities, it also has a hard time describing how PPPs expand core capabilities.⁷⁶

According to DoD’s Weapon System Acquisition Reform Report, public-private partnerships resulted in improved product support, performance, and business practices; updated technology and cost avoidance; and increased facility utilization.⁷⁷ As Jacques Gansler noted, public-private competition improves cost and performance. He stated, “The government is not cheaper...whenever we’ve had competitive sourcing, we get more than 30 percent cost savings, on average, with higher performance, no matter who wins – and the government most often wins.”⁷⁸ Additional reasons for forming a public private partnership for the depot include reduced cost of ownership and preserving skilled workforce. Contractors gain long-term contracts, increase profits, and leverage depot capabilities, equipment and facilities.⁷⁹ Ultimately, partnerships allow for cross-fertilization of best practices between industry and

government, which result in sustained readiness improvement. Most of the evidence still favors an increase in PPPs, not a retreat from them.

Like all ventures, there are ways to improve, or at least assure the success of PPPs. PPPs have to be developed with strategic alliances in mind. The integration of goals and objectives of all partners with a long-term strategy is critical.⁸⁰ Key to maintaining mutually beneficial relationships is full and open communication, long-term commitment, continuous improvement, and close collaboration based on trust.⁸¹ Transparency through comprehensive and consistent business case analysis is needed to support best value determination of life cycle product support decisions. The Navy has found that its success with PPPs and the Naval Aviation Enterprise construct is due to bringing all stakeholders to the table and managing holistically; long-term contracts allow them to reap the benefits of the partnership; and they recognize the private sector's need for profit provides incentives for improvements in performance.⁸²

RECOMMENDATIONS

1. Revise and improve service-reporting requirements in favor of a DoD wide measure of performance to provide accountability and establish a baseline of excellence for public and private sector.
2. Eliminate arbitrary 50/50 demarcation that provides a more flexible interpretation of true core requirements.
3. In-sourcing decisions need to take into consideration the health of the private sector as well as the public sector.
4. Identify core requirements and capabilities early in the acquisition process and link with source of repair analysis; continue to encourage cost saving best practices and readiness performance through PPPs and PBL initiatives.
5. Institute PPP strategy as part of the acquisition milestones.
6. Retain and recoup cost savings in the defense budget to improve modernization and revisit exclusion concerning modification in Section 2460.
7. DOD needs to establish overarching goals and measures to collectively assess PPPs.
8. Implement the DOD Product Support Business Case Analysis Guidebook as policy.
9. Ensure all stakeholders are involved and there's transparency, visibility, collaboration, and cross functional team participation from senior leadership (Industry ((CEOs, VPs) and DoD (Flag Officers)), Depots, OEMs, DLA, Service Logistics Commands/Agencies, Program Office, Foreign Military Sales, and policy makers (USD AT&L, ASD L&MR).

APPENDIX C: SUPPORTING DEFENSE ADVANCED MANUFACTURING

There are numerous initiatives underway nationally to strengthen, stabilize and sustain the manufacturing base within the United States. These efforts include State and Federal programs, initiatives, and legislation designed to support and sustain the manufacturing base within the United States. This section focuses on the efforts under way that impact the defense industrial base. These efforts are aligned to the NIST Advanced Manufacturing Partnership objectives (as detailed in the National Strategic Plan for Advanced Manufacturing) to demonstrate any gaps or overlaps in initiatives. Subsequently, these gaps and initiatives help to prioritize where resources should be focused for sustaining the defense industrial base.

Table 6: Manufacturing Programs aligned to Advanced Manufacturing Strategy Objectives

<u>NATIONAL STRATEGIC PLAN FOR ADVANCE MANUFACTURING OBJECTIVES: FEB 2012</u>	Obj. 1: Accelerate Investment through Federal capabilities and facilities (early procurement)	Obj. 2: Expand # of workers with skills in advanced manufacturing sector (more responsive education and training system)	Obj. 3: Create National and Regional public-private, government-industry-academic partnerships to accelerate investment	Obj. 4: Optimize the Federal government's investment through portfolio perspective across agencies	Obj. 5: Increase total U.S. public and private investment in R&D
NATIONAL EFFORTS THAT IMPACT MANUFACTURING					
DOC NIST Manufacturing Extension Partnership (MEP)	X		X		X
DOC NIST Engineering Laboratory	X		X		X
DOE Advance Manufacturing Office	X	X	X		X
DOE Advanced Manufacturing Office of Science and Technology Policy (OSTP), Advance Manufacturing Partnership	X	X	X	X	X
Manufacturing Institute (not government funded)			X		
NSF Directorate for Engineering	X	X	X		X
NIST Advanced Manufacturing Technology Consortia (AMTECH)	FY2013 NATIONALLY PROPOSED PROGRAM				
National Network for Manufacturing Innovation (NNMI)	FY2013 NATIONALLY PROPOSED PROGRAM				
DEFENSE RELATED EFFORTS					
DOD Manufacturing Technology (ManTech) Program	X		X		X
DOD Laboratory Enterprise	X		X		X

<u>NATIONAL STRATEGIC PLAN FOR ADVANCE MANUFACTURING OBJECTIVES: FEB 2012</u>	Obj. 1: Accelerate Investment through Federal capabilities and facilities (early procurement)	Obj. 2: Expand # of workers with skills in advanced manufacturing sector (more responsive education and training system)	Obj. 3: Create National and Regional public-private, government-industry-academic partnerships to accelerate investment	Obj. 4: Optimize the Federal government's investment through portfolio perspective across agencies	Obj. 5: Increase total U.S. public and private investment in R&D
Defense Advance Research Projects Agency (DARPA)	X				X
Defense Production Act Title III	X				X
NCDMM (not government funded)			X		X

Gaps/Challenges

As evidenced from Table 6, there are numerous programs designed to strengthen and enable the manufacturing base. However, there are clear gaps in DoD efforts to develop skills in advanced manufacturing and to reap the benefits of economies of scale and scope through a federal government portfolio approach to investment. From a funding and innovation perspective, DoD remains one of the largest R&D sources in the United States. However, the current budget proposals have disproportionate cuts to defense-related R&D which will negatively impact the level of innovation in the defense manufacturing base.

Proposed Initiatives to Address Gaps in Efforts for Advanced Manufacturing

The *National Defense Industrial Association (NDIA)*, *National Association of Manufacturers (NAM)*, and *Coalition for Prosperous America (CPA)* organizations, as well as many other interested parties, provide numerous recommendations for improving manufacturing in the United States.

National Defense Industrial Association (NDIA). NDIA is a partnership between government and industry that facilitates growth, innovation and technological advances in the defense industrial base.⁸³ General Policy Efforts Relevant to Manufacturing include:

- Align Defense Industry Investment and Capacity with National Security Requirements, Priorities and Budgets
- Pursue Efficiencies While Maintaining the Industrial Base to Ensure Military Readiness
- Enable International Competitiveness of U.S. Industrial Base
- Increase Awareness, Opportunity and Utilization of Small and Mid-Tier Businesses in Government Contracts.⁸⁴

National Association of Manufacturers (NAM). NAM is a manufacturer and industrial trade organization that advocates for a policy agenda that helps manufacturers create jobs⁸⁵. General Policy Efforts Relevant to Manufacturing include:

- The United States must create a dynamic environment that supports jobs and economic growth

- The United States must adopt policies that enhance access to new markets and support existing ones
- The United States must develop a skilled workforce that includes the best talent from inside and outside the country
- The United States must adopt policies that adopt and retain research and development activities and promote and protect manufacturers' intellectual property⁸⁶.

Coalition for Prosperous America (CPA). CPA is a non-profit organization focused on reforming trade policy and represents 2.7 million households comprised of agriculture, manufacturing and labor members. One of the group's leading intellectuals, Ian Fletcher, believes that a true level playing field in global trade is impossible, and no free-market solution will ever balance trade. In lieu, balanced trade will have to be some kind of managed trade, he concludes.⁸⁷ This organization places greater emphasis on:

- Achieving reciprocity in U.S. trade negotiations
- Extending benefits in preferential trade agreements such as the Trans-Pacific Partnership (TPP) to private companies⁸⁸
- Engaging, educating and informing citizens and local opinion leaders on manufacturing and agricultural issues
- Raising awareness with congress on the small to medium sized enterprises.

This section outlines those proposals that impact the critical areas of expanding workforce skills in advanced manufacturing, developing a federal or agency-wide portfolio approach to R&D investment and targeting key initiatives for allocating R&D funding.

Expanding Workforce Skills

Developing workforce skills remains critical to furthering advanced manufacturing due to the growing gap between the desire for qualified employees and the available pool of skilled employees. NAM has made several recommendations to expand the available number of skilled employees in the United States. NAM's specific goal is that, "Manufacturers in the United States will have the workforce that the 21st-century economy requires."⁸⁹ NAM highlights several initiatives that will help achieve this goal.

- Develop a more productive workforce and encourage innovation through education reforms and improvements. NAM recommends that the NAM-endorsed system of Manufacturing Skills Certifications be promoted throughout the industry. The Manufacturing Institute is currently leading this effort.⁹⁰
- Attract the best and brightest to the United States. NAM believes that a significant number of skilled employees can work in the United States if the immigration controls are eased and administratively simplified.⁹¹

NDIA also supports these efforts stating that, "the Manufacturing Skills Certification Skills System...is the first step in bringing sorely needed jobs back on-shore, and strengthening our manufacturing base."⁹² Additionally they believe that the government needs to take action to improve the image of manufacturing to attract more workers into this field. The manufacturing industry competes for talent with the same group of individuals that are being drawn into high-tech careers. Increasing the number of STEM graduates will require a coordinated effort between government, communities and the private sector.⁹³

Optimizing Investments by Implementing Agency-wide Portfolio Approach

Continuing to develop and define a portfolio approach to address advanced manufacturing would significantly benefit the DoD, Department of Commerce and Department of Energy. By identifying programs and initiatives to build synergies between agencies, the agencies may be able to optimize federal investment in advanced manufacturing as well as indirectly fostering R&D and building more skills in manufacturing. One initiative being proposed is the establishment of a National Network for Manufacturing Innovation (NNMI). The President's FY 2013 budget proposes \$1B in funding to establish the NNMI. This one time investment requires congressional approval and legislation. Current efforts are under way to facilitate discussions between the government, industry and academia on the focus of NNMI.

In addition to establishing multi-agency efforts, there continues to be a need for federal government and private sector coordination in advanced manufacturing. Initiatives focused on federal government and private sector coordination also encourage and optimize investment across agencies. To that end, the OSTP Advanced Manufacturing Partnership and the NIST AMTech program will provide value to the government and the defense manufacturing base. The AMTech program will "support high-value-added, knowledge intensive U.S. made products that respond to new market opportunities and generate high-skilled manufacturing jobs; discover cost-effective methods for making new products that safely exploit nanoscale materials; and develop new types of manufacturing tools and processes that allow cost-effective small batch production and create new market opportunities for small and mid-sized manufacturers⁹⁴." The President's FY 2013 budget request is \$21M to fund the start-up of the AMTech program.

Targeting key initiatives for R&D funding

The United States' ability to innovate has been critical to its past success in manufacturing. Government backed research and development has been a key component to innovation. Attempting to continue R&D while reducing the total federal budget provides significant challenges. The FY2013 budget request illustrates the level of reductions in R&D being done by the government, particularly within the DoD. NAM and NDIA both recognize the importance of government R&D and have recommendations to increase government funding. Additionally, both organizations have recommendations to incentivize private R&D as well as funding programs that have historically been the most successful.

NAM has established a goal that "Manufacturers in the United States will be the world's leading innovators."⁹⁵ The key components of this are R&D incentives and protection of intellectual property. NAM's specific recommendations include:

- Strengthen and make permanent the R&D tax credit. NAM recommends increasing the R&D credit to 20 percent and making it part of the permanent tax code.
- Support federal research agencies and public- and private-sector research
- Recognize IP as the basis of America's innovative economy⁹⁶

Of note, the Milken Institute also agrees with NAM but recommends a permanent 25 percent R&D tax credit to encourage businesses to increase their investment in product development, which would lead to the following micro and macro economic benefits:

- Creating new products and services

- Enhancing productivity growth
- Expanding investment in technology-intensive capital equipment
- Spurring greater exports, production, employment, and incomes
- Boosting Real GDP growth⁹⁷

If the United States were to expand the R&D tax credit to 25 percent, the following results could be realized through 2019:

- After 10 years [From 2010 estimates], real GDP is \$206.3B, or 1.2 percent, above the baseline projection in 2019
- Real business fixed investment rises 5.6 percent, or \$124.6B, above the baseline scenario in 2019
- Exports, especially technology-related goods and services, experience higher growth. By 2019, real exports stand at \$63B (2.1 percent) above the baseline projection
- Industrial production exceeds the baseline scenario by 4.4 percent in 2019. Total employment rises by 510,000 jobs (0.4 percent) above the baseline at its peak in 2017, and manufacturing employment jumps by 270,000 jobs (2.1 percent) above the baseline in 2019⁹⁸

R&D initiatives can be costly to firms in terms of risk and potential benefit. A permanent R&D tax credit would reduce the risks or uncertainty associated with R&D and delayed return on investment while taking full advantage of the long term positive externalities associated with creativity, innovation, and both product and process development efficiencies.

NDIA's recommendations follow a similar theme. NDIA also discusses the value of clustering for R&D and provides recommendations on funding for the DoD ManTech program. NDIA provides the following recommendations on R&D:

- Government policy should support the formation and management of clusters by offering a centralized process for creating and developing the clusters. Additionally a model for collaboration between clusters needs to be provided. Research Triangle North Carolina and Silicon Valley provide good examples of clustering and collaboration.
- The DoD ManTech program is underfunded. According to a 2006 Defense Science Board study, funding for ManTech should be approximately 1% of the defense R&D budget. Funding for ManTech should be about \$700M but is currently being funded at approximately \$200M. Historically, this program has saved the government billions of dollars in savings and cost avoidance. In these times of reduced budgets, additional spending towards ManTech could be significantly beneficial.⁹⁹

Conclusion and Prioritization

In this time of declining defense budgets and fiscal constraints, and based on the high priority being placed on advancing manufacturing efforts in the U.S, it is clear there are priorities on which defense resources could be applied to support defense advanced manufacturing. Specifically by further funding the DoD ManTech program based on potential commercialization of products for defense advanced manufacturing needs, defense manufacturing firms would gain further revenue streams and generate economies of scale. Additionally, by funding programs such as NNMI to develop portfolio approaches to advanced manufacturing focusing on programs

with a longer time horizon, the DoD and the Administration will take on initiatives that might otherwise be overlooked by private industry – given its shorter time to market. Therefore in order to maintain workforce skills, continue to be innovative, and maintain a stable and predictable environment where defense manufacturing firms remain viable, it should be the priority of DoD and the Administration to focus R&D efforts on those items which have the potential in the future for commercial needs, as well as focus on R&D or advanced manufacturing programs which may yield benefits in the 10 year time frame versus the immediate.

Appendix C – 1: Program Descriptions Definitions

Department of Commerce (DoC) NIST Manufacturing Extension Partnership (MEP). MEP is a Public/Private partnership that helps small and medium sized companies create/retain jobs and increase profits. MEP pairs businesses with government lab innovation and process solutions to increase their performance. For every \$1 of federal funds spent there is approximately \$30 in new sales growth, accounting for approximately \$3.6B in new sales annually.¹⁰⁰

DoC NIST Engineering Laboratory (EL). The EL promotes U.S. innovation and industrial competitiveness through anticipating and meeting the measurement science and standards for technologically intensive manufacturing.¹⁰¹

Department of Energy (DoE) Advanced Manufacturing Office (AMO). The AMO is a government program designed to develop and deploy new energy-efficient technologies for manufacturing.¹⁰² The DoE estimates that AMO has saved approximately 3300 manufacturing plants a total of \$1.6B per year in energy savings.¹⁰³

Office of Science and Technology Policy (OSTP) Advanced Manufacturing Partnership (AMP). The Advanced Manufacturing Partnership (AMP) is a national effort bringing together the Federal government, industry, universities, and other stakeholders to identify and invest in emerging technologies with the potential to create high-quality domestic manufacturing jobs and enhance the global competitiveness of the United States.¹⁰⁴

Manufacturing Institute. The Manufacturing Institute is a Washington, DC-based organization dedicated to improving and expanding manufacturing in the United States. They are affiliated with the National Association of Manufacturers and can best be described as part think tank, part solutions center.¹⁰⁵

NSF Directorate for Engineering. The National Science Foundation promotes the progress of engineering in the United States in order to enable the Nation's capacity to perform. Its investments in engineering research and education aim to build and strengthen a national capacity for innovation.¹⁰⁶

NIST Advanced Manufacturing Technology Consortia (AMTech). AMTech will establish industry-led consortia to identify and prioritize research projects supporting long-term industrial research needs. AMTech creates the incentive for manufacturers to share financial and scientific resources with universities, state and local governments and non-profits¹⁰⁷.

National Network for Manufacturing Innovation (NNMI). NNMI is a proposed program for FY 2013. This program is designed to be a multi-agency collaborative effort among the Department of Commerce (NIST), the Department of Defense, the Department of Energy and the National Science Foundation. NNMI will build a network of up to fifteen Institutes for Manufacturing Innovation around the country, serving as regional hubs of manufacturing excellence that will help to make manufacturers more competitive and encourage investment in the United States. The President's Budget proposes a \$1B investment over the next 10 years to create NNMI¹⁰⁸.

DOD Manufacturing Technology (ManTech) Program. The ManTech Program develops technologies and processes for the affordable, timely production and sustainment of defense systems. The program impacts all phases of acquisition. It aids in achieving reduced acquisition and total ownership costs by developing, maturing, and transitioning key manufacturing technologies. Investments are focused on those that have the most benefit to the Warfighter and include quick-hitting, rapid response projects to address immediate manufacturing needs.¹⁰⁹

DOD Laboratory Enterprise. The DoD Laboratories ensure continued U.S. military dominance against current and future threats through a continuous, vigorous and innovative Defense Research Enterprise. In an era of declining budgets and resource constraints, however, managing this effort requires concerted effort by the Director, Defense Research and Engineering ASD(R&E) to optimally balance effectiveness and efficiency in the pursuit of meeting the National priorities as defined by Departmental guidance.¹¹⁰

Defense Advanced Research Projects Agency (DARPA). DARPA's mission is to maintain the technological superiority of the U.S. military and prevent technological surprise from harming our national security by sponsoring revolutionary, high-payoff research bridging the gap between fundamental discoveries and their military use.¹¹¹

Defense Production Act Title III Authorities. Title III provides a set of unique economic authorities to incentivize the creation, expansion or preservation of domestic manufacturing capabilities for technologies, components and materials needed to meet national defense requirements.¹¹²

National Center for Defense Manufacturing and Machining (NCDMM). NCDMM is an organization that helps accelerate manufacturing solutions in small and medium sized manufacturing firms within the defense industrial base. Through cost avoidance, NCDMM has saved the DoD over \$500M.¹¹³

Private Organizations' General Policy Recommendations and Goals

National Defense Industrial Association (NDIA). NDIA is a partnership between government and industry that facilitates growth, innovation and technological advances in the defense industrial base¹¹⁴. General Policy Efforts Relevant to Manufacturing include:

- Align Defense Industry Investment and Capacity with National Security Requirements, Priorities and Budgets
- Pursue Efficiencies While Maintaining the Industrial Base to Ensure Military Readiness
- Enable International Competitiveness of U.S. Industrial Base

- Increase Awareness, Opportunity and Utilization of Small and Mid-Tier Businesses in Government Contracts¹¹⁵.

National Association of Manufacturers (NAM). NAM is a manufacturer and industrial trade organization that advocates for a policy agenda that helps manufacturers create jobs¹¹⁶. General Policy Efforts Relevant to Manufacturing include:

- The United States must create a dynamic environment that supports jobs and economic growth
- The United States must adopt policies that enhance access to new markets and support existing ones
- The United States must develop a skilled workforce that includes the best talent from inside and outside the country
- The United States must adopt policies that adopt and retain research and development activities and promote and protect manufacturers' intellectual property¹¹⁷.

Coalition for Prosperous America (CPA). CPA is a non-profit organization focused on reforming trade policy and represents 2.7 million households comprised of agriculture, manufacturing and labor members. One of the group's leading intellectuals, Ian Fletcher, believes that a true level playing field in global trade is impossible, and no free-market solution will ever balance trade. In lieu, balanced trade will have to be some kind of managed trade, he concludes.¹¹⁸ This organization places greater emphasis on:

- Achieving reciprocity in U.S. trade negotiations
- Extending benefits in preferential trade agreements such as the Trans-Pacific Partnership (TPP) to private companies¹¹⁹
- Engaging, educating and informing citizens and local opinion leaders on manufacturing and agricultural issues
- Raising awareness with congress on the small to medium sized enterprises.

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