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The Industrial College of the Armed Forces
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MANUFACTURING 2010

ABSTRACT: U.S. manufacturing remains strong and continues to be an overall engine of growth and innovation in the national economy. Without concerted and coordinated focus on maintaining American competitiveness, however, our advanced manufacturing base, and future growth prospects, will be eroded. We call for a National Manufacturing Strategy that will: invest in innovation infrastructure, particularly basic research and technology clusters; enhance the competitiveness of the U.S. business environment; foster a government-industry partnership to maintain a vibrant advanced manufacturing base, especially in the defense sector; establish a federal government mechanism to focus political attention and coordinate efforts, and; mount a public awareness campaign to reignite the American fascination with technology.

COL Pharisse Berry, U.S. Army
Lt Col Don Conley, U.S. Air Force
CDR Joshua Crowder, U.S. Navy
CAPT Thomas Fitzgerald, U.S. Navy
COL Ronald Fizer, U.S. Army
Mr. David Gibson, Defense Logistics Agency
CDR Leonard Haidl, U.S. Navy
Mr. Robert Kelly, Department of Navy
Mr. Steven Liebler, Department of Navy
Col John Migyanko, U.S. Air Force
Ms. Shanna Poole, Department of Navy
Lt Col Daniel Robinson, U.S. Marine Corps
Mr. Jonathan Shrier, Department of State
COL Raul Tangco, Armed Forces of the Philippines
Ms. Susan Thornton, Department of State

Professor Gerald Jerry Abbott, CAPTAIN, U.S. Navy (Ret.), Faculty
Professor Stephen Basile, Lead Faculty
Professor David Swain, CAPTAIN, U.S. Navy, Faculty

INTRODUCTION – THE NEED FOR A NATIONAL MANUFACTURING STRATEGY

In the wake of the 2008-09 global financial crisis, the debate over the future of the U.S. economy and the competitiveness of its industrial base and institutions has been heated, frequently involving discussions of the erosion of U.S. manufacturing and its associated high-paying jobs. Beyond the obvious implications for U.S. national security of an eroding Defense Industrial Base (DIB), it is increasingly clear that the future security of the United States depends overwhelmingly on its ability to maintain the sustainable growth of the world's largest economy and to assure continuing competitive advantages over other leading and emerging economies. The dominant economic position of the U.S. provides the foundation for all other aspects of its global influence, both soft and hard. Maintaining the lead in advanced manufacturing technologies and processes is crucial to future economic growth through contributions to innovation, productivity and value-added in the economy, as well as providing the impetus to further economic activity and high-paying jobs for manufacturing workers.

A number of groups have called for a National Manufacturing Strategy in recent years and for more attention to be paid to shoring up and supporting manufacturing through concerted government efforts.[1] Discussions of government support for particular sectors of the economy have often been marked by ideological differences, with some groups claiming that government programs are necessary to stem the outflow of good jobs and others that any government intervention (bailouts of bankrupt auto companies and banks, for example) is tantamount to socialism and a waste of taxpayer money. Although the debate has been vigorous, a consensus seems to be forming among a broad swathe of practitioners and policy makers that a national strategy for maintaining a competitive manufacturing base in America is needed.

The current straitened circumstances of both federal and local governments in the U.S. will dictate that measures foreseen by such a strategy be cost-effective, light-handed and practical, recognizing that it is not the role of the federal government to direct industry initiatives, but to coordinate, support and provide a fertile environment. Nevertheless, the current economic crisis also means increased demand and receptivity for a cohesive strategy and the mechanisms necessary to implement it. In our discussions with industry, government, international and academic officials on the challenges faced by U.S. manufacturing, it seems clear that there are a number of measures that can and should be taken to ensure that U.S. manufacturing competitiveness is preserved and that U.S. companies are best-positioned to pursue growth opportunities in the future. Recommendations for goals, policies, and implementing measures to accomplish this crucial task are detailed in the strategy roadmap below. While the scope of the issues affecting the U.S. manufacturing base is broad and we cannot address all the issues in detail here, we have attempted to pinpoint those policy areas where doable changes would have the greatest impact.

Methodology

Over the last six months, we, the members of the Industrial College of the Armed Forces (ICAF) Manufacturing Industry Study 2010, had the opportunity to speak with a wide range of local, national and international experts (see Appendix A) in an attempt to address the question, **"What**

new policies or actions would strengthen the U.S. manufacturing base, promote job creation, and improve the ability of U.S. manufacturers to compete in world markets?"

In our discussions, interviews and research, we looked at the strategic importance of manufacturing, the current health of the U.S. manufacturing base, its connections to and differences from the defense industrial base, and government policies and programs that affect the health of the U.S. manufacturing base.

We also investigated policies of other developed and emerging countries, including visits to Canada, France, Poland and Czech Republic and in-depth research on China and Mexico, establishing a firm basis for comparison with U.S. policies and for making recommendations on international competitiveness measures (see Appendix B)**.**

The Strategic Importance of Manufacturing

Manufacturing is often thought of as the transformation of raw materials into a usable end product by those working in plants, factories, or mills using power-driven machines and materials-handling equipment.[2] The broader definition of manufacturing, however, would include the entire value chain, UUfrom idea to market. This definition includes material, design, tooling, processing, production, control, fabrication, assembly, systems integration and all of the management activities associated with the value stream.[3] It also includes the intellectual property that is required and generated at all stages.

Beyond its obvious link to the U.S. Defense Industrial Base, a healthy U.S. manufacturing base is crucial to maintaining overall economic growth and competitiveness because of the contributions it makes to overall economic activity and employment, productivity, R&D and innovation, exports and the systems integration function that is crucial to adding value during production in today's complex, globalized economy.

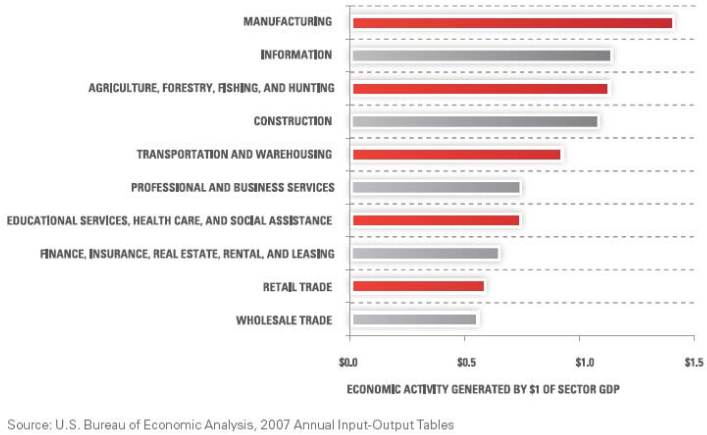
According to the U.S. Department of Commerce Bureau of Economic Analysis, in 2008, U.S. manufacturing accounted for $1.6 trillion in value-added output, which comprised 11.5% of total U.S. Gross Domestic Product (GDP),[4] making U.S. manufacturing equivalent to the 8th largest economy in the world.[5]

Although long-term economic competitiveness must be the primary target of a manufacturing strategy, a healthy U.S. manufacturing base has a significant impact on overall economic activity and, thus, a positive indirect effect on gross employment. In 2009 it was estimated that manufacturers employed 11.8 million Americans with another 6.8 million directly employed in non-manufacturing sectors such as professional services, wholesale trade, transportation, agriculture, and finance, insurance, and real estate.[6] This does not include the untold millions in non-manufacturing service industries whose livelihood is dependent on the earnings of manufacturing companies or the wages from manufacturing employees.

Manufacturing production also spurs demand in the rest of the industrial base including production of raw materials, energy, and construction. Manufacturing's backward linkage to the industrial supply chain is the highest among the major industry sectors with an estimated $1 of

final sales of manufacturing products supporting $1.40 in output from other sectors of the economy.[7]

Contribution by Sector to Economic Activity



Source: U.S. Bureau of Economic Analysis, 2007 Annual Input-Output Tables

Historically, leadership in science and technology has given the U.S. its competitive advantage and has generated significant productivity improvements and rapid economic growth, with at least half of U.S. growth since World War II attributed to technological innovation.[8] Manufacturing is the productive sector that drives new developments in science and technology, accounting for 70% of all R&D performed by industry in the United States. This investment in R&D and new manufacturing processes has allowed manufacturing to lead the way in improving labor productivity, which grew from 1987 to 2008 by 103% in the manufacturing sector compared to a 56% increase in the rest of the private sector.[9] These productivity increases allow U.S. manufacturers to remain globally competitive while maintaining higher wages and better benefits and living standards for U.S. workers. Additionally, the efficiencies associated with increased productivity have contributed to a 3% decrease in prices of manufactured goods since 1995, while prices in the overall economy increased by 33% in the same period.[10]

U.S. future competitiveness and sustainable growth depends on maintaining an edge in technological innovation. Not only are products in the mature stage of the product lifecycle not as profitable as products at the early stage of the innovation curve, but innovations in one area can spawn entirely new industries. For example, the internet was a by-product of other defense research and the MP3 player was developed from components spawned by U.S. government research at defense and energy labs over 30 years. High levels of innovation cannot be sustained, however, without a sufficient and vibrant manufacturing sector. The manufacturing sector employs 70% of U.S. scientists and engineers, includes some of the most technology-intensive industries and is the most intensive user of capital and technological innovation. Changes in technology lifecycles and industry structures mean that R&D requires coordination and collaboration both vertically in the supply chain and horizontally with other sectors. Co-location of R&D with other parts of the supply chain, including manufacturing processes, is essential for the transfer of tacit knowledge that is an integral part of the innovation cycle.[11] Without the continued presence of a strong manufacturing base, the opportunities for collaborations and integration for U.S. researchers will become increasingly limited and will result in a push to move to where the manufacturing collaborators are.

Modern manufacturing technologies are systems based on increasingly complex sets of technologies that are effectively integrated. High value-added and intellectual property intensive parts of the production chain increasingly involve systems integration. While some of the high-end systems integration work has moved to the service sector in the era of information-technology intensive production, the technology used by systems integrators is produced in advanced manufacturing. The inter-dependencies among sectors that contribute to these production chains, including advanced materials, components and subsystems, manufacturing systems and services such as software design, are increasing. Without the co-location of advanced manufacturing with other parts of the production system, the high value-added processes that characterize this part of the production process will be less efficient and more difficult.[12]

Manufactured products are also a mainstay of U.S. global exports, making up 69% of U.S. total exports.[13] Given current and likely continuing trade and budget deficits in the U.S., exports will become even more important to efforts to rebalance the global economy and decrease U.S. deficits. The President's National Export Initiative calls for doubling exports over the next five years. Only a robust manufacturing sector can contribute the production necessary to begin to meet this challenge.[14]

Current Trends and Future Challenges

We should note at the outset that, while we heard many expressions of concern during our research about the demise of U.S. manufacturing, overall the U.S. remains the largest and most competitive manufacturing producer, contributing 22% of total worldwide manufacturing in 2008,[15] the equivalent of the 8th largest economy in the world. In 1990, the U.S. share of global manufacturing was 23%, a loss of only one percent over an 18-year period. On average, U.S. manufacturing workers were more than twice as productive as workers in the next ten manufacturing countries and were even a third more productive than workers in Japan and Germany. In the 2009 World Economic Forum Global Competitiveness Report, the U.S. ranked number two in global competitiveness, earning plaudits for its comparatively free labor market, light regulation and advanced innovation environment. Relatively easy exit and entry for businesses, a transparent and predictable legal system and low barriers to cross-border collaboration were seen as continuing competitive strengths.[16]

Much of the public concern over the demise of U.S. manufacturing stems from the shrinkage of manufacturing jobs in recent years. However, the employment aspects of manufacturing are not the main strategic impetus for the maintenance of a competitive and substantial manufacturing base, especially since American manufacturing has remained competitive largely through increasing capital intensity and automation. Employment is, however, an important aspect when discussing a sector that contributes almost 12% of U.S. GDP and employs skilled, high-wage workers. It is clear that U.S. manufacturing has suffered recent job losses, with over 5.6 million manufacturing jobs lost in the last decade and approximately 2 million of those occurring during the latest recession.[17]

While the overall loss of U.S. manufacturing jobs is unquestionable, the actual number and reasons for this decline make employment a difficult measure of the current health of U.S.

manufacturing.[18] Many of the losses can be attributed to companies making decisions to offshore production to countries with lower labor costs, better access to local markets, more favorable corporate taxes or other incentives. Additional losses have been caused by the rapid increase in productivity due to technology improvements and a more skilled U.S. labor force, as noted above. Other employment losses can be attributed to outsourcing of non-core competency work such as financial, food service, and janitorial labor, which appears as a loss in manufacturing-related employment, although the service-sector nature of the job is unchanged.

A more relevant measure of the health of U.S. manufacturing is the growth in manufacturing output. While both manufacturing's share of U.S. GDP and employment have declined over the years, the value of constant-dollar manufacturing output continued to grow due to productivity growth. In contrast, between 2000-2007, manufacturing constant-dollar output was flat,[19] with a downturn to match the 2008-2009 recession. In part for these reasons, the 2009 ICAF Manufacturing Industry Study Report declared U.S. manufacturing to be "at a dangerous inflection point."[20]

Since last year, however, the U.S. economy has started to recover from the largest recession since the Great Depression and manufacturing production has started to rebound. The Institute for Supply Management (ISM) Purchasing Managers Index (PMI) showed the manufacturing sector expanded in April 2010 for the ninth consecutive month at the fastest rate of growth since June 2004. Additionally, the ISM's Employment Index reported the fifth consecutive month of growth in manufacturing employment.[21] The Federal Reserve's Industrial Production and Capacity Utilization release of 14 May 2010 showed that manufacturing output climbed 1.0 percent in April for a second consecutive month and that it had increased 6.0 percent from one year ago.[22]

While these reports indicate that manufacturing is recovering from the global recession, legitimate questions have been raised about the long term sustainability and competitiveness of the U.S. manufacturing base. This is caused not by the decline of U.S. manufacturing capability, but by the shrinking gap between the U.S. and the rest of the world in areas that have traditionally been the source of America's comparative advantage: educated workforce, infrastructure, R&D investment, technological innovation. For example, while the U.S. is continuing to attract researchers and fund significant R&D, other countries are making major efforts in these areas and are able to attract resources that previously would have come to the U.S. Globalization will continue to present U.S. manufacturers with difficult challenges as they work to penetrate foreign markets, take advantage of international collaboration, protect their market share in their home markets and protect the unique value-added of their products and intellectual property. Global markets require expanded production and collaborations to take advantage of opportunities, but, at the same time present risks of strengthening direct international competitors. The ever-changing calculus regarding raw materials, energy and transportation costs will also have a major impact on the competitiveness of U.S. manufacturers overseas. While supply chains have become globalized and vertically integrated, risks remain that these will become compromised and unsustainable at some point in the future.

The sustainability of the U.S. Defense Industrial Base is likely to come under pressure in the coming decades, as well, as public finances recover from the global financial crisis and defense

budgets are squeezed. Aside from traditional security concerns such as those covered in the 2010 Quadrennial Defense Review[23], manufacturers are likely to be increasingly involved in security efforts directed at advanced manufacturing processes that could pose major threats if allowed to fall into the wrong hands. This could impose greater costs on the development of advanced technologies such as biotech and nanotech than is currently foreseen and complicate considerations for international collaboration.

THE GOALS OF A MANUFACTURING STRATEGY

America's long-term economic competitiveness is threatened by a penchant for short-term solutions among both business and government and by a lack of coordination and leadership. The absence of a comprehensive U.S. manufacturing strategy and the slew of current ad hoc measures, often working at cross-purposes, are disadvantaging U.S. manufacturing and will ultimately lead to missed opportunities and may degrade U.S. industry's ability to compete in a globalized world. Other nations are aggressively pursuing policies to enhance their competitiveness in advanced manufacturing[24] and technology sectors and the U.S. can no longer afford to rely on short-term approaches to economic competitiveness. The time for a National Manufacturing Strategy that maximizes government's impact and leadership in the area of ensuring a healthy and competitive manufacturing base is now.

A National Manufacturing Strategy will allow the federal government to:

- channel limited economic development resources to those targeted advanced manufacturing areas that will contribute most significantly to sustainable U.S. economic growth over the next 10-20 years (rather than the current ad-hoc approach, but will require review mechanism to account for dynamic technologies);

- adopt policies to ensure sustained U.S. global competitiveness through innovation, advanced human capital and provision of a hospitable and attractive business environment for manufacturing and for the broader economy (to enhance the U.S. global competitiveness rating and attract manufacturing investment);

- prevent the U.S. (or North American) industrial base from eroding beyond a point deemed sufficient to meet minimum national defense requirements (to broaden this responsibility beyond DoD and make clear the importance of broader manufacturing to America's defense and prosperity). How to prop up the Defense Industrial Base, while compelling, falls outside the scope of the overall strategy presented here, although we believe that a number of our recommendations would benefit the Defense Industrial Base, as well, through supply chains and resulting robustness of the broader industrial base.

- Creation of manufacturing jobs is not an explicit goal of the strategy, but the growth produced by pursuing a concerted strategy will lead to increases in overall employment.

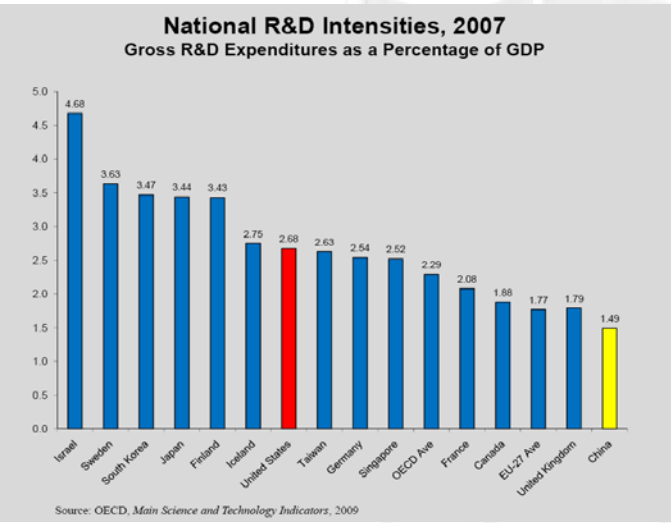
The strategy should set priorities for investing, supporting and incentivizing critical manufacturing and technology capabilities. Efforts are ongoing in the U.S. government in many

of these areas (See Appendix C), but often are insufficiently funded, coordinated or targeted to achieve maximum results. The difficulty of ensuring that federal and local efforts complement and reinforce, rather than counteract, each other should also be addressed. Only by focusing on priorities, and coordinating investments and efforts among all the relevant economic actors, can the US optimally mobilize its resources to maintain its competitive advantage in the global economy.

STRATEGY ELEMENTS AND RECOMMENDATIONS

Foster Innovation and Scientific-Technological Development

At least half of US economic growth since World War II has been attributed to technological innovation.[25] In order to foster innovation and promote technology development, it is incumbent on governments to invest in the basic building blocks of innovation, namely the R&D "commons" and human capital. The innovative returns on a commitment to research and development typically merit the investments, and the technological spillover has considerable economic and societal benefits. U.S. inventors currently claim about 50 percent of all U.S.-granted utility patents, a significant lead over its competitors, but down from 60 percent in 1980. As a percentage of GDP, "the United States, once the most R&D-intensive economy, has steadily slid to….eighth position in R&D intensity." [26]

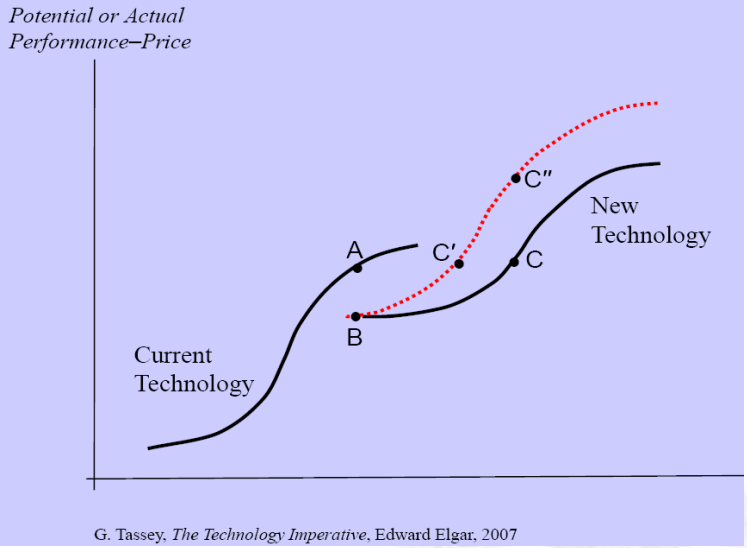


The federal government is the nation's largest supporter of basic research (funding an estimated 59.0% of U.S. basic research in 2007) primarily because the private sector asserts it cannot capture an adequate return on long-term fundamental research investments.[27] Federal government support for basic research, a key element in innovation, has declined from a height of nearly 2.5 percent of GDP in the heyday of the Apollo program to only about 0.3 percent in recent years.[28]

But R&D investment is not the only component of a successful innovation strategy. Research has revealed the importance of cutting-edge scientific output from academic institutions, capital investment, and the growth of the science and engineering workforce. All of these elements should be considered in the formulation of a national productivity and innovation strategy."[29]

To pursue these goals, we recommend the following policy elements:

1) Maintain emphasis on direct government funding of basic R&D and expand national innovation resources: the amount of federal funding for basic research should be doubled, sustained and should be fenced off.



R&D unlocks the technology and innovation cycle by providing for an accelerated ramp-up to "full speed," allowing the new technology to hit mainstream applications more quickly, and provides for a higher plateau or end-state. The final state is "a step above" what it would have been without upfront R&D.[30]

In the current tight budget climate, there will be pressure to cut federal research dollars. This would be a classic short-term approach to problem-solving and would be a huge mistake. Industry typically invests in lower risk areas that don't as often result in game changing innovation. With more industry investment and less government investment, applied research may be funded while basic research will suffer. While the government does not need to be the sole source of basic research funding, it will have to continue to play a leading role. Industry will invest where the risk is reasonable, as they need to be prudent about short term return on investment and growth timelines to meet shareholder expectations. Government should encourage public-private collaborations and invest government resources where the risk is greatest and the potential payoff highest.

2) Maximize the impact and target the composition of innovation resources: Innovation should be fostered by a rigorously reviewed national government strategy that looks at which sectors are most likely to produce sustainable economic growth and funnels resources to those areas. Approaches include:

- Development of a national manufacturing strategy that includes innovation targets; and,

- Development of technology clusters and R&D incentives for certain cutting edge sectors (see below). These could include federal matching funds for state cluster plans, federal dollars for infrastructure improvements to encourage better networking for technology investments, and incentives for technology investments in human capital via education improvements.

Within the fast-changing global landscape, the U.S. must continue to look toward future technological trends where it can recapture, reorient, and renew its competitive advantage to maintain global economic leadership. There are many promising areas where new technologies are likely to yield advances applicable to a broad range of productive sectors, including energy, information and communication technologies, nanotechnology, biotechnology, and advanced materials. Currently, the majority of federal basic research dollars go to health and defense research.[31] These resources should be better targeted and coordinated to ensure that we are maximizing opportunities in key cutting edge areas.

The Obama Administration has already highlighted the area of **energy technologies** as a key to future sustainable economic growth and has launched several initiatives to promote alternative energy research. The possibility of carbon pricing in the future lends urgency to this research and gives the private sector incentives to pursue and adopt new technologies. Government is assisting with both research dollars and early adoption incentives, support that should continue.

The rise of the internet and proliferation of **information and communication technology (ICT)** has had a dramatic impact on global interactions and the spread of information and ideas. In this evolving ICT environment, efficient and optimized use of an increasingly crowded RF-spectrum is leading to cooperative networking. Smart devices will utilize embedded intelligence to share information with each other about the RF spectrum and other environmental factors, and adjust operating parameters to dynamically optimize limited resources.[32] The web itself will possess intelligence, referred to as the semantic web, enabling computers and devices to understand, analyze, manipulate and share information.[33] As advances in human-machine interface, Artificial Intelligence, and Virtual Reality are coupled into this digital convergence, ICT is poised to dramatically shrink the global landscape. Progress in this area will also depend on investment in modern ICT infrastructure (see III. B.), such as broadband, covered in the Obama Administration's innovation strategy.

Nanotechnology is defined as the science of designing, building or utilizing unique structures that are smaller than 100 nanometers in size (a nanometer is one billionth of a meter).[34] This technology promises to be an engine for growth in the 21st century, opening the doors to more powerful computers, medical treatments, and extraordinary material created from scratch.[35] The potential for nanotechnology application is far reaching, including chemistry, coatings, apparel, solar power, automotive systems, robotics, aerospace and semiconductors.

Biotechnology is driving modern medical advances in genetic engineering, molecular biology, nanotechnology, IT and Artificial Intelligence that will improve healthcare, personalize medicine and increase life expectancy.[36] Artificial organs, grown organs, personalized treatment, cancer cure, and genetic therapy are all biotech related areas showing future promise.[37] While advances in these areas will greatly improve quality of life, the biotech field is one that faces unique challenges related to the social and moral implications of manipulating genetic blueprints and practicing potential life altering science.

New materials, a better understanding of properties and the ability to manipulate structure during fabrication can serve as enablers for other emerging systems and applications with significant effects.[38] A scientist at the National Science Foundation asserts that it is now possible to create "anything you can think of" – products with unique strengths, adaptive behavior and unusual qualities.[39] These new developments will make it possible to create as of yet unimagined new products made of unique materials.

All of these promising trends, however, are accompanied by challenges and obstacles to development. Many of these challenges can be addressed by providing an environment that allows new technological advancements to flourish. An ideal environment that facilitates the generation, growth and commercialization of these new trends comes in the form of **technology clusters**. A technology cluster is defined as "a geographical concentration of related technology

firms including competitors, suppliers, distributors, and customers; usually around scientific research centers and universities"[40] and such clusters have moved the focus of innovation from company R&D labs to networks of firms, universities and researchers. Examples include Research Triangle in North Carolina and Silicon Valley in California. Advantages that attract firms to these clusters include the presence of a large, skilled labor pool, availability of industry related materials and resources, and the intensity of knowledge exchange and spillovers.[41] The region as a whole also benefits from improved infrastructure, information flow and economic interactions, and secondary business opportunities that are not necessarily related to the core technology, but benefit from general economic expansion within the region. Technology clusters are founded upon, and take advantage of the unique knowledge, skills and assets resident in a region. They generate new ideas, technology and techniques that emerge as potential engines of future economic growth, global competitiveness, and prosperity. But with the development of off-shore manufacturing hubs in technology fields, some R&D has begun to follow manufacturing overseas, and proximity to the manufacturing process is often a key link in technological innovation. Federal and regional policy makers need to recognize the important role of manufacturing in technology clusters and should allocate resources to encourage cluster development. The Obama Administration has allocated some small funding to promote such clusters, but more collaboration and leadership could energize the development of manufacturing and technology clusters at little cost.

3) Attract Global Innovation Resources: Institute policies that ensure that the world's scientists and businesses continue to look to the U.S. as a research, innovation and design leader and that companies invest in the U.S. for innovative processes. Measures to attract overseas innovation resources include R&D tax credits, advanced higher education system and STEM training, and technology investment credits. Most important, however, is the maintenance of an attractive knowledge commons. Another area ripe for reform that is mentioned in the September 2009 Innovation Strategy is the need to reform the work visa system whereby needed foreign talent is permitted to be infused into the U.S. work force.42 This system is in dire need of a complete overhaul and reforms should ensure that future needs in cutting edge areas of science can be accommodated through an annual review by a business/science/government board that can revise prioritization categories so that the U.S. edge in advanced manufacturing is enhanced through this process.

4) Invest in Human Capital for Innovation: One widespread complaint from U.S. manufacturers is the difficulty of finding qualified workforce and the unsatisfactory quality and enthusiasm for manufacturing among high school graduates. In this area, government should foster a partnership between business and education to make needed adjustments to K-12 curricula and to teacher training programs and extracurricular activities so that excitement and skills relative to advanced manufacturing jobs are inculcated among America's youth.[43] The federal government also needs to ensure that programs aimed at the development of technical and engineering skills necessary to manufacturing processes are not eliminated in deference to declining budgets and a "new" emphasis on basic skills like reading and math test scores like that promoted by "No Child Left Behind."

The following is a list of programs/initiatives that have been implemented in different parts of the country that support the goals of readying U.S. human capital for technological innovation:

'America's 21st Century Learning System' prepared by the National Council for Advanced Manufacturing[44] recommends the following six basic principles:

- Promote and support the adoption of world-class learning standards, assessments, and curricula for PreK–14 students.
- Include applied learning in curricula for all PreK-12 students, leveraging business/education partnerships to ensure workplace-relevant learning activities.
- Require all graduating high school students to demonstrate mastery of the academic and workplace competencies outlined in the ETA Competencies Model.[45]
- Strengthen career counseling for students in grades 7-12 to help ensure that graduates gain access to postsecondary schools or productive employment.

Project Lead The Way (PLTW): This pre-engineering curriculum series is designed to provide supplemental math and science education through study and hands-on activities that show how the two subjects are applied to topics such as engineering design, computer-integrated manufacturing and civil engineering, among other fields.[46]

Educate to Innovate program: President Obama recently launched an "Educate to Innovate" campaign. This program is designed to improve the participation and performance of America's students in science, technology, engineering, and mathematics (STEM) disciplines. The program will include efforts not only from the Federal Government but also from leading companies, foundations, non-profits, and science and engineering societies.[47]

5) Maintain a Strong Intellectual Property Protection Regime: The Bayh-Dole Act has been a success in encouraging universities to invest in research that will lead to patents that bring subsequent royalty benefits. This policy should be continued and extended to other institutions, as warranted. The U.S. should continue to advocate for strong protection for intellectual property rights in international trade and economic agreements.[48]

Enhance the Competitive Environment for U.S. Manufacturing

In the recent KPMG[49] "2010 Competitive Alternatives" report, the U.S. was ranked 8th out of the 10 developed countries surveyed in terms of cost-effectiveness for doing business.[50] For the U.S. to maintain its competitive edge, it will need to pursue a strategy that enhances the business environment to allow U.S. manufacturers to compete effectively in today's global marketplace. The purpose of this strategy is not to "prop up" manufacturing sectors that no longer have a comparative advantage and cannot compete against emerging foreign competition, but to ensure that U.S. manufacturers have and keep the advantages inherent in an innovative, lightly regulated and dynamic economic system. The major areas cited[51] for needed improvements to the U.S. manufacturing environment are corporate tax policy, regulatory regime, international trade policy and export controls, health care costs and infrastructure investment.

We recommend the following policies and measures:

1) Adjustments to U.S. Corporate Tax System: One of the most notorious culprits for creating an unfavorable environment for U.S. manufacturers is the U.S. corporate tax system.

Virtually unchanged since the mid-1980's, U.S. corporate tax rates have remained steady while the majority of the rest of the world has purposely lowered their corporate tax rates to attract companies resulting in the U.S. now having the second highest corporate tax rate among OECD countries.[52] Canada is one of the countries we visited using pro-business tax policies as part of their national strategy to attract and develop high tech manufacturing. As a result, in this decade Canada's combined corporate tax rate (federal and provincial) has fallen from 43 to 31 percent and the Canadian government's goal is to have the lowest corporate tax rate among the G-7 countries by 2012.[53] Unfortunately for the United States, simply reducing the corporate tax rate alone will not achieve the desired effect since our corporate tax system is also overly complex and provides incentives for U.S. companies to make business decisions based on reducing tax burden instead of sound economic reasoning.[54] TTThe United States currently uses a hybrid worldwide system that taxes both the income of foreign firms earned within the U.S., as well as the worldwide income of U.S.-chartered corporations. For foreign subsidiaries of U.S. corporations, tax is generally paid when income is repatriated back to the U.S. as dividends or other intra-firm payments. This is referred to as deferral and it allows U.S. companies operating abroad to compete on more equal footing with firms from that country. However, because U.S. tax is only paid when foreign profits are repatriated, the U.S. corporate tax rate is only relevant when U.S. multinational corporations bring their foreign earnings back to the United States. This creates an incentive to reinvest that income abroad to avoid the repatriation tax. Although the worldwide system was once dominant, most OECD nations have made the switch to a territorial system and with Great Britain and Japan recently switching to territorial systems, the United States remains the only large economy with both a hybrid worldwide system and a corporate tax rate exceeding 30 percent.[55] Recognizing that a change to a territorial tax system would be politically and administratively difficult in the U.S., a lower overall corporate tax rate and a system that encourages profits earned overseas to be repatriated back to the U.S. would help make the U.S. more competitive with its trading partners.

2) Improve the Research and Experimentation (R&E) tax credit: All industry and government representatives we spoke with pointed out the flaws of the current R&E tax credit. These flaws included; (1) the credit has been a temporary provision for more than 25 years after its inception; (2) it has weak and arbitrary incentive effects; (3) it is not refundable – meaning unused credits cannot be used in later years; (4) the definition of qualified research remains incomplete and too ambiguous; and (5) the credit is not targeted at R&D investments that generate higher social returns than what can be accomplished with direct government spending on basic or applied research.[56] The decision for companies to invest in R&E is a long term investment decision, and while the efficacy of the R&E tax credit should not be overestimated, it should be made a permanent part of the tax code, designed as a level credit that doesn't penalize companies that are persistently innovative, and focused so that it stimulates the amount of funding in areas with the greatest social benefit.

3) Streamline Regulation, Increase Transparency and Predictability: It is important to recognize amid the criticism of burdensome U.S. regulations that the U.S. remains one of the least regulated developed economies. The U.S. was lauded in the 2010 World Economic Forum Competitiveness Report for having the lightest regulatory regime and most flexible labor market of the world's developed economies. Given the likely advent of new financial, health sector, and environmental regulations, it is crucial that local and national governments be cognizant of the

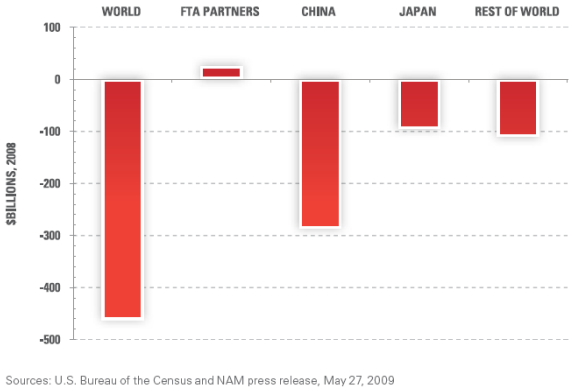
importance of limited regulation to competitive advantage and that they not act precipitately to impose costly new strictures on manufacturing. To this end, we advocate rigorously applying cost/benefit analysis to any new regulations and requiring certification by the accountable officials to the effect that, based on this analysis, the expected benefit will outweigh the cost.

What matters for competitiveness is not the number of regulations but their cost. Research published by the Small Business Administration (SBA) calculated the cost of Federal regulations at $1.1 billion in 2004. The study found that the burdens of Federal regulations fell disproportionately on the manufacturing sector and particularly on small manufacturers, defined as those employing fewer than 20 employees. The manufacturing sector as a whole had the highest regulatory costs per firm of $548,077, a figure that exceeded the sum of the costs per firm of the four remaining sectors ("other," health care, services, and trade).[57] The sense of a significant regulatory burden on manufacturers was also corroborated by a 2008 study by the Manufacturers Alliance/MAPI, which found that U.S. manufacturers carry a 17% disadvantage in "structural costs" as compared to their foreign competitors. The structural costs identified in that study are largely due to corporate taxes, rather than regulatory burdens, however, and the burden shrank to nearly half of the level identified in the Manufacturers Alliance's first study on the subject in 2003.[58] Small manufacturers face a disproportionately heavy burden, according to the SBA-sponsored study. Manufacturing firms with fewer than 20 employees faced regulatory costs per employee of $21,919 -- 118 percent higher than regulatory costs per employee for mid-sized manufacturing firms ($10,042) and 151 percent higher than regulatory costs per employee for large manufacturing firms ($8,748). The regulatory costs for small firms are concentrated in environmental regulatory costs and tax compliance costs, according to the study.[59] The Office of Information and Regulatory Affairs in the White House Office of Management and Budget, however, noted in 2009 that other studies have suggested that the relationship between firm size and regulatory burdens remains unclear.[60] With worrisome if inconclusive findings regarding the cost burden regulations impose on manufacturing firms, which in turn affects their ability to create jobs, it is important to ensure that regulations are adopted only after a weighing of these costs against the anticipated benefits of the proposed regulation.

4) Streamline and Improve Export Control Regime: Some headway has already been made in overhauling the illogical and overly burdensome U.S. export control regime. The April 2010 Defense Department review (see summary at Appendix D) of the regime makes a good start in addressing and proposing needed changes and we urge the Administration to follow through on its commitment to simplify and render more effective this woefully outdated system.

5) Pursue Trade Agreements, Open Markets And Enforcement: The U.S. should continue to lead on global market opening agreements and discourage protectionism that will slow global growth, while continuing to vigorously promote U.S. exports in overseas markets. As seen from the below graph, the U.S. in 2008 maintained a net trade surplus with Free Trade Agreement partners and will gain opportunities from opening markets. The U.S. needs to improve the compatibility of regulatory regimes, particularly environmental and safety, in future trade agreements, and should be aggressive in bringing cases of illegal or unfair trade practices to the WTO or other international bodies responsible for trade enforcement. Safeguard mechanisms should be invoked if the wheels of international trade law and practice move too slowly. Protection of intellectual property rights should continue to be at the top of the international trade

agenda with meaningful penalties for violators. Protection of industrial secrets will become an increasingly important topic for advanced manufacturing processes and technologies.



Sources: U.S. Bureau of the Census and NAM press release, May 27, 2009

It should be noted, however, that U.S. unemployment woes and trade imbalances with China are not primarily caused by an undervalued RMB-dollar exchange-rate. There is a significant body of empirical evidence that suggests U.S. trade imbalances with China will not be corrected via the exchange-rate mechanism.[61] A more productive approach would be for U.S. policymakers to address the macroeconomic structural imbalances between the two countries through coordination in the bilateral Strategic and Economic Dialogue.

The U.S. should maintain leadership in multilateral trade organizations to press for increased trade linkages and lower barriers, to address the need for rebalancing global trade, consumption and investment flows and to prevent a retreat to protectionism that would slow global growth and drive down living standards.

6) Address Rising Health Care Costs: Over 97% of U.S. manufacturers offer health insurance benefits to their employees.[62] In the past ten years, health care premiums for those providing this benefit have increased by over 100%[63] it is estimated that Americans spend more than two times as much ($7,290 compared to $3,000 in 2007 dollars) on health services than its global competition.[64] It is very difficult to predict how the new health care reform legislation will affect manufacturing costs in the next 15-20 years, because most of the provisions take effect at different intervals over the next ten years. At this point, though, it appears that: employees will pay a larger share of the costs, employers will shift away from the so-called "Cadillac"[65] plans, family members will have to pay a surcharge fee, and employees will face increased restrictions on their lifestyles in order to receive better rates from the health care plans.

In light of the current healthcare cost challenges to US manufacturing competitiveness, we recommend the following:

- Establish national standards to limit legal liability and punitive damages resulting from medical malpractice lawsuits. This would discourage the practice of defensive medicine, and eventually lower the costs of medical malpractice insurance, which would lower the costs doctors charge to patients to help them pay for that insurance.

- Develop a graduated scale for co-payments to dissuade patient requests for unnecessary or repetitive tests, and gratuitous visits to a healthcare professional or facility.

- Limit the size of medical insurance companies, health maintenance organizations and hospital conglomerates to discourage monopolies, prevent crowding out, and foster greater competition.

- Improve transparency to foster better consumer understanding of comparative healthcare provider and plans information, to include prices, services, and quality.

7) Investing in Advanced Infrastructure: Many manufacturers we spoke to noted that other developed and emerging countries have invested heavily in infrastructure to support modern manufacturing, while the U.S. has been complacent in the area in recent decades. Areas that require updating in the United States include transportation infrastructure, energy and power infrastructure, communications infrastructure, and public education, particularly at the secondary school level. Many emerging economies are benefiting from late comer advantages to building modern infrastructure. Although it is a significant investment to replace aging infrastructure, it is imperative that the U.S. not fall behind in this critical competitiveness area.

Enhance Business/Government Partnerships for Advanced Manufacturing

The Question of "Industrial Policy"

In discussing our strategy for maintaining a dynamic manufacturing sector in America, we have already suggested policies that will ensure that the U.S. remains a leader in overall innovation and quality of human capital and that the overall business environment remains competitive with environments found in other countries. But the experience of many industrialized countries, including the U.S., points to a need to give particular emphasis to certain sectors that are essential to advanced manufacturing, if such sectors are to thrive. Recently, these have included sectors such as steel, chemicals, transportation (rail, ships, autos, planes), tool and die, communications and electronics. Asian tiger economies in the 70s and 80s pursued export strategies and industrial policies that relied on government nurturing and protection of many of these sectors, allowing them to quickly and successfully penetrate more developed markets, while, at the same time, contributing to excess global capacity and downturns in these sectors in more advanced economies. They did this largely based on a strategy of following industrial leaders like the U.S. and Germany and making incremental efficiency improvements to production processes for products already in the mature stage of the product lifecycle.

As the post-WWII global economic leader, the U.S. has been guided by a doctrine of comparative advantage and open, competitive markets. With the rise of emerging industrial economies such as Japan, the U.S. has remained a technology leader, but ceded some production of mature products to other economies with more efficient production processes, lower wages, etc. As the U.S. manufacturing base has eroded in recent decades, however, many have asserted that this is a "false doctrine"[66] and that the U.S. has been hoodwinked into ceding manufacturing superiority to rival economies. One part of addressing this problem lies in appropriate remedies to ensure that trade is fair (see section III. B.). Another approach is reflected in calls for a more concerted industrial policy in the U.S. that looks systematically at sectors and processes necessary to maintaining an advanced industrial economy and implementing incentives and policies to ensure that those sectors remain vibrant.

A Strategy Doesn't Have to Pick Winners

Many in the U.S. are skeptical of the government's ability to anticipate and direct private sector innovation and competitiveness, but it is not necessary to "pick winners" in order to provide a reasonable foundation for sustainable advanced manufacturing in America. The policies in (III.A.) and (III.B.) of our strategy will help all private business in the U.S. remain competitive, but there is much government can do to sustain advanced manufacturing in particular, without favoring one industry or sector over another. These include introducing incentives for more efficient manufacturing processes and retrieving far-flung supply chains, better protection for the intellectual property vital to advanced manufacturing, government-supported manufacturing retraining, education and innovation-promotion programs, particularly in engineering and science fields that are vital to manufacturing. A strategy would also involve closer cooperation and alignment between local government advanced manufacturing promotion programs and national government incentives to maintain dynamic advanced manufacturing nationwide.

We recommend the following policy measures to promote a government-business partnership for advanced manufacturing:

1) Incentives for more efficient manufacturing: Manufacturing companies are confronted with an increasingly competitive global environment. In order to remain competitive, reduce production costs, increase quality of products, and achieve greater flexibility to quickly meet changing market demands, manufacturers need flexible sources of supply and reduced cost of inputs. Government can help manufacturers not only by fostering innovation (III. A.) and reducing regulatory and legal burdens and business costs (III. B.), but by improving **incentives for increasing productivity and modernizing production capabilities and equipment** (depreciation write-offs for new capital equipment is one example of such an incentive).

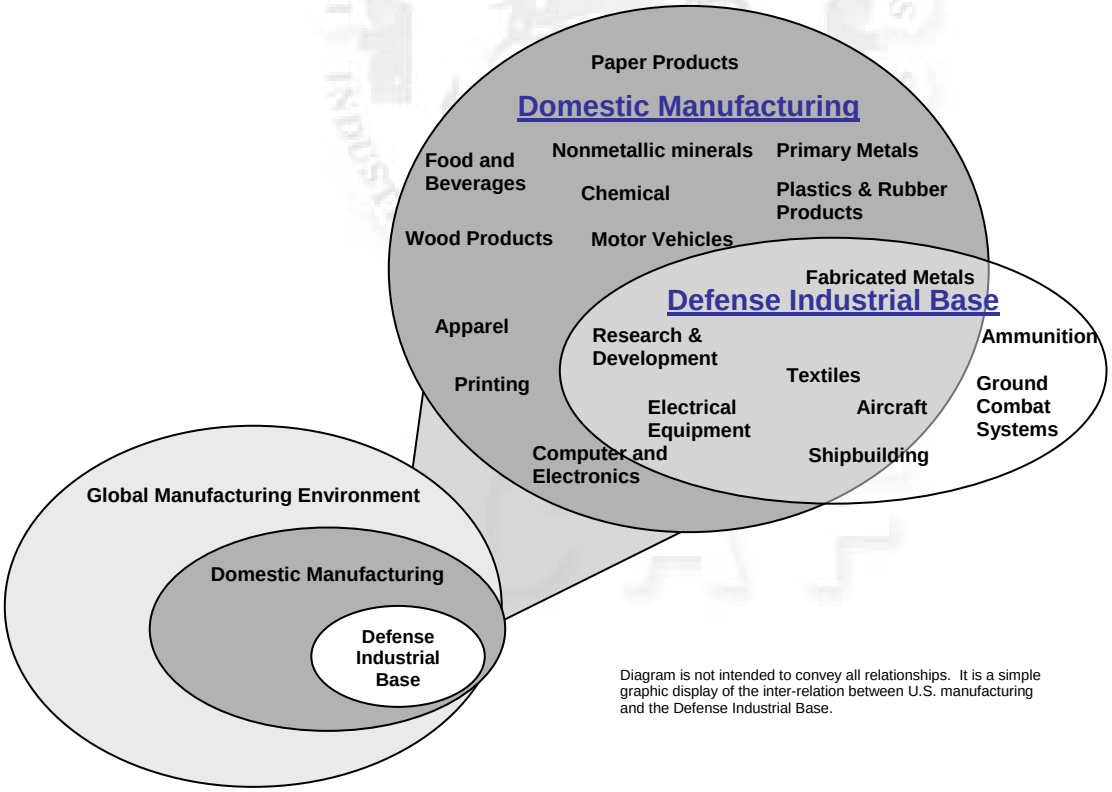
2) Retrieving supply chains: While many U.S. manufacturers are redoubling their efforts to remain competitive with greater efficiency and effectiveness without sacrificing the value of their customers' expectations, reinforcing and complementing these efforts by the federal government are also imperative in order to foster and create conditions for success in the market place and ensure manufacturing competitiveness. Bringing supply chains closer to base manufacturing processes could provide added flexibility and quality, while reducing risk, but cost will continue to drive supply chain choices. In cases where manufacturing supply chain decisions are not driven only or largely by cost, there may be government programs that could encourage manufacturers to bring supply chains home through a **"sustainable supply chain" or "greening manufacturing supply chains" initiatives** that incentivize companies to look locally first for supplies.

3) Improved Data Collection: Data sets on technology levels of exported products are currently inadequate and companies and countries face difficulties in assessing the level of technological competition they are facing in the marketplace. The USG should work with the OECD and other multilateral bodies to promote collection and publication of more detailed trade data that better reflects the technology intensity and content of exports.

4) Worker Retraining Programs: Federal and local government support for worker retraining programs is increasingly important in an era of short technology cycles and globalization. In order to keep labor markets unconstrained, worker retraining programs are critical and should be made a priority for both federal and local government programs. Worker relocation assistance would also help facilitate fluid labor markets that have been a traditional source of America's competitive advantage.

Maintaining Defense Critical Production in the U.S. Manufacturing Base

The Defense Industrial Base (DIB) is a sub-set of U.S. manufacturing (see diagram below). Actions that strengthen U. S. manufacturing capability, such as promoting innovation and research, development of technology clusters and improvements in STEM education skills, will also positively affect the DIB. These efforts alone cannot ensure a viable DIB, however, since the DIB is heavily dependent on non-market driven customers and must respond to numerous non-market incentives. Actions to strengthen the DIB should build upon the elements of this strategy to strengthen overall competitiveness through innovation and a stronger manufacturing base. Areas within the DIB that are absolutely necessary for national defense and not effectively supported by these actions will require more deliberate and targeted actions. The identification of minimum necessary capabilities in this category should be done by an interagency review of defense and law enforcement agencies' projected needs for capabilities over the next 20 years.



One approach is to specifically sustain these unique and essential DIB capabilities through federal government and private industry collaboration. The DIB includes commercial suppliers,

government – contractor operations, and service depots. Each of these provides a level of flexibility and risk. The strength of commercial suppliers would be enhanced to some extent by the adoption of a robust national manufacturing strategy, as we are recommending in this paper. One risk that would remain stems from business decisions that result in the off-shoring of production of essential defense related goods in the declining phase of their production curve coupled with an unstable demand potential. To address this gap, we recommend that the DoD Industrial Policy office develop a panel of agency, industry, and service representatives to identify and sustain those required capabilities. This panel could identify critical capabilities for national security and develop a plan to effectively preserve them. Options may include invoking Title III of the Defense Production Act[67] to modernize commercial operations or integrating that capability into a depot to better manage the workload and cost. In either case, these efforts should be integrated with the development of new products and phased out when those new products come on line. Additionally, national labs and research centers may be identified as a source of low rate production capability, if the necessary technology and skills are maintained in them.

A second approach to ensure that DIB capabilities are maintained is to develop deliberate strategic partnerships with allies. For example, the U.S. and Canada have had a joint U.S./Canada Defense Production Sharing Agreement[68] as part of the North American defense industrial base since 1956 and could pursue a single reciprocal defense procurement agreement which would streamline defense acquisitions and bring other strategic benefits. The U.S. also has a reciprocal defense procurement MOU with the UK[69] and should work toward intensifying cooperation under the agreement. In the future, partner nations could divide capabilities and essentially declare particular locations a sole source for those capabilities. While there are risks to such an approach, a cost/benefit analysis may make it clear that the gains in efficiencies greatly offset the probable costs of highly unlikely scenarios. Once this type of approach is proven, it may be able to be expanded and applied to agreements with other allies.

These two general approaches may be combined with specific recommendations from other industry studies. Success in sustaining the DIB will come from a combination of actions to promote a viable U.S. manufacturing sector and targeted actions regarding critical national security capabilities that cannot be sustained through normal market conditions.

Better Coordinate Strategy and Mobilize Government

The Federal Government has so far not been fully effective in developing and implementing a coherent manufacturing strategy. Two things have been missing:

- First, there needs to be a clearly identified institution within the Executive Branch with the wherewithal to coordinate and carry out a manufacturing strategy.

- Second, means should be developed to integrate all of the major stakeholders—including state and local governments, Congress, industry representatives, and labor representatives—into the development and execution of the strategy.

The Obama Administration appointed a White House-based manufacturing "czar" in 2009. While this appointment ensured that somebody with access to the President and his senior advisors is looking out for U.S. manufacturing interests from a whole-of-government perspective, this position alone is unlikely to be able to raise the level of effort of the Federal Government sufficiently in revitalizing the American manufacturing.

Two options are available. One would be to expand the role of the Manufacturing Policy Advisor to be the head of a White House Office of Manufacturing and Innovation (OMI) along the lines of the Council on Environmental Quality or the Office of Science and Technology Policy, with a staff of a half-dozen to a dozen well-qualified officials. This option would face a number of budgetary and practical challenges.

A more attractive and cost-effective option would be to build on the existing institutional foundations present at the U.S. Department of Commerce, where there is already an Assistant Secretary for Manufacturing and Services in the International Trade Administration, as well as the resources of the National Institute of Standards and Technology, the Patent and Trademark Office, and other elements relevant to U.S. manufacturers. The Commerce Department also serves as the secretariat for the Manufacturing Council, an existing Federally-appointed industry advisory committee that reports to the Secretary of Commerce.

Interagency coordination could be improved at the Federal level by establishing a new Under Secretary-level position at the Department of Commerce to serve as a Manufacturing Strategy Advisor. This individual, or the Deputy Secretary of Commerce, could join the White House manufacturing czar in co-chairing an interagency "deputies committee" to coordinate the development and execution of a manufacturing strategy, backed up primarily by staff of the Department of Commerce. The deputies committee would include senior officials from a broad range of Federal agencies, including various components of Cabinet agencies, including the Commerce Department, the U.S. Trade Representative's Office, the Department of Homeland Security, Defense, State, Treasury, Energy, and Transportation, and the Environmental Protection Agency, as well as sub-Cabinet agencies such as the Export-Import Bank of the United States, the Overseas Private Investment Corporation, and others. Establishing a regular schedule of quarterly or semi-annual meetings of this committee would ensure the cross-fertilization and coordination of efforts needed for success.

Coordination with key stakeholders (Members of Congress, state and local governments, industry, and labor) could be improved by strengthening the Manufacturing Council, establishing a Congressional-Executive Panel on Manufacturing, and establishing regional manufacturing councils in coordination with the regional governors associations. Among other benefits, these mechanisms would help strengthen coordination among states and the Federal Government in supporting industrial clusters, centers of excellence, and manufacturing support bodies across the nation.

In order to ensure the necessary pressure to produce results, the work of the interagency deputies committee and the stakeholder engagement bodies should build toward a recurring "Made in America Summit" featuring an appearance by the President of the United States. Each summit would be accompanied by a major trade show highlighting American manufacturing success

stories. At the first of these summits, the President could introduce (or receive) the manufacturing strategy, and at subsequent summits the President would highlight continuing advances in implementing the strategy and adjustments to it. The summits could be held annually or biennially so that every President would appear at more than one summit, improving each Administration's sense of a political imperative to achieve progress.

In the periods between national manufacturing summits, the Secretary of Commerce and a senior White House official such as the manufacturing czar or the head of the National Economic Council could host regional manufacturing summits in different parts of the country on a recurring basis in order to assure adequate attention to regional concerns and greater opportunities for small manufacturers to participate.

Reigniting the American Manufacturing Spark

Many advanced manufacturers in the U.S. today speak of a general disdain toward careers in manufacturing, especially among young people. The drive for engineering excellence that followed President Kennedy's challenge to put a man on the moon gave way to MBAs and investment banks in the 80s and 90s and prestigious professional careers as doctors and lawyers. Manufacturing's image eroded during the rust belt days of the 70s and 80s and has not yet recovered.

The federal government certainly has a role to play in galvanizing the public imagination in terms of manufacturing's contribution to America's future progress, and can take advantage of working with private sector implementers of such initiatives to give manufacturing a shot in the arm at a low cost to the taxpayer. For example, the Obama administration is currently playing up the importance of green technology jobs for America's hopes for economic recovery and is emphasizing the need for America to be in the forefront of cutting edge efforts to develop alternative fuels. These efforts, combined with federal and private sector dollars for R&D, will certainly help bring manufacturing back to the center of discussion on the future of U.S. innovation and economic growth. In this vein, additional initiatives could and should be launched to assist in the reversal of this manufacturing malaise:

- The President can make a dramatic announcement of a lofty and stretch goal for the nation's scientific-industrial complex to achieve in the next five years, much like Kennedy's space shot goal. The administration has already put several initiatives like this on the table (new battery technology, advanced vehicle technology), but the galvanizing power of one simple and compelling goal should not be underestimated.

- Announce a high profile, government sponsored prize for innovation in alternative energy. While several initiatives, both private and government-funded, are already underway (X Prize, DARPA Challenge, Hydrogen Prize, Global Security Challenge), more publicity and resource commitment are in order.

- Public service campaign aimed at bringing glamour and respect back to the professions that "make cool stuff."

- Education programs in public school that demystify and peak curiosity about manufacturing processes and jobs, for example popularization of Discovery Channel's "How It's Made" program, more factory visits for field trips, invention, robotics and industrial design competitions to be held alongside science fairs, history days and culture fairs.

- Promote a reality TV show for the best inventor – "American Geek Idol."

- Work with Hollywood to produce a series of SciFi movies involving a cool, young inventor who has a tool shop in his garage or some similar venture. Spinoffs will involve McDonald's toys and other popular items for kids.

THE WAY AHEAD

In a world of increasing complexity and uncertainty, the importance of continued sustainable economic growth to America's security and prosperity cannot be over-emphasized. We are in an era of increasing global competition for new sources of growth, and the U.S. should galvanize and focus available resources to compete successfully. The U.S. government can do more to improve America's chances of success by adopting a concerted manufacturing strategy that compels policymakers and stakeholders to take a longer term view and help position American industry for the future.

We recognize that the strategy elements articulated here form only the beginnings of the cross-sectoral and inter-organizational effort that is needed to prevent the erosion of American innovation and competitiveness in manufacturing. We hope, however, that these elements can lay the groundwork for a detailed strategy that would look out beyond the current political cycle and specify authorities, policy changes and funding that could, taken together, more forcefully address the emerging competitive threats to the U.S. manufacturing base. We believe enhancing the stature and authority of the Commerce Department's Manufacturing Sector department and linking it to an authoritative interagency process driven by the White House manufacturing point person would be an excellent start.

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APPENDIX A

Interviews and Site Visits

In Class

AFL-CIO Industrial Union Council
Department of Commerce, Bureau of Labor Statistics
Embry-Riddle Aeronautical University
Institute of Lean Systems
International Association of Machinists and Aerospace Workers
Manufacturing & Technology News
U.S. Business and Industry Council
U.S. Congress, House Armed Services Committee

United States

District of Columbia
National Association of Manufacturers, Washington

Maryland
Berry Plastics, Baltimore
Department of Commerce, National Institute of Science and Technology, Gaithersburg
Northrop-Grumman, Baltimore

Pennsylvania
Hamill Manufacturing, Latrobe
Kennametal Inc, Latrobe
Latrobe Specialty Steel, Latrobe
National Center for Defense Manufacturing & Machine (NCDMM), Latrobe

- ACS Precision, LLC
- Apex CNC Swiss, Inc.
- Conicity Technologies
- Cygnus Manufacturing Company
- Impact-RLW Systems, Inc.
- JIT Global Enterprises
- Peerless Precision, Inc.
- The Ex One Company
- Penn United Technologies

Virginia
BAE Systems, Arlington

Canada

Ottawa
Canadian Commercial Corporation, Ontario

- Industry Canada

- Canada Revenue Agency
- National Research Council Canada
- Defense Research and Development Canada
- Foreign Affairs and International Trade Canada
- Canadian Manufacturers and Exporters Association
- Canadian Advanced Technology Alliance
- PRECARN, Inc

Montreal
Bombardier Aerospace
Pratt and Whitney Canada

France

Paris
Organization for Economic Cooperation and Development (OECD)
U.S. Mission to the OECD

Poland

Rzeszow
PZL Mielec, Sikorsky Aircraft
WSK PZL Rzeszow, Pratt and Whitney Military Engines

Warsaw
Ministry of Economy
National Defense University of Poland
U.S. Office of Defense Cooperation
U.S. Commercial Counselor
U.S. Embassy

Czech Republic

Prague
Pilsner Urquell Brewery
Skoda Auto
Skoda Transportation
U.S. Embassy

APPENDIX B

International Competitiveness and Innovation Policies for Manufacturing

Canadian Organizations and Policies for the promotion of manufacturing, innovation and competitiveness:

Scientific Research & Experimental Development (SRED) tax credit/ incentive program- The SR&ED program is a federal tax incentive program, administered by the Canada Revenue Agency (CRA) that encourages Canadian businesses of all sizes, and in all sectors to conduct research and development (R&D) in Canada. It is the largest single source of federal government support for industrial R&D. The SR&ED program gives claimants cash refunds and/or tax credits for their expenditures on eligible R&D work done in Canada.

British Columbia's Venture Capital Investment Tax Credit- The British Columbia Ministry of Small Business, Technology and Economic Development recognizes the primary role of small business in diversifying the economy and in creating new jobs and offers three key programs to help small business gain access to capital. These programs offer tax credits to investors so small businesses can continue to lead the economic future of British Columbia. The Our provincial Venture Capital Program encourage investments in British Columbia businesses by providing British Columbia investors with a 30 per cent refundable tax credit.

Defence R&D Canada – Ensures the Canadian Forces are technologically prepared and operationally relevant. They advise on Science & Technology, conduct Defence research, development and analysis, assess technology trends, threats, and opportunities and engage industrial, academic and international partners in the commercialization of technology.

Centres of Excellence – clusters that promote technology transfer

National Research Council -Industrial Research Assistance Program- NRC-IRAP supports innovative Canadian firms to grow stronger, grow faster and grow bigger, through technology. NRC IRAP provides technical and business advisory services, networking opportunities and linkages, Competitive Technical Intelligence (CTI) and financial assistance to these firms.

Canada's Industrial and Regional Benefits (IRB) Policy- Approved by the Cabinet in 1986, the IRB Policy provides the framework for using federal government procurement to lever long-term industrial and regional development. An IRB is a contractual commitment by prime contractor to place work in Canada as a result of successfully bidding a Canadian defence program (100% of contract value). IRB are mandatory for projects over $100 million, discretionary in the $2-100 million range.

Precarn Incorporated- Precarn is an independent not-for-profit company that supports the pre-commercial development of leading edge technologies. Precarn works with Canadian companies who are seeking to commercialize their new ideas to get an edge in global markets. It tries to make Canadian firms more globally competitive through the increased development and use of intelligent information and communications technology (ICT) and expertise. Precarn funds

and coordinates collaborative research conducted by industry, university and government researchers, and promotes the importance of intelligent information and communications technology (ICT) throughout the Canadian economy. With investment from federal departments, such as Industry Canada, and provincial government agencies, Precarn plays a key role in growing and strengthening the network of intelligent systems experts, researchers and students. Precarn helps Canadian companies bridge the "innovation gap" ("Valley of Death") between university and government research and commercial application. The Precarn Model uses a collaborative research model that helps companies get to their endpoint faster, with less risk and more support.

Strategic Aerospace and Defence Initiative (SADI)- SADI is a program managed by the Industrial Technologies Office, a Special Operating Agency of Industry Canada. SADI provides Canadian companies performing work in the aerospace, defence, space and security (A&D) industries with repayable contributions for strategic R&D projects. It was launched in April 2007 as a replacement for the Technology Partnerships Canada (TPC) program. SADI funding helps support companies that are investing in R&D, allowing projects to proceed successfully and generating benefits for Canadians. SADI contributions will equal approximately 30 percent of a project's total eligible costs.

Export Development Canada (EDC) – provides export financing & insurance

Business Development Bank of Canada (BDC) – provides support for capital investments and start-ups

Canadian Foundation for Innovation – provides support for University & College research

Czech Republic Organizations and Policies for the promotion of manufacturing, innovation and competitiveness:

Ministry of Industry and Trade's National Policy of Research, Development- focuses public support on sustainable development, enhanced efficiency of the system of public support for R&D, uses R&D results in innovation and improves the cooperation of public and private sector in R&D.

Czech National Innovation Policy 2005-2010- supports technological and non-technological innovation in the Czech economy. Aimed at innovation of a technical nature.

European Union Policies for the promotion of manufacturing, innovation and competitiveness:

Erasmus Mundus Program- a cooperation and mobility program in the field of higher education that aims to enhance the quality of European higher education and to promote dialogue and understanding between people and cultures through cooperation with Third Countries. In addition, it contributes to the development of human resources and the international cooperation capacity of Higher education institutions in Third Countries by increasing mobility between the European Union and these countries.

Polish Organizations and Policies for the promotion of manufacturing, innovation and competitiveness:

Polish Ministry of Economy, Defense Industry Division- supports adaptation the productive potential as well as R&D to realization of new goals in range of modern armament and the military equipment, in conditions of membership of Poland in EU as well as during stricter competitiveness on armament world market, growth of innovation of defense companies, improvement of competitiveness of defense companies on national as well as world armament market and streamlining of costs of production armament as well as dual-use articles.

Polish Offset Policy- supports development of Polish industry, especially with regard to the Polish defense industry; gaining access to new export markets for Polish industry or increasing current export potential, transfer of new technologies and improvements in organization, development of research work, development of Polish universities and R&D centres and creation of new jobs in the Republic of Poland, in particular in regions affected by unemployment. Offset commitments entail purchase of shares from the State Treasury; financial contribution to a limited liability company or joint stock company and the conclusion and performance of sales contracts, delivery contracts, licence contracts, know-how contracts or other contracts for the transfer of rights or performance of services.

Chinese policies to promote innovation and high-tech manufacturing:

"Plan for the Development of Science and Technology" – Promulgated by the Chinese government in January 2006, this is a national strategy to nurture high-tech and high value-added production from 2006-2020. The strategy called for development of an "innovation-oriented society," for "leapfrog developments" in new science-based industries, increases in R&D expenditures to 2.5 percent of GDP and limits in dependence on imported technology to 30 percent. China continues to aggressively court multinationals to move R&D facilities to China through tax credits and other incentives.

Indigenous Innovation in Government Procurement: As part of its 2006-2020 National Science and Technology Plan, the Chinese government announced an "indigenous innovation" policy with respect to competing for government contracts, whereby successful bidders would be required to have indigenous intellectual property in certain key sectors. Although the policy has not been implemented, foreign firms have expressed concerns that this will effectively exclude them from China's large government procurement sector.

APPENDIX C

U.S. Innovation Initiatives

Selected United States' Government Organizations and Policies for the promotion of manufacturing, innovation and competitiveness:

The America COMPETES Act: Signed into law in August 2007, the America COMPETES Act (America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education and Science Act) provided funding for a number of programs to promote research and science and technology in American education.

DoD SBIR/STTR Program: These two Defense Department programs provide funding for early stage R&D directly to small technology companies or to small companies to support research collaboration with universities and other research institutions.

The Bayh-Dole Act: Encourages universities to perform basic research and apply for patents based on said research that will bring royalty benefits back to the university. These benefits are then used for additional university research.

Technology Clusters: A geographical concentration of related technology firms including competitors, suppliers, distributors, and customers; usually around scientific research centers and universities. Examples include Research Triangle in North Carolina and Silicon Valley in California.

America's 21st Century Learning System: Prepared by the National Council for Advanced Manufacturing to promote and support the adoption of world-class learning standards, assessments, and curricula for PreK–14 students. Includes applied learning in curricula for all PreK-12 students, leveraging business/education partnerships to ensure workplace-relevant learning activities.

Project Lead The Way: A pre-engineering curriculum series designed to provide supplemental math and science education through study and hands-on activities that show how the two subjects are applied to topics such as engineering design, computer-integrated manufacturing and civil engineering, among other fields.

Educate to Innovate program: This program is designed to improve the participation and performance of America's students in science, technology, engineering, and mathematics (STEM) disciplines.

R&E (research & experimentation)Tax credits: Approved annually by Congress. Allows businesses to deduct from their taxes expenditures for research and development.

DARPA Prizes: DARPA sponsored competitions such as the "Grand Challenge" for driverless vehicles and the Network Challenge for exploring the roles the Internet and social networking

play in the real-time communications, wide-area collaborations, and practical actions required to solve broad-scope, time-critical problems.

Technology Innovation Program (TIP): Sponsored by NIST. Competitions award funding for high-risk research in areas of critical national need and fund up to 50 percent of the proposed research project. TIP's 2010 competition is entitled, "Manufacturing and Biomanufacturing: Materials Advances and Critical Processes." Joint ventures between companies and research institutions are encouraged.

Baldrige Program: Sponsored by NIST. Educates organizations in performance excellence management and administers the Malcolm Baldrige National Quality Award. It is a public-private partnership dedicated to improving the performance of U.S. organizations by focusing on helping organizations achieve best-in-class levels of performance, identifying and recognizing role-model organizations and identifying best management practices, principles, and strategies

Department of Energy Alternative Energy Prize: A solar energy challenge to 20 collegiate teams to design, build, and operate solar-powered houses that are cost-effective, energy-efficient, and attractive. The winner of the competition is the team that best blends affordability, consumer appeal, and design excellence with optimal energy production and maximum efficiency.

National Institute of Standards and Technology Manufacturing Extension Partnership Program (MEP): A resource for helping manufacturers compete against low-cost competition. MEP provides companies with services and access to public and private resources that enhance growth, improve productivity, and expand capacity. It uses a national network with thousands of specialists who understand the needs of manufacturers and small businesses.

National Nanotechnology Initiative (NNI): A program established in fiscal year 2001 to coordinate Federal nanotechnology research and development. Provides a vision of the long-term opportunities and benefits of nanotechnology. By serving as a central locus for communication, cooperation, and collaboration for all Federal agencies that wish to participate, the NNI brings together the expertise needed to guide and support the advancement of this broad and complex field.

Chief Technology Officer of the United States (CTO): Created within the Office of Science and Technology Policy by President Barack Obama. The CTO will be using applied technology to help create jobs, reduce the costs of health care and help keep the nation secure. He is also tasked with increasing American's access to broadband.

APPENDIX D – EXPORT CONTROL REFORM PRESS RELEASE

THE WHITE HOUSE

Office of the Press Secretary

For Immediate Release April 20, 2010

Fact Sheet on the President's Export Control Reform Initiative

Earlier today, Secretary of Defense Robert Gates discussed the Administration's interagency review of the U.S. export control system, which calls for fundamental reform of the current system in order to enhance U.S. national security and strengthen our ability to counter threats such as the proliferation of weapons of mass destruction.

President Obama, in August of last year, initiated this comprehensive review to identify possible reforms to the system. Although the United States has one of the most robust export control systems in the world, it is rooted in the Cold War era and should be updated to address the threats we face today and the changing economic and technological landscape.

The assessment was conducted by an interagency task force created at the direction of the President and included all departments and agencies with roles in export controls. The assessment found that the current U.S. export control system does not sufficiently reduce national security risk based on the fact that its structure is overly complicated, contains too many redundancies, and tries to protect too much.

The current system is based on two different control lists administered by two different departments, three different primary licensing agencies, none of whom sees the others licenses, a multitude of enforcement agencies with overlapping and duplicative authorities, and a number of separate information technology systems, none of which are accessible to or easily compatible with the other, or agencies with no IT system at all that issues licenses. The fragmented system, combined with the extensive list of controlled items which resulted in almost 130,000 licenses last year, dilutes our ability to adequately control and protect those key items and technologies that must be protected for our national security. The goal of the reform effort is "to build high walls around a smaller yard" buy focusing our enforcement efforts on our "crown jewels."

The review's overall findings have the full support of the President's senior national security team.

Key Recommendations

The Administration has determined that fundamental reform of the U.S. export control system is needed in each of its four component areas, with transformation to a:

- Single Control List,
- Single Primary Enforcement Coordination Agency,
- Single Information Technology (IT) System, and
- Single Licensing Agency.

Implementation

The Administration will engage with Congress to consult and seek its input on the proposed reforms. To deploy the new system, the Administration has prepared a comprehensive, three-

phase approach and is currently moving forward to make specific reforms which can be initiated immediately and implemented without legislation. The approach will make the necessary changes to the current system to transition it to the revised, enhanced system in Phase III:

Phase I makes significant and immediate improvements to the existing system and establishes the framework necessary to create the new system, including making preparations for any legislative proposals. This phase includes implementing specific reform actions already in process and initiating review of new ones.

- o **Control List –** refine, understand, and harmonize definitions to end jurisdiction confusion between the two lists; establishes new independent control criteria to be used to screen items for control into new tiered control list structure.
- o **Licensing –** implement regulatory-based improvements to streamline licensing processes and standardize policy and processes to increase efficiencies.
- o **Enforcement –** synchronize and de-conflict enforcement by creation of an Enforcement Fusion Center.
- o **IT –** determine enterprise-wide needs and begin the process to reduce confusion by creating a single U.S. Government (USG) point of entry for exporters.

Phase II results in a fundamentally new U.S. export control system based on the current structure later this year. This phase completes deployment of specific Phase I reforms and initiates new actions contingent upon completion of Phase I items. Congressional notification will be required to remove munitions list controls or transfer items from the munitions list to the dual-use list, and additional funding will be required both for enhanced enforcement and the IT infrastructure.

- o **Control List –** restructure the two lists into identical tiered structures, apply criteria, remove unilateral controls as appropriate, and submit proposals multilaterally to add or remove controls.
- o **Licensing –** complete transition to mirrored control list system and fully implement licensing harmonization to allow export authorizations within each control tier to achieve a significant license requirement reduction which is compatible with national security equities.
- o **Enforcement –** expand outreach and compliance.
- o **IT –** transition toward a single electronic licensing system.

Phase III completes the transition to the new U.S. export control system. Legislation would be required for this phase:

- o **Control List –** merge the two lists into a single list, and implement systematic process to keep current.
- o **Licensing –** implement single licensing agency.
- o **Enforcement –** consolidate certain enforcement activities into a Primary Enforcement Coordination Agency.
- o **IT –** implement a single, enterprise-wide IT system (both licensing and enforcement).