



**REPORT TO THE PRESIDENT
CAPTURING A DOMESTIC COMPETITIVE
ADVANTAGE IN ADVANCED MANUFACTURING**

*Report of the Advanced Manufacturing
Partnership Steering Committee*

Annex 4:

Policy Workstream Report

Executive Office of the President

President's Council of Advisors on
Science and Technology

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PREFACE

In June 2011, the President established the Advanced Manufacturing Partnership (AMP), which is led by a Steering Committee that operates within the framework of the President's Council of Advisors on Science and Technology. In July 2012, the AMP Steering Committee delivered its report to PCAST, entitled *Capturing Domestic Competitive Advantage in Advanced Manufacturing*. PCAST adopted this report and submitted it to the President. The Steering Committee's report draws on preliminary reports prepared by several "workstreams." These workstream reports have been made available as on-line annexes to the Steering Committee report.



Report of the Advanced Manufacturing Partnership Steering Committee Annex 4:

Policy Workstream Report

EXECUTIVE SUMMARY

The United States is at risk of losing leadership in manufacturing. This is true not only in low-technology industries and products, but also with respect to our ability to manufacture the high-technology products that are invented and innovated in this country.

We do not believe that it is the role of government to formulate a national industrial policy of direct investment in or subsidies to specific firms. However, we believe strongly that the United States requires a coherent national policy framework oriented toward creating a favorable business climate for manufacturing that spurs investments and fosters partnerships between government, academia, and industry.

The manufacturing sector must have a competitive domestic environment, which includes a robust talent pipeline, physical capital, and intellectual capital. While these capabilities are important to the overall health of the U.S. economy, they are particularly necessary for the advanced manufacturing sector, which faces intense global competition. Every major economic competitor is taking steps to attract investment in advanced manufacturing, recognizing the impacts of that investment on the broader economy.

Given the strong link between innovation and advanced manufacturing, the Partnership has put forward a package of synergistic recommendations to encourage greater U.S.-based innovation, research and development (R&D), and investment in advanced manufacturing.

For the United States to continue to be an attractive location for businesses, it is important to build a policy framework that spurs investments and fosters partnerships between government, academia, and industry. The foundation of that framework is constructed through targeted policies in four areas that have a significant impact on advanced manufacturing:

- Tax policy,
- Smarter regulations,
- Trade policy, and
- Energy policy.

The Advanced Manufacturing Partnership (AMP) Steering Committee (SC) has developed additional specific recommendations in three areas to improve the climate for robust industry/university collaboration in research and commercialization, with the aim of reinvigorating what has been an historic strength of the United States:

- Remove barriers in tax-exempt buildings at universities to enable expanded university-industry collaborations,

- Expand capital resources for emerging advanced manufacturing enterprises, and
- Coordinate and expand existing programs that enable university researchers to interact directly with manufacturers.

CHARGE TO THE WORKSTREAM

The focus of the Policy Workstream is to create a policy environment that supports the overall objective of encouraging U.S.-based innovation, advanced manufacturing (and jobs), and international competitiveness and facilitating, where possible, government, academia, and industry collaboration. The workstream is also responsible for ensuring that the policy environment supports the work products of the other workstreams.

PROCESS FOLLOWED

August/September: Workstream participants drafted a summary paper with objectives, questions, and a timeline as a starting point for reactions and contributions from AMP Steering Committee. This draft was followed by several conference calls. A survey of major U.S. academic researchers engaged in manufacturing policy was also completed.

October/November: The workstream gathered more feedback on policy issues and objectives at the regional AMP Steering Committee meeting at Georgia Tech. Additional specific input was solicited from workstream members. On October 24, 2011, a face-to-face meeting with about 25 participants was held to review everyone's input and to solicit additional suggestions and focus. A final series of conference calls was held with workstream members the week of November 14 to discuss and review the draft interim report.

December/January: The workstream developed specific near-term actionable recommendations to encourage U.S.-based innovations and to improve the climate for university/industry collaboration. A draft document of recommendations was generated for review by the full AMP Steering Committee.

February: The workstream refined the near-term actionable recommendations and finalized this document so it could be included with the final AMP Steering Committee report.

KEY FINDINGS

The United States is at risk of losing leadership in manufacturing. This is true not only in low-technology industries and products, but also with respect to our ability to manufacture the high-technology products that are invented and innovated in this country.

We do not believe that it is the role of government to formulate a national industrial policy of direct investment in or subsidies to specific firms. However, we believe strongly that the United States requires a coherent national policy framework oriented toward creating a manufacturing climate that spurs investments and fosters partnerships between government, academia, and industry.

To attract investment and production, the United States must promote a competitive business environment, which includes a robust talent pipeline, capital, a 21st century

infrastructure, and strong investment in R&D. While these qualities are important to the overall health of the U.S. economy, they are particularly necessary for the advanced manufacturing sector, which faces intense global competition. Every major economic competitor is taking steps to attract investment in advanced manufacturing, recognizing the impacts of that investment on the broader economy.

RECOMMENDATIONS

Given the strong link between innovation and advanced manufacturing, the AMP Steering Committee has put forward a package of synergistic recommendations to encourage greater U.S.-based innovation, R&D, and investment in advanced manufacturing.

For the United States to continue to be an attractive location for businesses, it is important to build a policy framework that spurs investments and fosters partnerships between government, academia, and industry. The foundation of that framework is constructed through targeted policies in four areas that have a significant impact on advanced manufacturing:

- Tax policy,
- Regulatory policy,
- Trade policy, and
- Energy policy.

A final section of recommendations is specific to promoting partnerships between universities, industry, and Federal laboratories and to enhancing industry/university collaboration in advanced manufacturing.

Tax Reform

A key focus of the AMP Steering Committee is on the important linkage between U.S.-based innovation, R&D, and manufacturing. To encourage investment in the United States, we must reform our corporate tax system to create a more attractive environment for business to be able to compete globally. The United States has the highest statutory corporate tax rate—including Federal and State taxes—among the 34 members of the Organization for Economic Co-operation and Development (OECD). This tax rate is an impediment to businesses that seek to invest in our country and for U.S.-headquartered businesses.

Comprehensive U.S. tax reform is particularly important for the advanced manufacturing sector. Manufacturing is a source of direct and indirect high-paying jobs and is the underpinning of the U.S. middle class. Our current tax system discourages domestic capital investment in manufacturing, thereby undercutting the stability of the innovation and jobs engine that produced unparalleled economic prosperity during the last century. The tax system distorts investment by industry and asset type, with manufacturing, construction, and other high-wage industries paying a globally non-competitive statutory tax rate. The result is a decrease in aggregate investment in the sector.

For these reasons, the tax system has to be reformed to address the existing distortions and disincentives for manufacturing in the United States. A more favorable tax climate would serve a two-fold benefit: incentivize increased investment by U.S.-based businesses and

encourage more foreign direct investment in the United States, leading to an increase in investment, innovation, and jobs. Tax reform should also be internationally competitive with other tax systems in order to attract and retain advanced manufacturing and its associated innovation engine.

While there is a need for broad tax reform to make U.S. companies more internationally competitive, our recommendations are more specifically targeted to the promotion of advanced manufacturing in the United States. They add up to an integrated package of proposals that address the mobile nature of capital and intellectual property (IP) and enhance the incentive for retaining and reinvigorating the historical strength of closely connected U.S. research and production capabilities. We believe that additional tax incentives should flow to those entities that engage in all three critical advanced manufacturing roles (U.S.-based innovation, R&D, and manufacturing):

- **Lowering the corporate tax rate to bring it more in line with other advanced economies.** A rate reduction, combined with broadening the tax base, would encourage additional investment in American manufacturing by U.S. corporations and would position the United States as a more attractive region for direct investment by foreign corporations.
- **Recognize the importance of manufacturing through the tax code.** Given global competition and the ripple effect of manufacturing on the economy, any tax reform should encourage investment in manufacturing. This can be achieved through a reduced tax rate for domestic manufacturing activity.
- **Strengthened and permanent R&D tax credits.** Increase the R&D alternative simplified credit to 20 percent and make it permanent.
- **Creating an internationally competitive corporate tax system.** Our tax system must be redesigned in a way that encourages companies to invest in the United States by addressing the current law on foreign earnings of U.S.-based companies. In addition to lowering the overall corporate rate, reform must consider the tax treatment of overseas earnings of U.S.-based corporations, including consideration of a competitive partial exemption system similar to the type adopted recently by the United Kingdom or a minimum tax regime like the one in Japan. Ultimately, comprehensive tax reform must ensure that U.S. companies are competitive when operating abroad and in the United States.

The workstream recognizes that efforts to address long-term U.S. fiscal issues may bring about significant proposals that include a mix of rate reductions. The participants urge that this debate be particularly mindful of the imperative to recognize how this mix of actions may impact the climate for advanced manufacturing. The workstream also cautions against any new measures that could impede an improved climate for U.S.-based production or discourage investment in the United States.

Regulatory Policy

Regulation is an often criticized but vital function carried out by government. Well-conceived, science-based, and effectively implemented regulations are important tools for protecting consumers, workers, and the environment. When done right, regulation provides important societal benefits and can encourage greater competence and confidence in industry. Done excessively or inappropriately, or without unforeseen consequences in mind, regulatory policy can hamper innovation and international competitiveness. We recommend the following:

- **Early engagement.** Collaboration between regulators and the impacted community can drive significant improvements in the quality of the final rules. Robust dialogue with agencies ideally should occur well before the comment period. Improved use of the advanced notice rulemaking process¹ would allow manufacturers to contribute to cost-benefit analyses in a meaningful way that could make compliance more cost effective.
- **Objective cost-benefit analyses.** We recommend that cost-benefit analyses and risk assessments rely on the best available science.

Trade Policy

A fair and open international trading system provides the greatest opportunities for U.S.-based innovative manufacturing and, ultimately, for sustaining current jobs and creating new jobs. The U.S. Government needs to lead on a progressive trade policy, building on recent successes such as passing the U.S.-Colombia, U.S.-Korea, and U.S.-Panama Free Trade Agreements (FTAs). FTAs level the playing field for American exporters by eliminating tariff barriers to market access, reducing non-tariff barriers, and allowing access to dispute settlement systems.

Trade policy is an important consideration for manufacturers choosing to build new facilities, but we must not let our competitors outpace us in the race to negotiate further agreements. The United States must prioritize policies that help ensure access to foreign markets and promote global competitiveness. These policies must include a focus on non-tariff barriers and export control policies. The Trans-Pacific Partnership (TPP) is an example of a high-standard, ground-breaking negotiation that will cover new emerging barriers for cutting-edge technologies, promote regulatory coherence, address competition with state-owned enterprises, and provide a template for economic integration across Asia Pacific.

In balance with trade liberalization, the U.S. Government should focus strongly on enforcing trade rights, particularly those addressing market-distorting subsidies, unfair trade practices, and IP violations to level the playing field for U.S.-based manufacturing.

¹ Advanced rulemaking is intended to solicit comments and information from all segments of the public interested in a particular issue before an agency determines whether a rule (regulation) will be proposed.

As a near-term goal, the U.S. should:

- **Pursue increased market access.** The future key barriers are not tariffs. They are non-tariff barriers—regulatory and standards impediments that represent de facto market barriers. Examples of non-tariff barrier areas are innovation principles, regulatory reform and customs facilitation, forced technology transfer, and IP enforcement/counterfeiting. The Federal Government must strengthen the interagency process to create a consistent agenda on regulatory issues. The U.S. Government should strengthen cooperative, capacity-building initiatives with other key trading partners.
- **Launch new negotiations.** The U.S. Government has actively solicited input from industry on core economic trading partners for new negotiations. A number of regions, such as the Middle East and North Africa, can benefit from near-term capacity-building efforts to lead to eventual full trade liberalization efforts. In the interim, the U.S. Government should prioritize a Trans-Atlantic Partnership (TAP) negotiation, which would leverage the advanced economies of the United States and the European Union (EU) and allow both to address 21st century trade barriers (such as regulation, innovation, etc.) as a model for future multilateral trade liberalization.
- **Reform export controls.** The U.S. Government is making progress in reforming outdated export control regimes—starting with rebuilding the U.S. Munitions List—by harmonizing the export control licensing and administration procedures across all involved agencies and transitioning all involved agencies to a single information technology (IT) platform. The U.S. Administration should accelerate this work and actively incorporate industry input in a modernized export controls regime.

Energy Policy

Energy is a basic building block for today's advanced manufacturing applications. Advanced manufacturing uses innovative technologies to add value to raw energy inputs in order to produce modern materials and solutions, including electronic materials, pharmaceutical breakthroughs, and clean energy alternatives. However, U.S. energy policy must fully account for the impacts of energy costs on manufacturers and the potential to drive investment into new markets and applications as the United States seeks to transition to a sustainable energy future. Therefore, any effort to reinvigorate advanced manufacturing in the United States would not be complete without an examination of energy policy that seeks ample supplies to catalyze economic growth and prosperity. We recommend the following:

- **Focus on energy efficiency and conservation.** Energy efficiency is the most affordable and available way to lower energy costs and reduce carbon emissions and is particularly important to the manufacturing sector. Every dollar saved through energy efficiency efforts can be redeployed to expand business and preserve manufacturing jobs. For example, according to the Brookings Institute, if all eligible buildings in the United States were retrofitted over the next decade, roughly 215,000 direct jobs—127,000 of which are in manufacturing—would be created. We recommend policies that provide incentives for power generators and distributors to undertake cost-effective and

innovative energy efficiency measures and promote tools to assist all manufacturers in implementing energy efficiency measures.

- **Increase and diversify domestic supplies.** American economic growth will continue to rely on hydrocarbon energy (e.g., oil, naphtha, natural gas, ethane, or coal) and will require additional domestic supplies to improve energy security and reduce price volatility. These inputs are critical for the manufacturing process as both fuel and feedstock, serving as the basic building blocks of materials used in 96 percent of all manufactured goods, including products enabling the further development of renewable sources of energy, such as solar panels and wind blades. Onshore, increased supply from unconventional sources, such as natural gas, oil, and natural gas liquids from shale, will be important resources for the United States over the next several decades. The availability of these resources for value-added products must be a policy imperative to ensure economic growth and job creation. Producers and regulators need to work together to ensure that potential reserves can be brought to market in an environmentally acceptable manner at an affordable cost. Natural gas at stable, competitive prices will continue to incentivize American manufacturers to invest and create jobs in the United States. Today, industrial uses of natural gas as a feedstock are driving multibillion-dollar investments. In turn, multiplier effects from these investments will be felt across the economy, including other U.S. manufacturers less dependent on hydrocarbon feedstocks.
- **Speed development of renewable sources of energy.** Government, industry, and academia have roles in accelerating the development of effective and more sustainable alternative energy sources, including renewable sources. As global demand for clean sources of energy grows, the United States has the opportunity to play a key role in the manufacturing of advanced technologies, such as energy storage, photovoltaics, and wind power. Since 2008, the United States has nearly doubled renewable energy generation. In 2011, U.S. solar installations grew 109 percent, with the overall solar market surpassing \$8.4 billion. However, renewables remain a small fraction of U.S. energy use. Policies that primarily focus on driving down costs are needed. Lower costs, in turn, will help drive increased demand. We recommend the continued extension of financial incentives for public/private research into promising technologies and storage devices. Further, any incentives that spur the early adoption of innovative technologies, such as low- and no-carbon sources originating from coal, solar, natural gas, wind, tidal, and geothermal energy, must be targeted at technologies that demonstrate a path toward economically viability.
- **Transition to a low-carbon economy.** To create a sustainable energy future over the long term, we believe that the United States needs to shift to a low-carbon economy. The right mix of fundamental research, innovation, and aggressive implementation is needed to achieve this transition and continued economic growth. The development and implementation of a broad portfolio of technologies are essential for this transition. The United States has the technical capacity to accelerate development of sustainable energy options, but large-scale commercialization of new capital-intensive

manufacturing solutions will require increased public/private partnership. We recommend a targeted approach to promote aggressive basic research and development, with accelerated demonstration and deployment of clean energy and new-generation energy-efficient technologies. Government policy can help most in specific situations, such as when the costs and market development risks of critical technology exceed the commercial capabilities of individual companies, where the regulatory or liability risks are beyond the capacity of the private sector, and when investment timelines exceed the private sector's capabilities.

Empowering Enhanced Industry/University Collaboration in Advanced Manufacturing

One of the most significant hurdles to a robust manufacturing sector is the disconnect between U.S. manufacturers and the innovation dynamics that U.S. universities have developed following the Bayh-Dole Act. In order to overcome this, there is a need to address the fundamental barriers that impede small- and medium-sized manufacturing firms from engaging with university research and to ensure that an adequate technical talent base is developed to support innovation in advanced manufacturing. This approach includes exploiting the opportunities for synergy between initiatives designed to improve the overall climate for U.S. manufacturing and the environment for industry/university collaboration.

We have examined opportunities to accelerate the development of effective research and licensing agreements and have explored how agency research programs can be enhanced to contribute to this reinvigoration of industry/university collaboration.

Revenue Procedure 2007-47

The current Revenue Procedure 2007-47 restricts the "private business use" activities undertaken in universities buildings financed with tax-exempt bonds. Under these provisions, particularly sections 6.02 and 6.03, industry-sponsored research is considered a private business use unless the university obtains a fair market value for the outcomes of the research. Specifically, these provisions state that fair market value must be determined at the time the license or resulting technology is available for use.

Exceptions to these private use restrictions include licenses awarded to consortia of companies and non-exclusive licenses that provide similar use rights to all users. Should private uses exceed the limit (10 percent for public universities and 5 percent for private universities—though when bond transaction costs are included, the real limits are 8 percent and 3 percent), the tax-free status of the bonds may be revoked. Private-use activities also covered under the total space cap would include bookstores and other retail activities, such as coffee shops and restaurants. It also includes space allocated by universities to early-stage spin-out companies to undertake early research activities in labs of buildings with tax-exempt bond financing and space allocated for visiting industrial researchers.

These provisions have clearly had the effect of incentivizing universities to adopt policies of industrial collaboration that preclude exclusive licenses or stipulate that commercial licensing terms must be negotiated at the conclusion of the research. More specifically, these

provisions directly limit the ability of universities to enter into research agreements with companies that include upfront provisions for exclusive licenses to the resulting technologies.

These tax provisions and restrictions are unique to U.S. universities and create a competitive disadvantage at a time when research is increasingly a global enterprise and when a reinvigoration of industry/university interaction could contribute to securing leadership and domestic production in advanced manufacturing technologies and contribute to the robust insourcing of manufacturing. The restrictions directly conflict with the following imperatives that shape competitiveness in advanced manufacturing:

- 2007-47 adds friction and uncertainty to industry/university collaborations at a time when hyper competition rewards speed and flexibility. The inability to have certainty over commercial rights negotiations until after the completion of the research is a clear disincentive for U.S. manufacturers to pursue more strategic relationships with universities.
- 2007-47 reflects a linear view of the research continuum at a time when discovery often involves more iterative processes of interaction between fundamental and developmental advances. In essence, 2007-47 envisions a clear departure point between basic and applied research while emerging applications in highly interdisciplinary areas often involve a more integrated mix of basic and applied development.
- 2007-47 unintentionally creates the potential for competition between university commitments to support and nurture spinouts and industrial research agreements. Strategies for incubating early stage startups in university labs, for example, compete directly with industry-sponsored research agreements that have upfront licensing terms for space under the cap limit. This competition is clearly not in the public interest and comes at a time when the greater imperative is to foster synergy between the university start-up engine and the scale-up strengths of U.S. manufacturers.
- 2007-47 creates a barrier in allowing visiting industrial and Federal Government researchers to be embedded on university campuses to promote active collaboration.
- The Internal Revenue Service (IRS) recently completed a detailed audit on the cap allocation practices of 30 universities to guide further rulemaking—suggesting that the trend may be toward greater restrictions.

From the Morrill Act to the rapid development of collaborations by the Office of Scientific Research and Development (OSRD), a long history of policy initiatives have enabled American industry and universities to collaborate effectively in the face of changing circumstances. The proposal to create a waiver from or revise 2007-47, while not as grand in scale as the examples cited previously, is nonetheless designed to make a tangible impact on the day-to-day workings of research collaboration and create the context for more expedient partnership development capable of accelerating commercialization.

The proposal is designed to remove policy barriers and, more specifically, the policy “fog” that currently surrounds the development of collaborations, creating a context for more

transparent strategies and speedier development. A waiver from 2007-47 will not create uniform IP policies across all U.S. universities. The diversity of approaches—reflecting the variety of missions and focus that has been an historic strength—will continue to exist.

A waiver from 2007-47 does not create a new bureaucratic process. It leverages an existing one. The provisions for Form 990 submissions requiring the existence of a space allocation plan and monitoring capacity establish a compliance burden on universities that the waiver uses to reduce friction in the partnership process.

The proposal seeks to capture a full and robust vision of collaboration that extends from sponsored research to greater synergy between industry engagements and university start-up activities. Finally, the proposal levels the international industry/university research playing field.

- Establish a waiver from Revenue Procedure 2007-47 to enable expanded university/industry collaborations. Enable universities to apply for a waiver from Revenue Procedure 2007-47 restrictions on private use activities in buildings constructed with tax-exempt bonds for the specific purposes only of expanding industrial R&D collaborations. Universities would be eligible to apply for a waiver from the limits on private business use restrictions outlined in provision 2007-47 for specific industrial R&D collaborations only. This application would be developed under existing requirements for each university to have a formal plan and management strategy for monitoring the allocation of all private business use space under the limits that are mandated as part of the annual preparation of Form 990 and would be submitted with a copy to the Advanced Manufacturing National Program Office (NPO). Implementation should include a White-House-facilitated review by the Department of Treasury and the IRS Office of the Associate Chief Counsel. A model waiver request should be developed and should include the following:
 - An outline of specific strategies for industry partnerships for R&D. These strategies should include agreements containing exclusive rights provisions negotiated as part of the sponsored research and/or partnerships with industry to accelerate new business development that includes but is not limited to business-sponsored incubators for early stage startups, including university spinouts and joint venture companies and/or space allocations for fostering visiting industry and government scientist programs and/or the allocation of university labs and/or specialized equipment for access by small- and medium-sized industrial firms.
 - A clearly outlined strategy for developing and implementing the partnerships, including the development of standard licensing agreements for industry-sponsored research and faculty spinouts and demonstrated provisions for the ready adoption of industry master agreements.
 - A clearly outlined plan for engagement with industry in the development of partnerships to be covered under the waiver plan.
 - Clear evidence that the waiver is not designed to simply augment expansion of non-industry development partnerships and activities in tax-exempt bond space.

Capital Resources for Emerging Advanced Manufacturing Enterprises

A wide-range of issues relate to U.S. manufacturing's access to capital; however, in keeping with the AMP Steering Committee's focus on capturing domestic competitive advantage in newly emerging advanced manufacturing technologies, this outline seeks to highlight potential actions in three specific points on the development continuum. The first point in the funding continuum that these recommendations seek to address is the gap between the conclusion of basic research and early stage funding—the pre-seed funding necessary to develop prototypes and early stage market exploration and validation tools. The second point in the funding continuum that these recommendations seek to address is the funds needed for early stage scaling up of production to support activities (e.g., beta unit development) that are often required before large-scale financing can be secured from traditional sources. One critical opportunity in this regard is to identify a means of fostering greater synergy among university startups and larger manufacturing firms to take advantage of the scale-up capabilities that these firms bring to bear. The third point in the funding continuum that these recommendations seek to address are some concepts put forward to expand available funding to move from early stage scale-up to pilot plant development. The specific recommendations that follow are made for consideration.

Increase the Pipeline of Start-Ups in Advanced Manufacturing

Building upon a proposal developed by the nation's major university presidents for the National Advisory Council on Innovation and Entrepreneurship (NACIE), a recommendation is made to create a Phase 0 Small Business Innovation Research (SBIR) program for major research areas in advanced manufacturing. This program would provide support for the critical pre-early stage funding activities associated with testing the commercial potential of new technologies, including early prototype development and market development.

States such as Florida and Nebraska have worked with their universities to develop Phase 0 programs. Often these programs focus on helping already established start-ups prepare for formal SBIR applications. In addition to this focus, an advanced manufacturing Phase 0 program would focus on helping companies at the formation stage develop beta test results and customer relationships. In addition, greater attention to comply with Executive Order (EO 13329) issued by President Bush in 2004, requiring SBIR and Small Business Technology Transfer (STTR) programs to give high priority to manufacturing-related R&D projects would contribute to a more vibrant base of support for manufacturing related start-ups.

Expand the Resources Available for Early Stage Growth and Accelerate Start Up Interaction with Major Manufacturers

Some models designed to build upon innovative public/private partnerships have created stronger support to enhance the growth of early stage companies emerging from Federal research funding. For example, the National Science Foundation (NSF) created a 501(c)3 not-for-profit corporation (Innovation Accelerator) to expand resources to its SBIR award winners. Thus, far Innovation Accelerator has helped to establish a regional seed fund for NSF SBIR firms and has provided mentoring assistance and aid in leveraging \$200 million in investment for these firms. The recommendation is to expand the Innovation Accelerator program to support

start-ups emerging from Federal advanced manufacturing research programs. Support from Innovation Accelerator could include expanded mentoring initiatives, efforts to mobilize corporate partners interested in supporting beta testing of products, and/or the creation of a seed fund for advanced manufacturing start-ups.

By far, the strongest resource to nurture the growth of early stage advanced manufacturing companies is to increase the synergy between these firms and established U.S. manufacturers. This kind of start-up/established firm interaction is common among leading IT companies and in the life sciences but is less common in traditional manufacturing areas. The core of these interactions often involves activities that are not directly related to financing and are frequently vital pre-conditions to early stage and pilot plant development. These activities include concept validation that draws upon the broad market and production operations of leading manufacturers, use of specialized facilities, business and production mentoring, and early beta customer partnerships. These interactions can also lead to investment relationships from venture operations of major companies. In the ongoing evaluation of policies for advanced manufacturing, future policy reviews should also explore the tax treatment of investments by leading manufacturing firms in start-ups in the context of overall tax competitiveness improvements.

A focus on creating a national network to foster stronger start-up interactions with leading manufacturers would be a key element of the expanded mission of Innovation Accelerator. This network would complement and aid the efforts of individual universities to integrate a manufacturing focus into innovation ecosystem programs to create and support start-ups.

Clear the Pathway from Start Up to Pilot-Scale Production: Align to Full-Scale Market Development

One area often cited by technology based start-ups as a source of competitive disadvantage is the direct funding that many international competitors make available for pilot plant and early stage tool development and other fundamental building blocks needed to secure the financing for full-scale production. While the United States does not have a direct counterpart to these programs, some very successful models of strategic procurement initiatives directly support the growth of production capabilities.

The most effective U.S. counterpart to the “ramp-up” funding international competitors provide may be the Defense Production Act Title III funding. The Title III program is intended to provide the Department of Defense (DOD) “a powerful tool to ensure the timely creation and availability of domestic production capabilities for technologies that have the potential for wide-ranging impact on the operational capabilities and technological superiority of U.S. defense systems.” In recent years, investments under Title III have included projects in automated composites production, thermal battery industrial infrastructure, and biofuels production. Examining opportunities for advanced production procurement set-asides in other areas of Federal operations could yield a similar roster of diverse manufacturing-related applications that could benefit from a competitive program that supports early market demand and helps establish a production supply chain.

The key to the effectiveness of this approach is the ability to foster close interaction between acquisition and procurement operations and research initiatives in the early stages of technology development. A recommendation is made to create a formal collaboration between the Advanced Manufacturing NPO and DOD Title III and other relevant Federal procurement programs to identify opportunities for targeted procurement set-aside competitions that can create pathways to market growth beyond early stage funding and to help ensure that advanced manufacturing breakthrough technologies are integrated into a U.S. supply chain.

Keep Our Start-Ups Making It at Home: Strategies for Building Manufacturing Support Activities into University Innovation Ecosystems

The last 30 years has witnessed a dramatic transformation in university technology transfer operations and specifically in the emergence of comprehensive university infrastructures or ecosystems to encourage, support, and accelerate the development of spin-out companies. The emergence of these start-up ecosystems is a vital component of the competitive advantage that U.S. research universities provide to the American economy.

In its summary of technology transfer activity for Fiscal Year (FY) 2010, which was released in July 2011, the Association of University Technology Managers (AUTM) reported the following key indicators of this vitality for the 183 U.S. universities that reported results:

- 651 startup companies formed, 498 of which had their primary place of business in the licensing institution's home state—a more than 10 percent increase in start-up activity over the previous year,
- 657 new commercial products created, and
- 3,657 startups still operating as of the end of FY 2010.

The core components of this start-up engine are an extensive web of programming and support functions that universities have developed to increase the rate of new business formation by faculty and students. Among the activities that make up university innovation ecosystems are student and faculty entrepreneurship training programs, mentoring programs, entrepreneur-in-residence programs to link faculty to business expertise, pre-seed and seed funds, venture capital attraction, and incubator and often extensive partnerships with regional economic development organizations to provide additional resources for early stage growth.

The emergence of these comprehensive innovation ecosystems over the last 30 years has left U.S. universities without rivals in their ability to transform research into new business. However, these ecosystems have tended to be less structured in creating pipelines to domestic manufacturing opportunities and in mobilizing the resources and networks needed to connect start-ups to U.S. production.

Building a strong connection between university start-ups and the U.S. manufacturers and suppliers can make a vital contribution to ensuring future leadership in advanced manufacturing. Moreover, the development of a manufacturing focus in university innovation ecosystems offers additional opportunities for strengthening partnerships with U.S. manufacturers that, as noted previously, have vital resources to contribute in terms of capabilities to help scale up production.

The following actions could make a vital contribution to building a manufacturing focus into the university start-up support environment:

- **Keep score.** Incorporate manufacturing-related outcomes into university technology transfer benchmarks. A critical first step to reinforce the importance of building stronger linkages to manufacturing resources is to begin measuring and highlighting university success in capturing domestic production from technology transfer activities. Incorporating into annual AUTM reports a manufacturing impact component that reflects domestic production captured from start-ups and licensing activity would place manufacturing front and center in university technology transfer strategy development. Including these measures in the annual AUTM survey would also help stimulate a vibrant exchange on best practices and would encourage greater focus on manufacturing in regional economic development partnerships and among universities and manufacturers in the development of sponsored research partnerships.
- **Build stronger linkages between manufacturing support resources and university innovation ecosystems.** In addition to developing new measures to capture the success of universities in realizing the domestic production potential emerging from start-ups, a clear opportunity exists to identify some very specific activities to integrate a manufacturing focus into university innovation ecosystems. A first step in advancing these connections is to expand the work of the nation's Manufacturing Extension Partnerships (MEPs) to create direct supply-chain development, prototyping, and early stage engineering services for university start-ups. Several pilot programs have been launched by individual MEPs and work has begun on creating a national network to support the identification of potential suppliers for start-ups. These initial steps should be expanded, with the objective of creating the types of embedded connections to university technology transfer operations that early stage investment and incubation programs have fostered.

One potential area of focus of these expanded MEP connections would be to help ensure that three-dimensional (3D) production design and other next-generation "make" technologies are standard resources for early stage spin-out entrepreneurs. The specific objective is to ensure that every MEP has designed and implemented a formal start-up support strategy in collaboration with universities in their region. These strategies would formalize specific approaches to indicate how the MEPs and universities would work together to bring a manufacturing business plan development to the earliest phase of start-up creation.

Other partners can augment the role of MEPs. Organized labor brings unique resources for helping identify domestic production opportunities, and, as highlighted several times in this discussion, the scale-up strengths of leading manufacturers represent a unique resource for opening pathways to domestic production for university start-ups. Recognizing U.S. manufacturers as start-up support resources and as research partners would help reshape innovation ecosystems and add new dimensions to the historic relationship between industry and universities.

- **Implementation.** To begin speedy implementation of this recommendation, universities should direct their technology transfer managers to work with the AUTM’s leadership to help develop appropriate and effective measures of impact on domestic manufacturing. In developing these measures, the universities’ AUTM representatives can also craft a strategy to launch measures that can complement the goal of elevating attention to manufacturing, which pervades a number of the AMP Steering Committee recommendations.

To begin ensuring that specific manufacturing development services are standard components of all university innovation ecosystems, universities can work with the Advanced Manufacturing NPO to convene a meeting of MEPs and university technology transfer representatives. The purpose of this meeting would be to ensure broad-based awareness of existing pilot programs and supplier network development. The session could also lead to the development of a template for MEP/university collaboration strategies and feature best practice exchanges on strategies for engaging manufacturers and labor organizations as partners to support domestic production development.

Establish a “Make for America” Initiative

Create a coordinated inter-agency initiative under the direction of the Advanced Manufacturing NPO to expand existing programs that enable students, faculty, and post-doctoral researchers to interact directly with manufacturers and to establish a 501(c)3 organization to foster public/ private support for this expansion.

Both the Policy and the Education and Workforce Development Workstreams identified in their interim reports and recommendations the critical need to increase engagement between students, faculty, and post-graduate researchers and manufacturers, which this initiative seeks to integrate. Expanding this engagement provides underlying support to a host of strategic objectives. More robust interaction in the form of visiting programs can contribute to changing the image of manufacturing, to encouraging a broader recognition of the national imperative for U.S. leadership in advanced manufacturing, to increasing interest in formal curricula and degree programs, and significantly and rapidly to augmenting the ability of research universities to contribute to small manufacturing firms. Moreover, since major research engagements often begin with a visit or a conversation, expanding faculty and student interaction with companies can be a vital stimulant to increasing the pipeline of collaborations that other policy recommendations are designed to enhance.

In addition, a coordinated and enhanced initiative can directly complement related proposals—such as the Jobs Council recommendation for “community grand challenges” to improve the local environment for manufacturing firms. More pointedly, it is simply time to involve manufacturers in the kind of dynamic, often informal engagement that is the hallmark of interactions between universities and Internet and IT firms.

Effective Federal Government efforts are in place to build upon programs already in existence—most notably GOALI, the NSF-directed Grant Opportunities for Academic Liaison with Industry. However, these efforts are spread across agencies with little coordination, which restricts the overall ability to convey real engagement and build excitement regarding

manufacturing as a focus for research, education, and a career. We propose to create an inter-agency umbrella for energizing these efforts and to connect them seamlessly to private-sector-led initiatives, such as the Jobs Council initiative to spur the education of 100,000 engineers. Building upon models used in other policy initiatives, such as the efforts to better attract and support NSF SBIR recipients and to nurture the growth of education technology start-ups, this proposal calls for linking a clear inter-agency leadership directive with the formation of a not-for-profit corporation that can nimbly collaborate with private sector, foundation, and state and local government partners.

The Advanced Manufacturing NPO will be designated as the lead for providing inter-agency coordination of programs to facilitate university student, faculty, and post-doctoral engagement with manufacturing firms. In this role, the NPO will

- Establish a clear and compelling national numeric goal for a mobilizing and obtaining expanded internships and fellowships with companies that focus on advanced manufacturing;
- Develop a definition of the elements that would constitute a “Make for America” internship in order to allow enable existing programs to become affiliated and engaged;
- Develop alternative models for manufacturing internships and fellowships;
- Identify opportunities for synergy among agency program operations;
- Coordinate and promote internships and fellowships associated with manufacturing innovation institutes and create an umbrella Make for America marketing and recruitment strategy that elevates awareness and excitement for such programs;
- Make recommendations on long-term strategies for developing broad and strategic internship and fellowship programs that engage a diverse set of manufacturing sectors, regions of the nation, types of universities, majors of students and expertise of faculty; and
- Identify opportunities for enhanced internship and fellowship initiatives to strategically complement national technology development, commercialization, and small manufacturer competitiveness objectives. For example, create regional manufacturing “boot camps” for interns and fellows to provide an enhanced educational and networking experience.

Under the direction of the Advanced Manufacturing NPO, key steps include completing a detailed assessment of existing programs, exploring the potential for inter-agency coordination, engaging private sector and university partners building off of the AMP, investigating the value of an umbrella branding effort for elevating the programs, expanding interest and attracting additional resources, and examining the direct value of creating a not for profit corporation.

SUPPORTING MATERIALS

Literature Review

Since the spring of 2011, a number of excellent high-level reports have been prepared through a collaborative process involving government, industry, academia, and others whose recommendations are relevant and highly useful here. The following is a brief summary of noteworthy comments and highlights that directly relate to the nexus of U.S.-based innovation, R&D, and manufacturing.

- **President’s Jobs Council.** While claiming that there is no “silver bullet,” the council focused on regulatory reform and pushed for job-rich projects in infrastructure and energy, the promotion of entrepreneurial high-growth (jobs) firms, investments designed to increase U.S. jobs, a simplified regulatory review, and talent development. Their report also touched on increasing travel to the United States and streamlining inward investment and investor immigration. Improving the medical device approval process was also highlighted.
- **President’s Council of Advisors on Science and Technology (PCAST).** This council focused on taxes and innovation. The council called for investment in shared infrastructure facilities with universities, development of advanced manufacturing processes, and partnerships with industry/academia in broadly applicable future technologies, such as nano-manufacturing, IT, and advanced materials. The three compelling reasons cited for this investment in the PCAST support were (1) jobs, (2) innovation, and (3) security.
- **Commerce Secretary’s Manufacturing Council.** This council’s top recommendations were in the areas of tax reform, regulatory reform, and innovation and R&D. Specifically, they sought a 25 percent or lower tax rate, a territorial tax, and a permanent R&D tax credit. They also recommended external regulatory collaboration, benchmarking and streamlined regulations, and compliance. Regarding innovation, they pushed for increased investment in basic and applied technologies.
- **President’s Export Council (PEC).** This council has proposed a number of detailed letters of recommendation focusing on trade (FTAs, Russia’s accession to the World Trade Organization (WTO), and the TPP/21st century trade model) and on infrastructure development (investment prioritized by export value), work-force readiness, visa reform, and progress on export control reform. The PEC has gone further to develop a measurement device (stop/light chart) to track progress on the PEC’s recommendations.