



The Obama Administration's Proposal to Establish a National Network for Manufacturing Innovation

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Summary

Manufacturing plays an important role in the nation's economy, employment, and national defense. Accordingly, Congress has maintained a strong interest in the health of the U.S. manufacturing sector. Some analysts have expressed concerns about a decades-long decline in manufacturing employment punctuated by a steep drop from 2001-2010, as well as about the offshore outsourcing of production and related functions, such as research and development, by U.S. manufacturers. Others see the U.S. manufacturing sector as vibrant and healthy as evidenced by growth in output and productivity.

The Obama Administration has undertaken a number of initiatives intended to support U.S. manufacturing, including establishment of the Advanced Manufacturing Partnership, Advanced Manufacturing National Program Office (AMNPO), Advanced Manufacturing Technology Consortia program, National Robotics Initiative, and Materials Genome Initiative.

In his FY2013 budget, President Obama proposed the creation of a National Network for Manufacturing Innovation (NNMI) to help accelerate innovation by investing in industrially relevant manufacturing technologies with broad applications, and to support manufacturing technology commercialization by bridging the gap between the laboratory and the market.

The NNMI proposal calls for the establishment of up to 15 Institutes for Manufacturing Innovation (IMI) funded through a one-time infusion of \$1 billion in mandatory funding to the Department of Commerce's National Institute for Standards and Technology (NIST) and carried out over a period of 10 years. Each IMI would be comprised of stakeholders from industry (including large companies and small- and medium-sized manufacturing enterprises), academia, federal agencies, and state government entities. According to the proposal, each IMI is to be competitively selected, serve as a regional hub for manufacturing innovation (as well as part of the national network), and have a unique focus area (e.g., an advanced material, manufacturing process, enabling technology, or industry sector). The NNMI would be managed collaboratively by NIST, the Department of Defense, Department of Energy, National Science Foundation, and other agencies.

An Administration official has testified that the NNMI program has not yet begun and that the establishment of the NNMI will require congressional authorization and funding. No legislation has been introduced to establish the NNMI. However, the President announced his intention to establish a pilot institute using current year funding; in this regard, the Department of Defense issued a Broad Agency Announcement (BAA) in May 2012 to award up to \$30 million for an institute focused on additive manufacturing. The pilot is described as "the first institute to be launched within the National Network for Manufacturing Innovation" and "a proof-of-concept for the potential subsequent institutes." The BAA limits the types of organizations that can compete for the award of this institute to universities and non-profit organizations. Universities must incorporate in their proposals a partnership with a cluster of manufacturing firms and associated institutes; non-profit industry consortia must incorporate a partnership with universities for applied research.

The AMNPO has published a request for information seeking public comment on various aspects of the NNMI to aid in the development of the institutes and the network. Topics included in the RFI include technology focus areas, structure, governance, sustainability, and education and workforce development.

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Overview

Congress maintains a strong interest in the health of the U.S. manufacturing sector due to its central roles in the U.S. economy and national defense. With respect to the economy, manufacturing accounts for about 12% of the nation's gross domestic product (GDP) and nearly two-thirds of U.S. exports. Manufacturing enterprises directly employ nearly 12 million U.S. workers and indirectly support millions of additional jobs in other industries (e.g., banking, shipping, insurance). Manufacturers also fund about two-thirds of the nation's industrial research and development (R&D), providing a foundation for technological innovation and continued U.S. technological leadership. In addition, manufacturing workers earn higher annual pay and benefits (an average of \$77,186 in 2010) than their non-manufacturing counterparts (an average of \$56,436 annually).¹ With respect to national defense, the United States depends heavily on its manufacturing base to produce the weapons, aircraft, vehicles, ships, and other equipment needed to protect the nation.

Analysts hold divergent views of the health of U.S. manufacturing. Some see the U.S. manufacturing sector as vibrant and healthy. Those holding this view tend to point to, among other things, the sector's strong growth in output and productivity, as well as the United States' world-leading share of global manufacturing output. In addition, some analysts note that between January 2010 and June 2012 manufacturing employment added about half a million jobs, growing to nearly 12.0 million.^{2,3}

Other analysts believe that the U.S. manufacturing sector is at risk. Among the expressed concerns of those holding this view, include:

- a “hollowing-out” of U.S. manufacturing resulting from the decision of many U.S. manufacturers to offshore production activities and other corporate functions (e.g., research and development, accounting, information technology, tax planning, legal research);⁴
- focused efforts by other nations to grow the size, diversity, and technological prowess of their manufacturing capabilities, and to attract manufacturing operations of U.S.-headquartered multinational companies using a variety of policy tools (e.g., tax holidays, worker training incentives, market access, access to rare earth minerals); and
- a decades-long decline in U.S. manufacturing employment, punctuated by a steeper drop from 2001 to 2010. In January 2010, U.S. manufacturing employment fell to its lowest level (11.5 million) since March 1941, down more than 41% from its peak of 19.6 million in June 1979.⁵

¹ National Association of Manufacturers website, *Facts About Manufacturing*, <http://www.nam.org/Statistics-And-Data/Facts-About-Manufacturing/Landing.aspx>

² For more information, see CRS Report R41898, *Job Creation in the Manufacturing Revival*, by Marc Levinson.

³ Bureau of Labor Statistics, U.S. Department of Labor, Current Employment Statistics survey database, data for manufacturing employment, all employees, seasonally-adjusted, <http://data.bls.gov/cgi-bin/dsrv>.

⁴ For more information, see CRS Report R41712, *“Hollowing Out” in U.S. Manufacturing: Analysis and Issues for Congress*, by Marc Levinson.

⁵ See footnote 2.

The recent recession, relatively slow pace of recovery, and concerns about the prospects for double-dip recession⁶ have contributed to increased concerns about the health of U.S. manufacturing. Some stakeholders and policymakers advocate for macro-level changes to improve the business environment, including reducing tax and regulatory burdens on manufacturers and reforming the nation's tort laws.

Others—including President Obama—support more direct and focused efforts funded by the federal government. In particular, President Obama has undertaken and proposed a variety of initiatives (e.g., the Advanced Manufacturing Partnership, the National Robotics Initiative, Materials Genome Initiative) to help address concerns about U.S. manufacturing. One of the President's key proposals to help U.S. manufacturers is the establishment of a National Network for Manufacturing Innovation.

In February 2012, the Obama Administration released *A National Strategic Plan for Advanced Manufacturing*, a report by the President's National Science and Technology Council, putting forth a strategy to guide Federal advanced manufacturing R&D investments. The report notes

The acceleration of innovation for advanced manufacturing requires bridging a number of gaps in the present U.S. innovation system, particularly the gap between R&D activities and the deployment of technological innovations in domestic production of goods.⁷

The proposed NNMI seeks, in part, to bridge the innovation gap asserted in this report.

Administration Proposal

President Obama proposed the establishment of a National Network for Manufacturing Innovation (NNMI) in his FY2013 budget, and formally introduced the concept on March 9, 2012, in a speech at the Rolls-Royce Crosspointe jet engine disc manufacturing facility in Prince George County, VA.

According to the proposal, the purpose of the NNMI is to bring together industry, universities and community colleges, federal agencies, and regional and state organizations

to accelerate innovation by investing in industrially relevant manufacturing technologies with broad applications, and to support manufacturing technology commercialization by bridging the gap between the laboratory and the market.⁸

In particular, the NNMI seeks to “advance technological innovation at a pace much faster than any one company could on its own,”⁹ integrate innovation resources, improve the competitiveness of U.S. manufacturing, and encourage investment in the United States.¹⁰

⁶ For additional information about the recession and the subsequent pace of economic growth, see CRS Report R41444, *Double-Dip Recession: Previous Experience and Current Prospect*, by Craig K. Elwell.

⁷ National Science and Technology Council, Executive Office of the President, The White House, *A National Strategic Plan for Advanced Manufacturing*, February 2012, p. 1, http://www.whitehouse.gov/sites/default/files/microsites/ostp/iam_advancedmanufacturing_strategicplan_2012.pdf.

⁸ National Network for Manufacturing Innovation, <http://www.manufacturing.gov/amp/nnmi.html>.

⁹ Testimony of Patrick D. Gallagher, Under Secretary for Standards and Technology, U.S. Department of Commerce, before the U.S. Congress, House Committee on Science, Space, and Technology, Subcommittee on Technology and (continued...)

The NNMI would consist of

a network of institutes where researchers, companies, and entrepreneurs can come together to develop new manufacturing technologies with broad applications. Each institute would have a unique technology focus. These institutes will help support an ecosystem of manufacturing activity in local areas. The Manufacturing Innovation Institutes would support manufacturing technology commercialization by helping to bridge the gap from the laboratory to the market and address core gaps in scaling manufacturing process technologies.¹¹

The NNMI would be managed collaboratively by the Department of Commerce's (DOC) National Institute of Standards and Technology (NIST), the Department of Defense (DOD), Department of Energy (DOE), National Science Foundation (NSF), and other agencies.¹²

Funding

As proposed in the President's FY2013 budget, NIST would receive a one-time infusion of \$1 billion in mandatory funding in FY2013 to be spent over 10 years (FY2013-FY2022, see **Table 1**).¹³ Federal funds would be used to help establish and support up to 15 Institutes for Manufacturing Innovation (IMIs, which collectively would form the NNMI) on a cost-shared basis with industrial, academic, and state and local organization partners. Each IMI is expected to become financially sustainable within seven years.¹⁴ Funding for the program would be front-loaded with \$206 million in spending projected for FY2013, and a total of \$839 million in spending in the first five years.¹⁵

(...continued)

Innovation, *Assembling the Facts: Examining the Proposed National Network for Manufacturing Innovation*, 112th Cong., 2nd sess., May 31, 2012.

¹⁰ National Institute of Standards and Technology, "Request for Information on Proposed New Program: National Network for Manufacturing Innovation (NNMI)," *Federal Register*, Vol. 77, No. 87, pp. 26509-26511, May 4, 2012, <https://federalregister.gov/a/2012-10809>.

¹¹ U.S. Department of Commerce, FY2013 Budget in Brief, February 2012, p. 123, http://www.osec.doc.gov/bmi/budget/FY13BIB/fy2013bib_final.pdf.

¹² *Federal Register*, Vol. 77, No. 87, pp. 26509-26511, May 4, 2012, <https://federalregister.gov/a/2012-10809>.

¹³ In a telephone conversation on July 6, 2012, NIST indicated that the funding horizon may be reduced to seven years. In addition, the hearing charter for the House Committee on Science, Space, and Technology, Subcommittee on Technology and Innovation's hearing on *Assembling the Facts: Examining the Proposed National Network for Manufacturing Innovation*, May 31, 2012, stated that federal support for the institutes would span a period of five to seven years.

¹⁴ Testimony of Patrick D. Gallagher, Under Secretary for Standards and Technology, U.S. Department of Commerce, before the U.S. Congress. See footnote 2.

¹⁵ Office of Management and Budget, Executive Office of the President, *Fiscal Year 2013 Budget of the U.S. Government*, February 2012, Table S-9, p. 217.

Table 1. Proposed Schedule of NNMI Expenditures

in millions of dollars

FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
\$ 206	\$ 131	\$ 174	\$ 189	\$ 139	\$ 69	\$ 44	\$ 28	\$ 16	\$ 4

Source: Office of Management and Budget, Executive Office of the President, Fiscal Year 2013 Budget of the U.S. Government, February 2012, Table S-9, p. 217.

Structure and Guiding Principles

The National Network for Manufacturing Innovation would be composed of competitively selected, independently managed Institutes for Manufacturing Innovation. Each IMI would have a specific focus area and serve as a regional innovation hub. Focus areas could include an advanced material (e.g., carbon nanotubes), manufacturing process (e.g., additive manufacturing), enabling technology (nanotechnology), or industry sector (e.g., medical devices).

The institutes would bring together large companies, small and medium-sized enterprises, academia, federal agencies, and state governments to accelerate innovation through co-investment in industrially relevant manufacturing technologies with broad applications. The institutes would be focused on helping to bridge the gap between basic research and product development, provide companies with access to cutting edge capabilities and equipment, and an environment for educating students and training workers in advanced manufacturing skills. The institutes would seek to reduce the costs and risks of commercializing new technologies and to address relevant manufacturing challenges on a production-level scale.¹⁶ While the IMIs are intended to serve as regional hubs for manufacturing innovation in specific focus areas, collectively the institutes would also function as a network for the sharing of knowledge and best practices.

Patrick Gallagher, Under Secretary of Commerce for Standards and Technology/Director of NIST, testifying before the House Committee on Science, Space, and Technology, Subcommittee on Technology and Innovation, articulated a number of key principles that would guide the governance and work of the NNMI:

- An interagency program management team would define the NNMI's and IMIs' organizational design, manage an open and competitive selection process, and execute the awards process. The team would also define the selection criteria to be used, incorporating public input (see "Outreach Efforts").
- Each IMI would integrate capabilities and facilities needed to address cross-cutting manufacturing challenges that, if met, have the potential to retain or expand domestic manufacturing on an economically sound basis.
- IMIs would conduct applied R&D and development projects to reduce the cost and risk of commercializing new technologies or solve generic industrial problems, conduct education and training efforts at all levels, develop methodologies and practices for supply chain integration, and engage with small and medium-sized enterprises.

¹⁶ *Federal Register*, Vol. 77, No. 87, pp. 26509-26511, May 4, 2012, <https://federalregister.gov/a/2012-10809>.

- Each IMI would have a core of two or more companies, incorporate industry in agenda development, and have direct involvement of industry scientists and engineers in institute projects.
- IMI awards would be made in the form of grants, contracts, and cooperative agreements, possibly over multiple rounds of competitions.
- IMI proposers would be expected to show how federal investments would stimulate investments by the organizations comprising the partnership and/or from other non-federal sources.
- Subsequent federal support for an IMI would be contingent on demonstration of this additional investment, on progress to self-sustainability, and on progress toward meeting the goals of the NNMI.¹⁷

The following additional IMI principles were included in a Request for Information (RFI) published by the Advanced Manufacturing National Program Office (AMNPO) in the *Federal Register*.¹⁸

- Long-term partnership between industry (including small, medium, and large firms), educational institutions, non-government organizations, and state, regional, and local economic development authorities;
- Flexibility to form integrated teams of industrial and academic experts from multiple disciplines to solve difficult problems and to develop the future workforce;
- Adaptability for education and workforce development at multiple levels, including K-12, professional credentialing, undergraduate and graduate education, and mentoring and professional development;
- Involvement of industry associations, professional societies, and economic development organizations for validation and linkages to broader industry and regional activities;
- Analytical capability to identify critical emerging technologies with transformational impact and operational capacity in translating these technologies into products and businesses for the market;
- Ability to engage and assist SMEs to effectively deploy technologies; and
- A sustained focus on innovation with a strong reputation for quality and success.¹⁹

The NNMI is said to be modeled after the German Fraunhofer Institutes (see “The Fraunhofer-Gesellschaft Model” box below) which some consider to be a key facet of Germany’s high-tech manufacturing success.²⁰ The Council on Competitiveness,²¹ Information Technology and

¹⁷ Testimony of Patrick D. Gallagher, Under Secretary for Standards and Technology, U.S. Department of Commerce, before the U.S. Congress. See footnote 2.

¹⁸ The AMNPO is an interagency body hosted by the DOC’s NIST, and includes DOD, DOE, NSF, the National Aeronautics and Space Administration, and other agencies. <http://www.nist.gov/director/nnmi-050412.cfm>

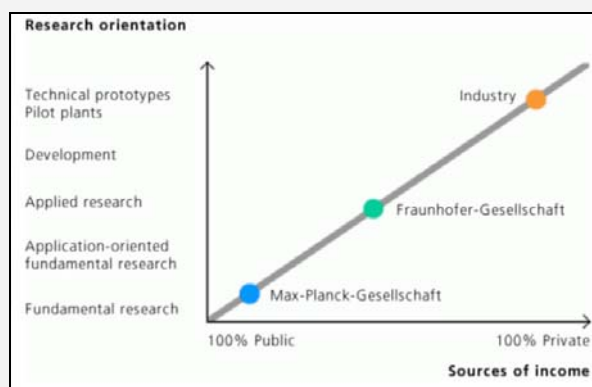
¹⁹ *Federal Register*, Vol. 77, No. 87, pp. 26509-26511, May 4, 2012, <https://federalregister.gov/a/2012-10809>.

²⁰ U.S. Congress, House Committee on Science, Space, and Technology, Subcommittee on Technology and Innovation, *Assembling the Facts: Examining the Proposed National Network for Manufacturing Innovation*, 112th Cong., 2nd sess., May 31, 2012.

Innovation Foundation,²² and President's Council of Advisors on Science and Technology²³ and other organizations have endorsed the NNMI concept or proposed a network of U.S.-based public-private manufacturing centers similar to the NNMI.

The Fraunhofer-Gesellschaft Model

The Fraunhofer-Gesellschaft* is a German-based, application-oriented research organization that seeks to bridge the innovation gap that can exist between fundamental research activities and commercial applications. In particular, Fraunhofer illustrates the position of its work along the innovation path as being between the Germany's Max-Planck Institutes, which conduct fundamental basic research, and industry, and its sources of funding as being balanced between public and private sources. (See graph below.)



Fraunhofer has more than 80 research units, including 60 Fraunhofer Institutes, throughout Germany with more than 20,000 staff members. Fraunhofer reports its annual research budget as €1.8 billion (approximately \$2.2 billion). More than 70% of Fraunhofer's funding is provided through contract research with industry and publicly financed research projects; the balance is provided by the German federal and Länder (state) governments as base funding used to support longer-term, pre-competitive. According to Fraunhofer, the organization bolsters the competitive strength of the economy in their region, and throughout Germany and Europe, by promoting innovation, strengthening the technology base, improving the acceptance of new technologies, and helping to train scientists and engineers.

Fraunhofer has three subsidiaries, including Fraunhofer USA, a wholly-owned non-profit organization headquartered in Plymouth, Michigan. As of 2010, Fraunhofer USA operated six centers in the United States, each working in collaboration with one or more Fraunhofer Institutes in Germany. Total 2010 revenues for Fraunhofer USA were \$40 million, of which \$20 million were posted by the Fraunhofer Center for Molecular Biotechnology in Delaware, and \$4 million by the Fraunhofer Center for Sustainable Energy Systems in Massachusetts.

* "Gesellschaft" is a German word meaning association, society, or institute.

Sources: Fraunhofer-Gesellschaft website, <http://www.fraunhofer.de>; Fraunhofer *Annual Report* 2010.

(...continued)

²¹ Council on Competitiveness, *Make: An American Manufacturing Movement*, Washington, DC, December 2011, pp. 63-64, http://www.compete.org/images/uploads/File/PDF%20Files/USMCI_Make.pdf. “

²² The Information Technology and Innovation Foundation, *A Charter for Revitalizing American Manufacturing*, Washington, DC, 2011, p. 2; and “ITIF Welcomes President Obama’s Proposal on Manufacturing Innovation,” press release, March 9, 2012, <http://www.itif.org/pressrelease/itif-welcomes-president-obamas-proposal-manufacturing-innovation>.

²³ President’s Council of Advisors on Science and Technology, *Report to the President on Ensuring American Leadership in Advanced Manufacturing*, Washington, DC, June 2011, <http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-advanced-manufacturing-june2011.pdf>.

Preliminary Activities

The Obama Administration has undertaken efforts to lay a foundation for the NNMI in advance of possible congressional authorization and funding. In particular, the Administration is proceeding with the establishment of a pilot institute and has initiated an outreach effort to incorporate the perspectives of industry, academia, and non-profit organizations. In particular, the outreach effort is intended to identify a wide-ranging set of technology focus areas for the IMIs, and ideas on IMI and NNMI institutional design and governance to include issues such as treatment of intellectual property and management structure.²⁴

Pilot Institute

In his announcement of the NNMI in March 2012, President Obama also committed to the establishment of a pilot institute using existing resources from the Department of Defense and other federal agencies.²⁵ In May 2012, DOD published a broad agency announcement (BAA, a tool used for contracting) soliciting technical and cost proposals for an Additive Manufacturing Innovation Institute, describing it as “the first institute to be launched within the National Network for Manufacturing Innovation” and “a proof-of-concept for the potential subsequent institutes.”²⁶ (The BAA describes additive manufacturing as “a revolutionary suite of manufacturing technologies for building up parts, and potentially entire systems, in a layer-by-layer fashion, placing material precisely as directed by a 3D digital file.”) The lead agency to launch this institute is the Office of the Secretary of Defense (OSD), Manufacturing and Industrial Base Policy, through OSD Manufacturing Technology. The pilot institute award and management will be a cross-agency effort, primarily led by the Defense-wide Manufacturing Science and Technology Program Office, executed through the Air Force Research Laboratory.

According to the BAA, the pilot initiative, called the Additive Manufacturing Innovation Institute, is intended to

bridge the gap between basic research and product development, provide shared assets to help companies access cutting-edge capabilities and equipment, and create an unparalleled environment to educate and train students and workers in advanced manufacturing skills. The pilot Institute will serve as a technical center of excellence, providing the innovation infrastructure to support manufacturing enterprises of all sizes... The goal of the pilot Institute is to increase the successful transition of additive manufacturing technology through advanced manufacturing innovation, create an adaptive workforce capable of meeting industry needs, further increasing domestic competitiveness, and meet DOD, DOE, and other participating civilian agency requirements.²⁷

²⁴ Ibid.

²⁵ President Barack Obama, *Remarks by the President on Manufacturing and the Economy*, The White House, Petersburg, VA, March 9, 2012, <http://www.whitehouse.gov/the-press-office/2012/03/09/remarks-president-manufacturing-and-economy>.

²⁶ *A Pilot Institute for the National Network for Manufacturing Innovation (NNMI)*, Solicitation Number BAA-12-17-PKM, Department of the Air Force, Air Force Materiel Command, May 8, 2012, <https://www.fbo.gov/?s=opportunity&mode=form&id=2bbada5cae4ab97438dc3f57fed050d0>.

²⁷ Ibid.

According to the BAA, total funding for the Additive Manufacturing Innovation Institute is anticipated to be approximately \$60 million, of which \$30 million would be federal funding provided by several agencies²⁸ and an additional \$30 million which “is strongly desired to be provided as cost share, both direct and in-kind,” by the stakeholders.²⁹ In addition, once the institute is established it would be a “likely candidate for additional funds on a competitive basis”—up to \$15 million in federal funding for specific projects.³⁰ These additional funds bring total potential federal funding to \$45 million, and total institute funding to as much as \$75 million.

The BAA limits the competition for the pilot institute to universities and non-profit organizations (offerors) that are registered as a U.S. organization.³¹ If the offeror is a university, it must propose a partnership with a cluster of manufacturing firms and associated institutes. If the offeror is a non-profit industry consortium, it must propose a partnership with universities for applied research. The BAA encourages the inclusion of small businesses in all offers as part of a teaming arrangement. Federally funded Research and Development Centers (FFRDCs) may be eligible offerors, subject to Federal Acquisition Regulation provisions governing FFRDCs, as well as to other conditions.

An offeror must, among other things: provide the outline of a comprehensive financial plan to achieve sustainability of the institute within five years; provide a detailed business plan that includes appropriate roles for resources from the federal government, state government(s), local government(s), industry, academia, and other formal partners; provide a plan for how other federal programs (such as the Small Business Innovation Research program³² and Manufacturing Extension Partnership³³) can be leveraged and used to supplement the institute; and demonstrate that their proposal has the potential to advance manufacturing within the United States.³⁴

The NNMI interagency team hosted a proposers’ day to share its views of the pilot institute, answer questions, and provide an opportunity for networking among potential team partners. Nearly 300 people from industry, academia, government, and other organizations attended this event.³⁵

²⁸ The BAA restricts the use of federal funding to direct support of the goals of the institute, for applied research, education and training, and infrastructure development, and explicitly prohibits the use of government funds to build buildings or to buy land or facilities.

²⁹ Ibid.

³⁰ Testimony of Patrick D. Gallagher, Under Secretary for Standards and Technology, U.S. Department of Commerce, before the U.S. Congress, May 31, 2012.

³¹ According to the BAA, non-U.S. organizations may be allowed to use the Institute, subject to the sensitivity of the applied research.

³² For additional information on the Small Business Innovation Research Program, see CRS Report 96-402, *Small Business Innovation Research (SBIR) Program*, by Wendy H. Schacht.

³³ For additional information on the Manufacturing Extension Partnership program, see CRS Report 97-104, *Manufacturing Extension Partnership Program: An Overview*, by Wendy H. Schacht.

³⁴ *A Pilot Institute for the National Network for Manufacturing Innovation (NNMI)*, Solicitation Number BAA-12-17-PKM, Department of the Air Force.

³⁵ Testimony of Patrick D. Gallagher, Under Secretary for Standards and Technology, U.S. Department of Commerce, before the U.S. Congress, May 31, 2012.

Outreach Efforts

The Advanced Manufacturing National Program Office has initiated efforts to engage manufacturing innovation stakeholders in industry, academia, and regional and state communities. On May 4, 2012, AMNPO issued a Request for Information (RFI) in the *Federal Register* seeking public comment on various aspects of the NNMI, including technology focus areas, structure, governance, sustainability, and education and workforce development.³⁶

In addition, the AMNPO, in cooperation with stakeholders and local organizations, is hosting a series of workshops around the country seeking public comments on the NNMI from SMEs, large manufacturers, universities and community colleges, state and local governments, economic development organizations, and other stakeholders. The first of these workshops was held on April 25, 2012, at Rensselaer Polytechnic Institute (RPI) in Troy, New York. NIST advertised the workshop on its website as an “opportunity to help design the National Network for Manufacturing Innovation.”³⁷ A second workshop was held on July 9, 2012, at the Cuyahoga Community College, in Warrensville Heights, Ohio. Both workshops were organized around the four broad topic areas (and associated questions) published in the NNMI RFI, namely: technologies with a broad impact, institute structure and governance, strategies for sustainable institute operations, and education and workforce development.

Over 250 participants attended the first workshop at RPI (approximately 44% from academia, 34% from industry, 10% from economic development organizations, and 12% from local, state, and federal government) offering 1,600 individual ideas. A report, *Designing for Impact I: Workshop on Building the National Network for Manufacturing Innovation: Summary of Results*, summarizing the ideas put forth by stakeholders at the workshop was published in June 2012 and is available on the manufacturing.gov website.³⁸

Legislative Status

The creation of the NNMI depends on congressional authorization and funding. The Administration is currently seeking one or more Members in each legislative chamber to work with to develop, sponsor, and champion legislation to authorize and fund this effort.³⁹ According to the President’s proposal, funding for the NNMI would be made through one-time mandatory funding of \$1 billion. The use of mandatory funding for the NNMI would allow funding to be provided by a law other than an appropriations bill, removing the funding decision from the regular appropriations process.⁴⁰ To date no legislation has been introduced in either chamber.

³⁶ *Federal Register*, Vol. 77, No. 87, pp. 26509-26511, May 4, 2012, <https://federalregister.gov/a/2012-10809>.

³⁷ NIST website, <http://www.nist.gov/director/nnmi-050412.cfm>.

³⁸ *Designing for Impact I: Workshop on Building the National Network for Manufacturing Innovation: Summary of Results*, Energetics Incorporated, as prepared for the Advanced Manufacturing National Program Office, National Institute of Standards and Technology, June 12, 2012, <http://manufacturing.gov/amp/rpi-summary-of-results.pdf>.

³⁹ Testimony of Patrick D. Gallagher, Under Secretary for Standards and Technology, U.S. Department of Commerce, before the U.S. Congress, May 31, 2012.

⁴⁰ Mandatory spending is controlled by laws other than appropriations acts, often through authorizing legislation. Authorizing legislation establishes or continues the operation of a federal program or agency, either indefinitely or for a specified period. In contrast, discretionary spending is provided and controlled through the annual appropriations process. For additional information on mandatory funding, see CRS Report RL33074, *Mandatory Spending Since 1962*, (continued...)

Issues for Consideration

The proposed National Network for Manufacturing Innovation raises a variety of issues for Congress, some of which were raised in a hearing on the proposal held by the House Committee on Science, Space, and Technology's Subcommittee on Technology and Innovation in May 2012. Among the questions Congress may wish to consider as it takes up legislation to establish and fund the NNMI:

- **Is the U.S. global competitive position in manufacturing in decline? If so, what factors are contributing to the decline? What are the potential implications of U.S. manufacturing competitiveness decline?**

Some assert that U.S. manufacturing is healthy and growing, pointing to indicators such as increased output and productivity; others assert that U.S. manufacturing is in decline, pointing to decreased manufacturing employment and the movement of production and related functions to other countries.

Those that see U.S. manufacturing as healthy generally assert that increased globalization and efforts to facilitate trade naturally lead companies seeking to maximize profits, open new markets, increase global market share, and better serve their customers to locate some of their production and related activities outside the United States. They also argue that, in competing against other multinational corporations, they must undertake such efforts to remain competitive. Some also argue that a variety of factors in the U.S. market (e.g., tax rates, regulations, tort law) place a heavy burden on U.S. manufacturing; in contrast, other nations may have much lower labor costs and their governments may offer a variety of incentives (e.g., tax holidays, worker training, rapid permitting) to attract and retain the manufacturing and related activities of U.S.-based companies.

Many who see U.S. manufacturing in decline assert that U.S. manufacturing capacity is being “hollowed” out as production facilities and supporting functions (such as R&D, information technology, and accounting) are sited overseas, leaving only a shell of a corporation located physically in the United States. Some experts assert that a nation's (or a state's or a region's) manufacturing strength depends on a “critical mass” of companies that are engaged in similar and supporting activities, creating a synergy that increases the overall strength of the firms in the cluster due to a number of positive reinforcing factors (e.g., knowledge sharing, attraction of workforce talent, new start-ups, establishment of new plants, co-location of supply chains, improvements in infrastructure). As U.S.-based firms move production and related activities outside the United States, some believe that this “critical mass” may be lost, starting a downward spiral in which the synergies are lost and firms opt to move operations outside the United States where such clusters have developed.

Accordingly, many who subscribe to this view believe that manufacturing employment will decline, R&D activities will relocate to be near production facilities, and service firms that support manufacturing will be lost. In addition, some assert that the “hollowing out” will result in the loss of manufacturing capabilities needed to support the nation's military and increase the manufacturing know-how of potential adversaries.

(...continued)

by D. Andrew Austin and Mindy R. Levit.

- **Should the federal government directly or indirectly support the competitive position of the U.S. manufacturing sector? Which federal policies and programs should be prioritized? Why should the NNMI be prioritized over other approaches? Is the NNMI duplicative of other federal efforts?**

There are many views as to what the federal government can and should do to support the competitive position of the U.S. manufacturing sector. In general, some prefer an approach that reduces costs and other burdens on manufacturers, such as reducing taxes, regulations, and frivolous lawsuits. Others prefer an expanded direct role for the federal government, such as increasing federal support for manufacturing R&D, providing grants and loan guarantees for domestic manufacturing, and, in some cases, subsidizing production of products for which there are deemed positive benefits for the nation that cannot be captured by the manufacturer (economists refer to such benefits as positive externalities). With a range of options that might be pursued to improve the competitive position and strength of U.S. manufacturing, some may believe that the NNMI should be given high priority due to its perceived benefits (e.g., advancing research discoveries toward market-ready technologies).

Others may believe that the role envisioned for the NNMI should be performed by the private sector; that the federal government should not favor or subsidize particular companies, industries, or technologies; that the NNMI would be ineffective or counterproductive; that the funds that would go to the NNMI should be used to support manufacturing in other ways; that the funds should be used for different federal functions altogether; or that the funds should be directed toward deficit reduction. Some may believe that the NNMI is, in part or in whole, duplicative of other federal programs, such as the Manufacturing Extension Partnership; or, as a new and separate program, represents an increasing fragmentation of federal efforts to help manufacturers.

- **How would the “national network” aspect of the NNMI operate? What role would the federal government have in the national network?**

Implicit in the title of the National Network for Manufacturing Innovation is the notion that there would be a national network. The Administration’s proposal does not discuss how the individual institutes would function as a network. Congress may want to explore what form the network would take (e.g., a national network office with staff, a database of information), what functions it would perform (e.g., sharing of lessons learned, referrals of companies to centers with specific expertise), who would perform the functions (e.g., NIST, AMNPO, IMIs), and how the performance of these functions would be paid for (e.g., federal funding, private funding from the IMIs).

- **Should the NNMI be funded on a mandatory or discretionary funding basis? Should a one-time advance appropriation be provided for the proposed ten-year life of the program, or should the NNMI be subject to annual review, oversight, and consideration in the regular annual appropriations process? Which programs would be cut or eliminated as offsets for the NNMI’s proposed \$1 billion mandatory appropriation?**

The NNMI could be supported through either mandatory⁴¹ or discretionary funding. The Obama Administration has proposed one-time mandatory funding of \$1 billion to be used

⁴¹ See footnote 40 for information on mandatory funding and how it differs from discretionary funding.

over the course of ten years. This approach may provide a higher degree of certainty about the availability of out-year funding for the NNMI (though Congress could opt later to rescind all or part of such funding). Such an approach would require offsets from other mandatory funding. Alternatively, providing funding through annual appropriations might allow Congress greater oversight opportunities and flexibility in modifying the program and its funding levels. If the NNMI were to be supported through discretionary funding, cuts would need to be made from other discretionary spending. The Obama Administration's FY2013 budget request specified a number of cuts in mandatory spending, but did not specify which cuts would be used to offset proposed funding for the NNMI.

- **What is the appropriate role of the federal government in manufacturing-related innovation? Should the federal government's role end with basic research funding, or include funding for applied research, development efforts focused on cost reduction and technical feasibility, or demonstration projects?**

There are many views regarding the appropriate role of the federal government in the innovation process. While there has been a general consensus on the federal government's support for basic research, congressional efforts to provide later stage support for innovation (aside from meeting government mission requirements, such as national defense) have been met with opposition from different quarters.

Among the arguments put forth by supporters of later-stage federal investments (e.g., applied research, development efforts, and demonstration projects):

- In some cases, important benefits—e.g., economic, social, national security—may be achieved that would not otherwise be achieved due to factors such as the absence of market incentives (e.g., development of drugs for diseases or conditions that only affect a small number of people) or the inability of a single company or group of companies to undertake such efforts due to high-cost, high-risk, and/or long time horizon for achieving a return on investment. Benefits that cannot be captured by a company (or group of companies working together) that brings a product or service to market are referred to by economists as “positive externalities.” Unable to capture these benefits, a company is not likely to consider them in its decision making regarding whether to pursue the development of such a technology or product. Accordingly, economists assert that the result may be private sector underinvestment in beneficial R&D. Some analysts argue that, in such cases, public investment may be justified to induce the development of these technology (and the realization of these benefits) by sharing costs and risks.
- Such efforts are needed to ensure U.S. leadership in technologies and industries critical to U.S. national security and economic security.
- Such efforts are needed to offset the industrial policies of other nations that make the business environment in the United States comparatively less attractive.

Among the arguments put forward by opponents of such efforts:

- Such efforts constitute an “industrial policy,” resulting in distortions in markets and flows of capital by substituting governmental preferences for market forces.
- Government is not able to make better decisions than markets, therefore federal funding for such activities is generally inefficient or wasted.

- Such efforts constitute “corporate welfare” as they provide direct or indirect public subsidies to for-profit corporations, enriching shareholders and others at the expense of taxpayers.
 - Government funding and tax, regulatory, or policy decisions may be used for “crony capitalism,” i.e., to explicitly reward political supporters or punish opponents.
 - The ability to provide direct federal funding to companies or industries can lead to governmental corruption, fraud, and graft.
 - The absence of express authority in the Constitution to engage in such activities makes such efforts unconstitutional.
 - The current economic condition of the United States with respect to the budget deficit, national debt, and future financial liabilities does not allow for such expenditures, irrespective of merit and efficacy.
- **How can the NNMI contribute to the retention of manufacturing-related activities in the United States, both broadly as well as with respect to the R&D that the IMIs advance toward commercialization?**

The innovation process can be extremely challenging. Even good ideas can fail due to a number of reasons (e.g., technical, cost, and risk barriers; disconnection from market needs; absence of standards; regulatory hurdles). A major thrust of U.S. science and technology policy has focused on how to move new ideas and insights from the laboratory into the marketplace.

In the past, the strength of the U.S. economy and its position in the global economy largely meant that the success of U.S.-based companies in overcoming the obstacles to innovation and moving a process or product into the market resulted in production-related activities and jobs in the United States. Today, however, companies have increased options (and sometimes incentives) to establish production facilities outside the United States. If a primary goal of the NNMI is to stimulate domestic production activities and to capture the associated jobs, Congress may wish to explore whether and how the NNMI would serve to encourage domestic production based on the technologies it advances through the innovation process.

- **Which agency/agencies should lead and manage the NNMI?**

President Obama’s has proposed that funding for the NNMI be given to the National Institute of Standards and Technology, an agency of the U.S. Department of Commerce, through one-time mandatory funding of \$1 billion to be spent over ten years. The NNMI would be managed collaboratively by the Department of Commerce’s (DOC) National Institute of Standards and Technology (NIST), the Department of Defense (DOD), Department of Energy (DOE), National Science Foundation (NSF), and other agencies.

As the recipient of the funds, NIST appears to be the de facto lead on the initiative. In addition, the Under Secretary for Standards and Technology and Director of NIST was the only administration official to testify at a House hearing on the NNMI.

NIST has played an important role in the federal government’s efforts to support U.S. manufacturing since its establishment as the National Bureau of Standards in 1901. Beyond its core mission in measurement science (i.e., metrology) and standards, NIST took on its

current name and was given additional authorities and programs by Congress in the late 1980s. Among these new programs were several programs focused on supporting U.S. firms, including the Advanced Technology Program (ATP, a program to accelerate the development of generic, pre-competitive, high-risk, high-payoff technologies; ATP was eliminated in 2007 and replaced by the Technology Innovation Program (TIP) which was subsequently eliminated);⁴² the Malcolm Baldrige National Quality Award (a program to encourage the adoption of quality management principles by private companies and non-profit organizations); and the Manufacturing Extension Partnership (MEP, a program to enhance productivity, technological performance, and strengthen the global competitiveness of small and medium-sized U.S.-based manufacturing firms).⁴³

The Department of Defense is also playing a key role in the NNMI. In particular, DOD has issued a solicitation to establish a pilot institute focused on additive manufacturing, describing it as “the first institute to be launched within the National Network for Manufacturing Innovation” and “a proof-of-concept for the potential subsequent institutes.”⁴⁴

Congress may wish to consider whether to designate a lead agency for the NNMI and to provide that agency with governance authorities and responsibilities, or whether to parse NNMI authorities and responsibilities among several agencies. Alternatively, Congress might opt to provide the Administration with flexibility to assign agency roles and responsibilities.

- **What requirements must be met for an IMI to be considered self-sustaining? With respect to federal policy, what would be the consequences for an IMI that does not become self-sustaining?**

As articulated by the Obama Administration, an IMI is to become self-sustaining no later than seven years from its award date. However, no definition of self-sustaining has been put forward by the Administration, nor is there any indication of consequences for failure to become self-sustaining. In addition, the Administration has stated that it expects that IMIs would be eligible to compete for funds for project specific activities under other (i.e., non-NNMI) federal programs.⁴⁵ How would such funding be considered with respect to the requirement for self-sustainability?

Federal requirements that organizations become self-sufficient have not always met with success. For example, the Omnibus Trade and Competitiveness Act of 1988 (P.L. 100-418), which established the NIST Manufacturing Extension Partnership program,⁴⁶ required centers to become self-sufficient within six years:

In no event shall funding for a Center be provided by the Department of Commerce after the sixth year of the operation of a Center.⁴⁷

⁴² For additional information see CRS Report 95-36, *The Advanced Technology Program*, by Wendy H. Schacht.

⁴³ For additional information, see CRS Report 97-104, *Manufacturing Extension Partnership Program: An Overview*, by Wendy H. Schacht.

⁴⁴ See footnote 19.

⁴⁵ Testimony of Patrick D. Gallagher, Under Secretary for Standards and Technology, U.S. Department of Commerce, before the U.S. Congress. See footnote 2.

⁴⁶ P.L. 100-418 uses the term “Regional Centers for the Transfer of Manufacturing Technology” to what is now called the Manufacturing Extension Partnership program.

⁴⁷ P.L. 100-418.

Congress later amended the MEP authorities in the Technology Administration Act of 1998 (P.L. 105-309) to allow centers to continue receiving federal funds if the center “has received a positive evaluation through an independent review,” though it restricted funding after the sixth year to be no more than “one third of the capital and annual operating and maintenance costs of the Center.”⁴⁸

Congress may wish to consider whether to legislatively require that IMIs become self-sufficient, the time period within which self-sufficiency would need to be achieved, and the consequences of failing to do so.

- **What will be the role of the federal government, if any, in the NNMI after the end of the ten-year funding period?**

As proposed, the NNMI would receive a one-time appropriation to be spent over 10 years. The Administration has not articulated its vision for the NNMI past the end of this period. Congress may wish to consider what role, if any, the federal government would play in coordinating or sustaining the network after the end of this period.

- **What role, if any, should the federal government play in advancing technologies that can contribute to manufacturing competitiveness?**

Rapid technological advances may bring revolutionary changes to the manufacturing sector in the United States and abroad. Currently technologies such as grid computing, multi-core processors, massively parallel supercomputers, and new modeling software allow for more expansive, less expensive, and faster testing of designs. For example, automobile manufacturers are using these technologies to supplement physical crash testing of vehicles, thereby reducing costs, increasing passenger safety, and allowing for design considerations that might not otherwise have been possible.⁴⁹ According to Ford Motor Company:

Prior to the first XJ prototype crashing into a barrier, Jaguar engineers performed more than 500 computer-simulated crash events using sophisticated crash-modeling software and this was followed up by physical tests.⁵⁰

Further, new technologies, materials, processes, and design tools may allow for low-cost, high-customization, small lot-size production. In addition, new collaborative innovation models may open the possibility of making once-proprietary product design processes available to external creators.

These new technologies and processes—and others that are likely to emerge from global research and development efforts—may displace existing industries, companies, and workers; shift value-added in the innovation process; and affect the competitive position of nations in manufacturing. In deciding whether to authorize and fund the NNMI, Congress may also wish to consider what the appropriate role of the federal government should be, if any, in advancing the U.S. position in manufacturing broadly (i.e., what boundaries should be set, if any, to define the appropriate roles of government and the private sector).

⁴⁸ P.L. 105-309. For further discussion, see CRS Report 97-104, *Manufacturing Extension Partnership Program: An Overview*, by Wendy H. Schacht.

⁴⁹ Deborah Wince-Smith, “High Performance Computing for All,” *Issues in Science and Technology*, Summer 2009.

⁵⁰ Ford Motor Company website, http://media.ford.com/article_download.cfm?article_id=14028.

The Administration is currently seeking input from the stakeholder community with respect to a number of questions related to the foci, structure, governance, sustainability, education, and workforce development efforts of the NNMI and the individual IMIs. Congress may wish to explore these questions (see **Appendix**) and to hold hearings on what the Administration has learned from stakeholders in the course of its outreach activities.

Appendix. NIST Request for Information Questions

The National Institute of Standards and Technology posed the following questions in a Request for Information published in the *Federal Register* (77 FR 26509) on May 4, 2012, seeking public input on the proposed National Network for Manufacturing Innovation. Commenters were advised that the questions were intended to assist in the formulation of comments, and were not to be construed as a limitation on the number of comments that interested persons may submit or as a limitation on the issues that may be addressed in such comments.

Technologies with Broad Impact

What criteria should be used to select technology focus areas?
What technology focus areas that meet these criteria would you be willing to co-invest in?
What measures could demonstrate that Institute technology activities assist U.S. manufacturing?
What measures could assess the performance and impact of Institutes?

Institute Structure and Governance

What business models would be effective for the Institutes to manage business decisions?
What governance models would be effective for the Institutes to manage governance decisions?
What membership and participation structure would be effective for the Institutes, such as financial and intellectual property obligations, access and licensing?
How should a network of Institutes optimally operate?
What measures could assess effectiveness of Network structure and governance?

Strategies for Sustainable Institute Operations

How should initial funding co-investments of the Federal government and others be organized by types and proportions?
What arrangements for co-investment proportions and types could help an Institute become self-sustaining?
What measures could assess progress of an Institute towards being self-sustaining?
What actions or conditions could improve how Institute operations support domestic manufacturing facilities while maintaining consistency with our international obligations?
How should Institutes engage other manufacturing related programs and networks?
How should Institutes interact with state and local economic development authorities?
What measures could assess Institute contributions to long term national security and competitiveness?

Education and Workforce Development

How could Institutes support advanced manufacturing workforce development at all educational levels?
How could Institutes ensure that advanced manufacturing workforce development activities address industry needs?
How could Institutes and the NNMI leverage and complement other education and workforce development programs?
What measures could assess Institute performance and impact on education and workforce development?
How might institutes integrate R&D activities and education to best prepare the current and future workforce?

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