Participant Advance Information

Logistics

Workshop Times

Thursday, Oct. 18, 2012

See page 5 for the Workshop agenda

7:30 am— Registration Check-in
Light Refreshments Available to Paid Participants
8:30 am— Call to Order (Auditorium)
5:00 pm— Workshop Adjourns

Food and Beverages

Your registration fee includes continental breakfast beginning at 7:30 am Mountain time, morning coffee break, a boxed lunch, and an afternoon snack break.

Workshop

Millennium Harvest House Boulder

Location and Instructions

1345 28th Street, Boulder, CO 80302. (+1-303-443-3850)
Instructions for reaching the Millennium Harvest House may be found at http://www.millenniumhotels.com/millenniumboulder/

Hotel

To make a room reservation at the Millennium Harvest House Boulder call 303-443-3850. There are a number of other hotels in the vicinity close to the event location.

Parking

Free parking for workshop attendees is available on-site at the Millennium Harvest House.

Directions to Millennium Harvest House

The Millennium Harvest House Boulder is located at 1345 28th Street, Boulder, CO 80302 which is adjacent to the University of Colorado Boulder, and is approximately a 40 minute drive from the Denver International Airport. Please be aware that travel time may be longer during rush hour. Please plan accordingly. A detailed map and directions to the Millennium Harvest House can be found here.

Website

Detailed directions for arriving at the Millennium Harvest House Boulder may be found at the website: http://www.millenniumhotels.com/millenniumboulder/hotel-location/

Workshop Organizers/Sponsors

Organizers The interagency Advanced Manufacturing National Program Office (AMNPO), hosted by the National Institute of Standards and Technology (NIST), an agency of the U.S. Department of Commerce.

Local Hosts Colorado Office of Economic Development and International Trade, the University of Colorado Boulder, Colorado State University and NREL- the Energy Department's National Renewable Energy Laboratory

Coordinating agencies Department of Energy's Advanced Manufacturing Office, Department of Defense, Department of Education, Department of Labor, NASA, and National Science Foundation

Workshop Objective and Topics

The objective of the Designing for Impact workshop is to inform workshop participants on the proposed National Network for Manufacturing Innovation (NNMI), and to solicit individual participant insights and ideas. Workshop dialogue will address the following topics:

1. Technologies with Broad Impact (examples could include emerging process technology, class of advanced materials, broadly useful enabling technologies for optimizing manufacturing capabilities, or industry sector)
2. Institute Structure and Governance
3. Strategies for Sustainable Institute Operations
4. Education and Workforce Development

The National Network for Manufacturing Innovation (NNMI)

In his budget for fiscal year 2013, the President proposes creating a network of up to 15 regional Institutes for Manufacturing Innovation (IMIs or institutes). Funded by a proposed one-time, $1 billion investment, this network - the National Network for Manufacturing Innovation (NNMI or network) - responds to a crucial competitiveness challenge and threat to future prosperity: Closing the gap between research and development (R&D) activities and the deployment of technological innovations in domestic production of goods.

The proposed NNMI will be composed of IMIs around the country, each serving as a hub of manufacturing excellence that will help to make United States (U.S.) manufacturing facilities and enterprises more competitive and encourage investment in the United States.

The network and its individual IMIs will enable companies to collaborate and access the capabilities of our research universities and other science and technology organizations to support scaling up manufacturing and assembly processes. At the same time, the IMIs will help to meet the challenge of building the pool of high-skilled talent that advanced manufacturing requires.

Institutes for Manufacturing Innovation (IMIs)

The NNMI will consist of dynamically linked regional clusters of manufacturing innovation. An IMI - each with its own technology focus - will leverage and expand the industrial, research, and institutional strengths of the region. The Institute will be a central element, designed to catalyze collaboration and maximize shared infrastructural resources. The focus of each Institute will be unique, determined through a competitive application process, but all IMIs will concentrate on adopting, refining, and applying promising emerging technologies.

In bridging the gap between applied research and product development, IMIs will provide shared assets to help companies gain access to cutting-edge capabilities and equipment, and to educate and train students and workers in

advanced manufacturing skills. Over a specified period, each IMI will become a self-sustaining technical center of excellence.

As nodes of a network, IMIs will synergistically complement each other and benefit from shared approaches to such matters as intellectual property, contract research, and performance metrics. While the institutes will be regionally focused, the network will be national, integrated, and dynamic, aiming to fostering innovation and delivering new capabilities that can impact the manufacturing sector on a large scale.

Workshop attendees should familiarize themselves thoroughly with the materials being provided within this advance package to maximize their participation and to be best prepared to engage in the detailed workshop dialogue discussions.

Workshop Format and Process

Plenary Presentations and Regional Perspectives: Participants will hear welcoming remarks from the local host and co-organizers, followed by presentations from the U.S. Department of Commerce National Institute of Standards and Technology and the Advanced Manufacturing National Program Office, offering federal perspectives on the proposed IMIs, NNMI, as well as a keynote address on the significance of manufacturing to Colorado. This will be followed in the afternoon by a panel discussion featuring regional leaders addressing the challenges and solutions for Education and Workforce Development.

Facilitated Breakout Sessions: A facilitation team composed of a federal agency representative, professional facilitator, and scribe will support each dialogue topic discussion. Each Workshop participant will participate in three dialogue topics. *Dialogue topics and room assignments will be indicated on the attendee list in your registration package.* Participants will engage in active discussion, and will have the opportunity to provide individual inputs that will assist the AMNPO in the development of the new program should the NNMI be funded. Participants will be asked to provide input on the topics shown below. Please review these topics and formulate your input in advance of the workshop. Dialogue topic worksheets will be provided in your registration package along with a description of each Dialogue topic. Dialogue topic worksheets will be turned in to facilitators prior to leaving the breakout session.

Dialogue Topics:

Dialogue 1: Technologies with Broad Impact

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

Dialogue 2: Institute Structure and Governance

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

Dialogue 3: Strategies for Sustainable Institute Operations

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

Dialogue 4: Education and Workforce Development

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

Workshop Agenda

Designing for Impact IV:

Workshop on Building the National Network for Manufacturing Innovation

Millennium Harvest House Boulder

October 18, 2012 ♦ Boulder, CO

7:30am **Sign-In and Continental Breakfast Opens**

8:30am **Call to Order and Start of Plenary Session**

Welcome Remarks

- Kathleen Hogan - Deputy Assistant Secretary Energy Efficiency, U.S. Department of Energy
- William Farland - Senior Vice President for Research, Colorado State University
- Patricia Rankin - Associate Vice Chancellor for Research, University of Colorado Boulder

Keynote Addresses

- **Why Manufacturing Matters to Colorado**
  Ken Lund - Director, Colorado Office of Economic Development and International Trade
- **Innovation and Economic Impact**
  Phillip Singerman - Associate Director for Innovation and Industry Services, NIST/U.S. Department of Commerce
- **Framing the Challenge**
  Mike Molnar - Director, Advanced Manufacturing National Program Office

10:20am **Break**

10:35am **Workshop Period I - Designing for Impact Dialogues**

Featuring:

- Technologies with Broad Impact
- Institute Structure and Governance
- Strategies for Sustainable Institute Operations
- Education and Workforce Development

11:40am **Lunch Program.**

Pick up boxed lunch.

12:00pm **Regional Perspectives - A Panel of Regional Leaders:**

Focus on Education and Workforce Development

Discussion followed by Q&A.

- Drew Crouch - Vice President, Technology, Ball Corporation
- Jason Gies - Vice President, Firehole Technologies
- Naseem Munshi - President and CEO, Composite Technology Development, Inc.
- Kathy Rowlen - CEO, InDevr
- John Vukich - Dean, Economic and Workforce Development, Pueblo Community College

Facilitated by:

- Tim Heaton - President, Colorado Advanced Manufacturing Alliance

1:10pm **Workshop Period II - Designing for Impact Dialogues**
Featuring:
- Technologies with Broad Impact
- Institute Structure and Governance
- Strategies for Sustainable Institute Operations
- Education and Workforce Development

2:10pm **Break, Rotate to next Dialogue Session**

2:20pm **Workshop Period III - Designing for Impact Dialogues**
Featuring:
- Technologies with Broad Impact
- Institute Structure and Governance
- Strategies for Sustainable Institute Operations
- Education and Workforce Development

3:20pm **Networking Session**

3:50pm **Concluding Session**
Report Out from Dialogue Team Leaders

Closing Remarks and Next Steps
- Dana Christensen - Deputy Laboratory Director for Science & Technology, National Renewable Energy Laboratory
- Mike Molnar - Director, Advanced Manufacturing National Program Office

4:30pm **Adjourn**

Backgrounder I:
Summary of Input Offered at Prior *Designing for Impact* Workshops

This is the third workshop on Building the National Network for Manufacturing Innovation; previous workshops were held in Troy, NY and Cleveland, OH. Like the present event, these workshops sought to solicit recommendations, ideas, and other input on the design, governance and other aspects of the proposed NNMI.

This *Backgrounder* is arranged by dialogue topic, and summarizes the input from the Troy and Cleveland workshops. The goal is to provide background, not to restrict thinking or confine discourse to previous topics. Detailed individual workshop reports from each workshop may be found online by clicking on the following links:

- Rensselaer Polytechnic Institute, Troy, New York, April 25, 2012
- Cuyahoga Community College, Corporate College East, Warrensville Heights, Ohio, July 9, 2012

Dialogue Topic 1: Technologies with Broad Impact

1. What criteria should be used to select technology focus areas?

Previous discourse offered the following general design principles in previous workshops:

1. Technologies should have broad application across multiple industries, and should address a national need. Technologies should leverage and enhance the regional supply chain.
2. The targeted Technological Readiness Level and Manufacturing Readiness Level should be 4-7; there should be a strong market potential, and 3-5 year time-to-market.
3. Technologies should be enabling, with transformational potential; they should be cross-cutting, widely adaptable, and driven by industry needs.
4. The technologies should have the potential to increase the number of domestic jobs, and should have an impact on energy and environmental sustainability.

2. What technology focus areas that meet these criteria that would you be willing to co-invest in?

The technology focus areas that were most frequently quoted were sensors; modeling/simulation software; composites; biomanufacturing, additive manufacturing, advanced materials (and composites); and nanotechnology. More generally, participants pointed out the need to address challenges faces by small and medium-sized companies, namely, scaling up and gaining access to modeling and simulation abilities, access to verification and validation processes and metrology.

3. What measures could demonstrate that Institute technology activities assist U.S. manufacturing?

To demonstrate that the institute technology programs assist U.S. manufacturing, participants recommended metrics on jobs created (re-shored or new), the number of startups including SMEs, partnerships in the institute, application of methods developed by the institutes by industry, the use of surveys, and the tracking of technologies infused into the marketplace (using a process similar to NASA's "mission use agreements").

4. What measures could assess the performance and impact of Institutes?

1. The number and quality of new or re-shored manufacturing jobs, global market share of exports, and trade balance.
2. Number of new partnerships and number of applications of the technology (touchpoints).
3. Infusion of technologies into the marketplace, the number of new startups in the region, and the size of the Institute's IP portfolio.
4. Retention rate for Institute members, participation of SMEs in the institute, and the amount of industry funding received.
5. The number of projects that develop from TRL5 to TRL8, and the number of licenses generated from the Institute.

Dialogue Topic 2: Institute Structure and Governance

5. What business models would be effective for the Institutes to manage business decisions?

A number of models were suggested, notably the Fraunhofer-Gesellschaft model, non-profit associations [501(c)(3) or (6)] Sematech, the National Science Foundation Engineering Research Centers, EWI, and national laboratories like Sandia and Oak Ridge. It was suggested that the Institutes remain flexible, not prescriptive, in developing business models. The business model will need to evolve during transition from federal funds to private sector funding.

6. What governance models would be effective for the Institutes to manage governance decisions?

Institutes can take many forms, with different management structures and membership rules. The business models that were suggested included the type normally used by business (a Board of Directors with a CEO that reports to the board, perhaps including a private sector advisory board), as well as referring to existing models as examples of effective structures (Fraunhofer, Sematech, NSF Engineering Research Centers, Edison Welding Institute). A holacracy model was also suggested. The vision of a National Network of Institutes can be promoted by forming a council of IMI directors to share best practices.

7. What membership and participation structure would be effective for the Institutes, such as financial and intellectual property obligations, access and licensing?

Regardless of the structure, the Institute should have certain characteristics. It has been suggested that there should be a low barrier for entry for all stakeholders, and a fee for services should be considered. Participation structures could be modeled after Fraunhofer or I/UCRCs, etc. The treatment of intellectual property has had a number of suggestions, including the pooling of IP, where the institute controls maturation and licensing and perhaps with limited licenses granted to all Institute members. Alternatively, the Institute could follow an "inventors owned" model, where IP and licensing rights are shared by the contributors to the project.

8. How should a network of Institutes optimally operate?

The network should be flexible, growth-oriented, and responsive to changing needs in industry. The Institutes should adopt consistent contractual vehicles, forms, and guidelines to establish trust with multiple institutes. Institutes should share pre-competitive information and research results with one another and with the public. This could be done through an annual conference, annual technology showcase, and via the website. Members could also form self-assembled teams to work on proprietary projects.

9. What measures could assess effectiveness of Network structure and governance?

The effectiveness of the Network structure could be assessed by tracking the number of member companies, technology transfer successes, venture capital raised, and new IP. Other measures of assessment include surveys of stakeholders; the number of projects completed and time required; and the number of new and retained manufacturing jobs.

Dialogue 3: Strategies for Sustainable Institute Operations

10. How should initial funding co-investments of the Federal government and others be organized by types and proportions?

It was common to attempt allocations of federal funding, such as (but not limited to): 2/3 R&D, 1/6 industry, 1/6 educational outreach; 50% equipment and facilities, 30% students and training, 20% strategic hires; 50% industry and 50% government. There was a desire expressed to limit overhead to 20%, and to avoid bricks and mortar investments. The suggestion was made to fund part-time sabbaticals to enable industry to work in academia and vice-versa. The Institute should also request machines and equipment to be donated.

Assessment measures included the number of new products created, and the increase in the manufacturing section of the US balance of trade.

11. What arrangements for co-investment proportions and types could help an Institute become self-sustaining?

Self-sustainability was discussed at length, with recommendations of fostering industry presence by gradually decreasing federal funding on projects to allow SMEs to join activities with an incentive to invest later. Sustainability requires generation of funding, which can be done by collecting membership fees; by encouraging investment by allocating percentage of IP ownership with investment; and funding from revenues and royalties associated with IP. The National Nanotechnology Initiative, the Fraunhofer Institute and the STAR agency for Science, Technology, and Research were references as useful models for co-investment.

12. What measures could assess progress of an Institute towards being self-sustaining?

It was expressed that the IMIs need to be hands-on and one step ahead of industry; in other words, a place where stakeholders can get work done more effectively than they would on their own. Measures to assess the progress of an Institute could include the growth in the number of industry members over time, particularly small and medium-sized businesses, the number of early members that reinvest, the IP licensing revenue, the development of new products and/or processes, or the Institute's income compared to recurring expenses.

13. What actions or conditions could improve how Institute operations support domestic manufacturing facilities while maintaining consistency with our international obligations?

Prior to accepting a project, the IMI could review each business plan to see where the company plans to manufacture, and charge higher licensing fees for manufacturing performed abroad, and/or could offer right of first refusal for domestic manufacturing. Workshop participants noted the supply chain as a key determining factor in domestic manufacturing and noted that the IMIs could serve as a source to help fill gaps in the supply chain and help manufacturing for these technologies become more sustainable in the U.S.

14. How should Institutes engage other manufacturing related programs and networks?

Manufacturing programs and networks should be engaged by helping companies overcome and eliminate bottlenecks in the supply chain, helping companies move from TRL or MRL of 4-7 to 8-10, and identify partners to solve multi-disciplinary challenges. Some workshop participants also suggested that NNMI critically evaluate all existing manufacturing programs and networks to see whether they successfully increase TRL for basic research, generate revenue through IP, or provide significant cost savings to the government.

15. How should Institutes interact with state and local economic development authorities?

IMIs could offer a tax rebate or other tax incentives to promote collaboration with state and local economic development authorities. The state and Institute should have a strong partnership to create a strong strategy toward cluster building and incubators. SSTI (www.ssti.org) could be a useful resource to engage states and coordinate efforts. In addition, these local and regional organizations can help attract new manufacturers to the region who are symbiotic with the technology focus of the Institute. One participant suggested that a formal process be established to allow states to discuss their needs with the Institute. A searchable database could help people identify initiatives relevant to their needs and avoid duplication of efforts.

16. What measures could assess Institute contributions to long term national security and competitiveness?

Several measures can be used to evaluate Institute contributions to national security and competitiveness, including the following:

- Institutes create new markets, techniques, products (e.g., could be measured by awards)
- Institutes address and overcome pain points in industry
- More technologies are manufactured in the U.S.
- More technologies are developed for federal acquisition programs (DoD, DOE, NASA, etc.)

In addition, IP licenses could be limited to domestic use.

Dialogue 4: Education and Workforce Development

17. How could Institutes support advanced manufacturing workforce development at all educational levels?

Discussions centered around suggested best practices and assessment. Suggested activities to promote education and workforce development included:

1. Bring manufacturing to students, such as by bringing 3D printers to schools.
2. Bring students to manufacturing. Industry partners can host them, or Institutes can develop on-site fab labs.
3. Offer free online training courses (based on Khan Academy model).
4. Use video games for recruiting.
5. Educate children before 7th and 8th grade so they don't track out of pre-algebra & courses for STEM careers.
6. Gender differences need to be acknowledged and projects design accordingly. For example, design projects can be a toothbrush; not a car transmission.
7. Internships are critical for college-age students.
8. Incorporate manufacturing into the curriculum and develop materials (high schools & community colleges).
9. Change the perception of manufacturing with youth, students, and parents.
10. Fund scholarships at associate, undergraduate and graduate levels.

18. How could Institutes ensure that advanced manufacturing workforce development activities address industry needs?

The Institutes should have industry representation in the governance. As new technologies enter industries that require manufacturing, new sets of skills are required. The Institutes need to take the pulse of regional industry needs and ensure that lower skill workers are getting the training they need to enter middle skill jobs. The focus should be on unemployed, underemployed, and displaced workers, as well as returning military personnel. Master's Degree programs can be developed at regional universities to address emerging needs.

19. How could Institutes and the NNMI leverage and complement other education and workforce development programs?

The NNMI could leverage and complement other education and workforce development programs by benchmarking best practices. TechShop (a membership-based workshop that provides access to tools and instruction), Dept. of Labor workforce development programs and SME videos were identified as models.

The Institutes could each establish a library so members can easily learn about complementary education and workforce development programs, and federally funded programs such as NSF's Advanced Technology Education Program and NIST's Manufacturing Extension Partnerships. Industry partners could publish information that details the types of skills they would like to see in their current and future employees and the IMIs. IMIs could bring in high-profile speakers and develop seminars/programs that piggyback on regional events. They could also establish an Office of Workforce Development Advisory Council to ensure that industry, academia, and government labs are collaborating and supporting one another in education and workforce development. Similarly, the Institutes could partner with jobs centers to establish training pathways for displaced workers. They could also engage vocational/technical schools, skilled trade organizations, trade unions, and apprenticeship programs.

20. What measures could assess Institute performance and impact on education and workforce development?

The following were suggested: take measures of employment, either from number of employers that hired new workers, numbers of student placements in industry, job performance, etc. Assessment could be performed with a five-year follow-up. A useful measure of performance and impact could be the number of courses offered by the IMIs. ABET outcomes could also be used. Participants noted the importance of publicizing the impact of the Institutes, to demonstrate their value to stakeholders and voters.

21. How might institutes integrate R&D activities and education to best prepare the current and future workforce?

Students at all levels should be involved in industry-driven R&D programs. Industry participants pointed out that they have good success using internships, co-ops, and apprenticeships as a way to prepare their workforce. Teacher/faculty externships were also proposed. The Institute could offer continuing education units and training focused on specific employer needs. They might also offer a prize or award for completing an NNMI project. It was noted that teaching hospitals are a useful model: the institutes could connect industry with educators and provide students opportunities for real-world experiences.

Backgrounder II:
About the National Network for Manufacturing Innovation

In his 2012 State of the Union address, President Obama laid out his "blueprint for an economy that's built to last – an economy built on American manufacturing, American energy, skills for American workers, and a renewal of American values."

"This blueprint," he said, "begins with American manufacturing."

The President chose this starting point for good reason. Numerous recent reports have documented how critical U.S. manufacturing is to innovation, jobs, the economy, exports, and national security. He has initiated a set of actions designed to make our manufacturing sector more competitive and to encourage more domestic investment here, in the United States. These actions encompass sound tax policies, enforcement of trade laws, and investments in innovation, advanced technology, education, and infrastructure.

According to the non-partisan Council on Competitiveness, "U.S. manufacturing is more important now than ever." While not dismissing serious challenges posed by low-cost competitors and rivals that are fast advancing in technological capabilities, the council maintains that "enormous opportunities to increase production and grow exports" lie ahead for U.S. manufacturers. "The digital, biotechnology, and nanotechnology revolutions," it reports, "are unleashing vast opportunities for innovation and manufacturing."

Moving to put his blueprint into action, the President has launched a major, new initiative focused on strengthening the innovation performance, competitiveness, and job-creating power of U.S. manufacturing: the National Network for Manufacturing Innovation (NNMI). The network will help to address a damaging inconsistency in U.S. economic and innovation policies. The federal government annually invests more than $100 billion in research and development (R&D) and offers a tax credit for industry-funded R&D. Yet, these measures are not matched by corresponding, strategically designed and implemented efforts and incentives to encourage domestic manufacturing of technologies and products ultimately arising from U.S. discoveries and inventions.

The NNMI Proposal

In his budget for fiscal year 2013, the President proposes creating a network of up to 15 regional Institutes for Manufacturing Innovation (IMIs). Funded by a proposed one-time, $1 billion investment, this network—the NNMI—responds to a crucial competitiveness challenge and threat to future prosperity: Closing the gap between research and development (R&D) activities and the deployment of technological innovations in domestic production of goods.

IMI activities may include, but are not limited to: applied research and demonstration projects that reduce the cost and risk of commercializing new technologies or that solve generic industrial problems, education and training at all levels, development of innovative methodologies and practices for supply-chain integration, and engagement with small and medium-sized manufacturing enterprises (SMEs).

The proposal implements recommendations made by the President's Council of Advisors on Science and Technology and a wide range of other experts and organizations. It recognizes that investing in basic research isn't sufficient to ensure that a new technology crosses the bridge from invention to product development and process prototyping to manufacturing at scale.

The IMIs will bring together industry, universities and community colleges, federal agencies, states, and localities to accelerate innovation and subsequent market-share growth by investing in industrially-relevant manufacturing product and process technologies with broad application. Together, industry partners, state and local agencies, foundations, and others will co-invest with the federal government in each IMI. A strong partnership between industry and local stakeholders is required for federal efforts to serve as a catalyst.

The President unveiled his proposal to build the NNMI on March 9, 2012. At the same time, he initiated steps to jumpstart the network by launching a pilot Institute for Manufacturing Innovation, using existing resources from the Departments of Defense and Energy; NASA, the National Institute of Standards and Technology, and the National Science Foundation also ultimately contributed funding. On May 9, the federal government issued a solicitation for proposals from teams led by non-profit organizations or universities to establish an Additive Manufacturing Innovation Institute, which would serve as a proof-of-concept/ prototype IMI.

The Need for NNMI

Many technologies rooted in U.S. research fail to mature to full scale-up and commercialization in domestic factories. As documented by National Science and Technology Council, "A gap exists between R&D activities and the deployment of technological innovations in domestic production of goods," contributing significantly, for example, to the disturbing and still-growing trade deficit in advanced technology products.

In 2011, the U.S. ran a $99 billion deficit in trade of advanced technology products, accounting for 17 percent of the total U.S. trade deficit. The U.S. has lost 687,000 high-technology manufacturing jobs since 2000, when the nation posted a $5 billion trade surplus in advanced technology products.

Manufacturing plays a disproportionately large—and valuable—role with respect to the nation's innovation capacity. It accounts for about 12 percent of the nation's gross domestic product, but performs 70 percent of domestic industry R&D and employs 60 percent of industry's scientists and engineers. Thus, manufacturing remains the essential core of the U.S. economy's innovation infrastructure. The rapidly growing high-tech service sector gets most of its technology from manufacturing firms.

Other nations also recognize the strong links between manufacturing, innovation, and prosperity. Not only that, many are making investments to strengthen the links. Currently, Germany, Korea, and Japan each have more R&D-intensive manufacturing sectors than the United States, and all three have positive balances in trade of goods.

Accelerating innovation and implementation of advanced manufacturing capabilities requires bridging a number of gaps in the present U.S. innovation system. "Market failures" are a major deterrent to private-sector investment to advance and refine new, cutting-edge technologies with the ultimate goal of realizing their transformative potential. Time horizons typically exceed investor expectations for realizing returns, and technical and commercial risks are greater.

As a result, companies are reluctant to invest in technology development efforts that aim beyond incremental improvements in existing products and processes.

Knowledge spillovers are a related obstacle to patient, sustained private-sector investment in developing promising leapfrog technologies all the way through to the points of manufacturing and commercial feasibility. Similarly, because of spillovers and the so-called free-rider problem, no single company will take on the risk and devote the resources needed to build the full infrastructure of underpinning manufacturing capabilities and complementary resources that would benefit an entire industry and even groups of industries.

Historically and even today, the U.S. has excelled at basic science, invention, and innovation. But the commercial and economic rewards that can sprout and grow from these important early-stage accomplish are realized in the post-innovation stages—especially at the point of manufacturing scale-up and commercialization.

As technologies and products become more complex and their life cycles shrink, successfully mastering all the stages from laboratory to marketplace requires contributions from a large network of organizations—from suppliers of equipment, parts, and services to schools, colleges, and training programs to utilities and other infrastructure systems. As global competition to manufacture and sell high-value-added products intensifies, the capabilities and performance of these innovation ecosystems also must improve.

The President's proposed NNMI and the regional collaborations it catalyzes will address barriers to rapid and efficient development and commercialization of new advanced product and manufacturing-process innovations. The network and its individual IMIs will enable companies to collaborate and access the capabilities of our research universities and other science and technology organizations to support scaling up manufacturing. At the same time, the IMIs will help to meet the challenge of building the pool of high-skilled talent that advanced manufacturing requires.

Defining the NNMI

The NNMI will consist of up to 15 dynamically linked regional clusters of manufacturing innovation. An IMI—each with its own technology focus area - will leverage and expand the industrial, research, and institutional strengths of the region. Each Institute will be central to the local innovation ecosystem, designed to catalyze collaboration and maximize shared infrastructure. The focus of each Institute will be unique, determined through a competitive application process, but all IMIs will concentrate on adopting, refining, and applying promising emerging technologies.

In bridging the gap between applied research and product development, IMIs will provide shared assets to help companies gain access to cutting-edge capabilities and equipment, and to educate and train students and workers in advanced manufacturing skills. Over a specified period, each IMI will become a self-sustaining technical center of excellence

As nodes of a network, IMIs will complement each other's capabilities and benefit from shared approaches to such matters as intellectual property, contract research, and performance metrics. While the institutes will be regionally focused, the network will be national, integrated, and dynamic, aiming to fostering innovation and delivering new capabilities that can impact the manufacturing sector on a large scale.

Planning the NNMI

The NNMI program will be managed by the interagency Advanced Manufacturing National Program Office (AMNPO). Participating agencies include the Department of Defense, Department of Energy, Department of Commerce's National Institute of Standard and Technology (NIST), NASA, the National Science Foundation, and other agencies. Industry, state, academic, and other partners will co-invest in the IMIs. As proposed, the federal government will make a $1 billion, one-time investment in the NNMI program.

Federal, cost-shared funding will be allocated by means of competitive solicitations staged over several years. This start-up investment will support capital and initial operating expenses for up to 15 Institutes. Federal support will be contingent on co-investment by businesses and other non-federal entities and on progress toward sustainable operations. Institutes must become financially sustainable within seven years.

Each IMI will integrate capabilities and facilities required to reduce the cost and risk of commercializing new technologies and to address relevant manufacturing challenges on a production-level scale. Each will have a well-defined technical focus and will be selected through a competitive process.

Institutes will be able to form multi-disciplinary research and demonstration project teams that include both industrial and academic experts. Integral elements of IMI partnerships, participating research universities and other educational institutions will allow affiliated researchers and students to participate in these project teams, which also will include personnel from participating companies.

Next Steps: Detailed Design from Broad Public Engagement

To strengthen the information base for Congressional consideration and to facilitate input from key stakeholders, the AMNPO has issued a Request for Information (RFI) specific to the NNMI. As part of its outreach and information-gathering effort, the office is holding regional workshops across the country. The workshops also will focus on the design, operation, technology emphases, and other as aspects of the network and its constituent IMIs.

This consultative process for the NNMI will have similarities to the consultative process for the pilot institute but will be much broader in scope. Through these outreach efforts, the federal agency partners will seek to identify a wide-ranging set of technology focus areas for up to 15 IMIs The RFI and workshops also will explore institutional design and governance issues, such as the ownership and handling of intellectual property generated by the NNMI and management of the network as a whole to amplify the impact of its member Institutes.

Specifically, the AMNPO is seeking input pertaining to four key aspects critical to the effectiveness of the NNMI:

- IMI Focus Areas: Technologies with broad impact , such as an emerging process technology, class of advanced materials, broadly useful enabling technologies for optimizing manufacturing capabilities, or industry sector;
- IMI Structure and Governance;
- Strategies for Sustainable Institute Operations; and
- Education and Workforce Development

An interagency program management team will review public input gathered through workshops, responses to the NNMI RFI, and the AMNPO's Advanced Manufacturing Wiki. The interagency will be responsible for designing the network and conducting open competitions for selecting recipients of IMI awards.

More information is available at the AMNPO's advance manufacturing web site:
http://manufacturing.gov/advanced_manufacturing.html