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Request for Information Response Summary for the National Network for Manufacturing Innovation

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http://manufacturing.gov/docs/NNMI_RFI_Report_20130813.pdf

National Institute of Standards and Technology
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U.S. Department of Commerce
Rebecca M. Blank, Acting Secretary

National Institute of Standards and Technology
Patrick D. Gallagher, Under Secretary of Commerce for Standards and Technology and Director

Forward

The NNMI program has the goal of advancing American domestic manufacturing. The program will seek to accomplish this by creating a robust national innovation ecosystem anchored by up to fifteen Institutes for Manufacturing Innovation (IMIs). The NNMI will fill a gap in the innovation infrastructure, allowing new manufacturing processes and technologies to progress more smoothly from basic research to implementation in manufacturing. The NNMI program has a scale and focus that is unique, and it is built upon concepts of a strong public-private partnership.

Beginning in April 2012, a broad public engagement strategy by the Advanced Manufacturing National Program Office (AMNPO) was used to obtain input for the NNMI program design, initiated by a federally sponsored Request for Information (RFI) and series of regional workshops. The RFI period has ended, and the responses are summarized in this report.

Abstract

Beginning in April 2012, a broad public engagement strategy by the Advanced Manufacturing National Program Office (AMNPO) was used to "crowd source" the NNMI program design, initiated by a Federally sponsored Request for Information (RFI) and a series of regional workshops. Comments in response to the RFI were accepted through October 25, 2012.

The RFI sought open input on the NNMI and specific input on 21 questions in four categories related to the structure and operations of the individual Institutes and the NNMI. The topics areas were Technologies with Broad Impact, Institute Structure and Governance, Strategies for Sustainable Institute Operations, and Education and Workforce Development.

In total, the AMNPO received a total of seventy-eight (78) separate RFI responses from industry, academia, economic development, State and regional authorities, national laboratories, and private citizens, representing the viewpoints of more than 100 separate entities. Each response was reviewed at least twice by representatives of different agency partners in the Advanced Manufacturing National Program Office. This report summarizes their findings, and the RFIs were used in the preparation of the preliminary design of the NNMI. The complete collection of RFI responses is available at http://www.manufacturing.gov/pubs_resources.html.

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1. Introduction

Recognizing that a vibrant advanced manufacturing sector is vital to the American economy and national security, President Obama has proposed in his FY2013 budget a $1 billion investment in a National Network for Manufacturing Innovation (NNMI) program. This program will seek to advance American domestic manufacturing by creating a robust national innovation ecosystem anchored by up to fifteen Institutes for Manufacturing Innovation (IMIs).

Beginning in April 2012, a broad public engagement strategy by the Advanced Manufacturing National Program Office (AMNPO) was used to "crowd source" the NNMI program design, initiated by a Federally sponsored Request for Information (RFI) and a series of regional workshops. Comments in response to the RFI were accepted through October 25, 2012.

The RFI sought open input on the NNMI and specific input on 21 questions in four categories related to the structure and operations of the individual Institutes and the NNMI. The topics and questions were:

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?

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?

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?

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?

In total, the AMNPO received a total of seventy-eight (78) separate RFI responses from industry, academia, economic development, State and regional authorities, national laboratories, and private citizens, representing the viewpoints of more than 100 separate entities. The complete collection of RFI responses is available at http://www.manufacturing.gov/pubs_resources.html.

These queries have also been posed at a series of four workshops organized by the AMNPO and its partner agencies. The workshop reports are also available at http://www.manufacturing.gov/pubs_resources.html. This report summarizes the RFI responses, and maintains the organization of the queries listed above in order to allow direct comparisons to reports on workshop findings.

2. Query 1: Technologies with Broad Impact

2.1 What criteria should be used to select technology focus areas?

- Technologies should have broad application (horizontal impact) across multiple industries, and should address a national need. Technologies should leverage and enhance the regional supply chain (vertical impact).
- The targeted Technological Readiness Level and Manufacturing Readiness Level should be 4-7; there should be a strong market potential.
- Technologies should be enabling, with transformational potential; they should be cross-cutting, widely adaptable, and driven by industry needs.
- The technologies should have the potential to increase the number of domestic jobs, and should have an impact on energy and environmental sustainability.
- Technologies should have geographical diversity.
- OSD ManTech Directorate and Joint Defense Manufacturing Technology Panel executive board should pick topics.
- Should involve infrastructure modernization.
- Areas should be technology intensive, not labor intensive.
- Focus on custom manufacturing (e.g., homes, clothing, pharmaceuticals for unique DNA, etc.).
- Clusters in rural communities.
- Focus should not be dictated before the solicitation. (This appeared multiple times in responses.)
- Industry must have skin in the game – at least 50%.

2.2 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
- energy devices/storage/renewable energy
- nano/micro technologies
- advanced lightweight materials and composites
- forming/casting/joining processes
- flexible/photonic/organic electronics
- additive manufacturing
- smart/precision machining
- robotics
- pharmaceutical/biomanufacturing

More generally, respondents pointed out the need to address challenges faced 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.

RFI specific suggestions, grouped into various classes:

Enabling Technology

bio-inspired manufacturing
bioprocessing
cryogenic techniques
cyber security
cyberphysical manufacturing
manufacturing equipment
    customizable manufacturing tools
mechatronics
MEMS/NEMS and embedded technologies
nano/bio manufacturing
nano/micro manufacturing
surface engineering
manufacturing facilities/wafer fab

Industry Sectors

chemical
cyber security
electronics
    custom electronics
    electronics assembly
    flexible electronics
    nanoelectronics
    organic electronics
    printed electronics
electro-optical devices
energy
    clean, renewable, alternative
    energy-conversion equipment
    biofuels
    fuel cells
    grid technologies and integration
    natural gas
    solar cells
    wind
energy storage and batteries
fluid power/pneumatics
food
healthcare
    biomedical devices
    nanomedicine
    personalized medicine
    pharmaceuticals
    tissue engineeing
high-performance computing
maritime technologies
national security and terrorism
optics
    imaging
    photonic integrated circuits
thermal processing and HVAC
transportation
    natural gas vehicles
water and water distribution

Manufacturing Processes

additive manufacturing
assembly and joining
    multi-material joining
    solid state welding and joining
coating and deposition
    printing
    roll-to-roll processing
composites manufacturing
electron beam processing
laser processing
    laser cutting
    laser marking
    laser sintering
    laser tracking and welding
machining and precision machining
near-net shape technologies
    casting
    extrusion
    forging
    forming
    hydroforming
    molding
    rolling
polymeric-based web conversion
powder metallurgy
separations and purification
surface finishing and peening
wide bandgap manufacturing

Manufacturing Systems

automation technologies
autonomy
digital manufacturing
digital model-based manufacturing
dynamic machine tool management
manufacturing strategy development
robotics and autonomy
sensors
    for diagnosis and control
    for harsh conditions
    for remote sensing
servo technologies
smart/intelligent manufacturing
    sensor-integrated manufacturing

Materials

"smart" materials
advanced magnets
amorphous metals
biomaterials
biomedical materials
ceramics
chemicals
coatings, thin films and surface treatments
    electronic
    mechanical
    optical
    synthetic biology
composites
    high-temperature
electro-optical materials
lightweight materials
    alloys
    structural ceramics
metamaterials
nanomaterials
    carbon nanotubes
    nanocomposites
next-generation semiconductors
photovoltaics
powder
superalloys

Metrology and Characterization

advanced metrology
in-situ metrology
materials characterization
    thin film and bulk stoichiometry
non-destructive evaluation

Product Development/Manufacturing Software/Tools

"big data"
design tools and informatics
information technology systems
modeling and simulation
rapid prototyping
mass customization/custom electronics

Sustainable Manufacturing

energy efficiency/shortage
repair welding
thermoplastic recycling
reducing greenhouse gases
wastewater reclamation and reuse

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

To demonstrate that the Institute's technology programs assist U.S. manufacturing, respondents recommended metrics on jobs created (re-shored or new), the number of startups including SMEs, partnerships in the Institute, application of methods developed within 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").

2.4 What measures could assess the performance and impact of Institutes?

- The number and quality of new or re-shored manufacturing jobs, global market share of exports, and trade balance.
- Number of new partnerships and number of applications of the technology (touchpoints).
- Infusion of technologies into the marketplace.
- The number of new startups in the region and the technology area.
- The size of the Institute's IP portfolio.
- Retention rate for Institute members and participation of SMEs in the Institute.
- The amount of industry and federal research funding received.
- The number of projects that develop from TRL4-7 to TRL8-10, and the number of licenses generated from the Institute.
- Number of students and industrial personnel involved in Institute research and workforce development activities.
- Quality and number of outreach activities to promote manufacturing within communities and the general public.

3. Query 2: Institute Structure and Governance

There were more than 50 responses to the NNMI RFI addressing the proposed structure and governance of an IMI. Respondents were a mixture of industry, academia, individual citizens, and alliances.

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

- Create a non-for-profit entity that acts as the recipient and manager of federal and leveraged funds.
- Each institute would have a "semi-autonomous" structure.
- Business model: precompetitive/collaborative environment, open access to tools/tech, etc. either fee based or membership based, annual fee with sliding scale costs, financial and business accountability with leadership and an Executive Committee.
- Business model should be a consortium (collaborative effort leveraging resources by combining public and private resources to expand program scope, investigate technology options, and produce higher quality solutions).
- Simple and streamlined business and governance models- determined at regional level. Recommend each institute has a board with fiduciary responsibility and business AND technology advisory group. However, management is not required to take advice from the boards.

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

- A Board of Directors for the IMI must include representation from all stakeholder groups
  - Governance should be provided by a Board of Directors which appoints a President and CEO, who is responsible for implementing a management structure and for day-to-day operations. Institutes should not be operated by universities, national labs, or governmental entities.
  - Cannot be overly influenced by one group, company, or person
  - Technology advisory groups acting as "circles of excellence" in relevant technology areas should be established to give advice on program objectives, project selection, and progress reviews.
- The Federal funding agency should avoid too much involvement in the management of the Institute. It should take a hands-off approach regarding day-to-day and month-to-month decisions.
  - Should not have government organizations making the decisions or calling the shots

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

- Membership should be on a "pay-to-play" basis, with members joining because they see value in membership
- Joint investment, joint involvement, and joint governance must address the culture and practices of the academic institution, private business/industry, and government at all levels for the Institute to have an impact regionally on jobs as well as nationally and globally in terms of technology innovation and deployment.
- Issues such as partial ownership of the new technology or conflicts of interest are particularly problematic, but will have to be worked and well known by the Institute stakeholders.
    - Three IP scenarios: Institute Member IP, Company Protected IP, Public Domain, Open Source IP
    - Membership fees can be based on organization revenue, organization type, or a fixed amount. The cost of a specific project should be covered by a subgroup of members who see value in supporting the project. The subgroup should determine the policy for any intellectual property created by an individual project, subject to governing law.

3.4 How should a network of Institutes optimally operate?

- Each Institute should function as a stand-alone center. The National Network should be a loose confederation sharing good practices, with minimal oversight and governance from the National Network.
- The network of Institutes should be a meta-version of the individual Institutes. The network should be governed by a board composed of a representative from each individual Institute. The network should have a full time director who reports to the board. The cost of operation of the network should be shared by each of the Institutes. Both the network and the individual Institutes must be provided the flexibility to modify the governance structure and business model as the network gains operational experience.
- There should be frequent sharing of information and lessons learned. Interaction should foster "innovation at the margins" recognizing that institutes have similar missions and objectives with common stakeholders at the national level. Other than information sharing and learning, institutes should operate independently of one another.
    - Client problem-solving should be the focus of network learning opportunities, tapping the value of the peer network in solving problems.
    - The heads of each Institute should meet regularly to coordinate joint activities such as prototype demonstration programs and educational outreach programs. The Subpanel Chairman will be responsible for coordination and collaboration across the Institutes within a Subpanel, and the National Council will meet to coordinate across Subpanels. Each Institute should be financially secure on their own so there will not be provisions for sharing financials across Institutes.

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

- Since the National Network should exist to help individual Institutes perform more effectively, the best measures would relate to the extent to which good practices are shared and adopted by multiple Institutes across the Network.
- Measures of network structure should mirror measures of effectiveness at the institute level, and might also include:
    - Number and quality of interactions between and among institutes
    - Diffusion of lessons and innovative approaches across institutes
    - To assess the network structure and governance, the following measures are suggested:
        - Number of institutes complying with centralized governance
        - Revenues of a centralized institute from industry participants
        - Number of patents / IP filed by all institutes
- The effectiveness of the Network's governance will be demonstrated when Institutes need to be added or removed, especially after the three-year initial government investment is completed.

4. Query 3: Strategies for Sustainable Institute Operation

4.1 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, etc. There was a desire expressed to limit overhead to 20%, and to avoid bricks and mortar investments. The initial investment should establish infrastructure and social capital. 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.

There was also an attempt to allocate funding by source, such as no more than 25% from industry, no more than 40% in state funding, no more than 5% from other, etc. It was suggested that not more than 30% of funding should be expended on education. Assessment measures included the number of new products created, and the increase in the manufacturing section of the US balance of trade.

A raw comment provided was that "Initial funding should be provided such that the Institutes have an incentive to grow industry-based revenues. For example, funding should shift from a heavy Federal cost share of 80% to 20% over a five year period" (State of Colorado, OEDIT).

Finally, other opinions included:

- If Institutes do not meet mandated performance targets, their government funding should be removed.
- Federal funding should continue until Institutes are self-sustaining. A small amount to sustain overhead and infrastructure should not be seen as a demerit.
- A venture capital model, led by a non-profit, with a tiered membership.

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

One recommendation was to make it clear up front that federal funding on projects would gradually decrease and that SMEs join activities with an incentive to invest later when the benefits of involvement are clearly demonstrated. 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. Proprietary research institutes with partial government subsidy for research were also mentioned (e.g., Bell Labs, SEMATECH, etc.).

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

Measures to assess the progress of an Institute could include the growth in the number of industry members over time, particularly SMEs, the number of early members that reinvest, the IP licensing revenue, the development of new products, patents and/or processes, the Institute's income compared to recurring expenses, number of new jobs in American manufacturing created, and the number of new exports. As one respondent stated, "Direct and in-kind support is the best measure of Institute potential for self-sustenance." Decreases in federal funding after the first 7 years may decrease interest of industry partnerships. The pay-to-play model, even in early years with increases through the end of federal funding, will ensure companies, governments, and universities are committed to Institute success. As related to technology areas, a broad focus will benefit sustainability. Also, there were warnings that macro-economic performance measures are difficult to use, that the most accurate and useful information will be at the IMI level. Finally, 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.

4.4 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. Respondents 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.

4.5 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. Institutes can seek out interdisciplinary research and encourage collaborative funding of projects. Some respondents 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.

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

IMIs could be offered 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 realizable 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 respondent suggested that a formal process be established to allow states to discuss their needs with the Institute. Finally, a searchable database could help people identify initiatives relevant to their needs and avoid duplication of efforts.

4.7 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:

- Number of new markets, techniques, products, etc. that the Institutes create.
- The TRL level progress of SMEs collaborating with the Institutes.
- Increase in manufacturing share of the GDP.
- Decrease in the trade deficit.
- Increase in the number of technologies that are manufactured in the U.S.
- Increase in the number of technologies that are developed for federal acquisition programs (DoD, DOE, NASA, etc.).
- Number of IP licenses granted (which could be limited to domestic use).
- Number of re-shored products achieved.

5. Query 4: Education and Workforce Development

This topic did not receive as much attention as the first three topics. When education and workforce development were mentioned, they were acknowledged as important, but few specifics were recommended. The few responses in this area centered around suggested best practices and assessment. Suggested activities to promote education and workforce development included:

- Bring manufacturing to students, such as by bringing 3D printers to schools and sponsoring appropriate contests.
- Bring students to manufacturing. Industry partners can host them, or Institutes can develop on-site fab labs.
- Offer free online training courses (based on Khan Academy model).
- Use video games for recruiting.
- Educate children before 7^{th} and 8^{th} grade so they do not track out of pre-algebra and other courses needed for STEM careers.
- Incorporate manufacturing into the curriculum. Develop curriculum materials for high schools and community colleges including both degree programs and certificates.
- Change the perception of manufacturing with youth, students, guidance counselors, and parents.
- Tap into the pool of returning veterans.

Assessment could be performed by evaluating metrics such as the number of veterans, K-12, undergraduate, graduate, and continuing education students involved; the number of students placed in industry (as well as demand-driven metrics such as the number of employers that hired new workers and the duration of employment); the number of fellowships and internships created; the number of collaborative projects between industry and academia; and the number of courses (including continuing education), accredited programs, and certificates offered by Institutes. It was suggested that ABET outcome evaluations are relevant and could be used.