



Rensselaer

VICE PRESIDENT FOR RESEARCH

Rensselaer Polytechnic Institute

National Network for Manufacturing Innovation (NNMI) Response to Request for Information

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Introduction:

Founded in 1824, Rensselaer Polytechnic Institute in Troy, NY is the nation's oldest technological university and is anchored by the founding philosophy of "the application of science to the common purposes of life." The Institute is especially well-known for its success in the transfer of technology from the laboratory to the marketplace so that new discoveries and inventions benefit human life, protect the environment, and strengthen economic development.

In the past decade, Rensselaer has dramatically expanded its research enterprise by leveraging our existing strengths and focusing on five signature research areas: Energy, Environment, and Smart Systems; Nanotechnology and Advanced Materials; Biotechnology and Life Sciences; Computational Science, Engineering and IT; and Media Arts, Science, and Technology.

Last year, the President's Council of Advisors on Science and Technology (PCAST), produced a report to the President entitled, "Ensuring American Leadership in Advanced Manufacturing." In addition, PCAST recently adopted the report, "Capturing Domestic Competitive Advantage in Advanced Manufacturing" which was prepared by the Advanced Manufacturing Partnership (AMP) Steering Committee. These reports have made numerous recommendations to the President, including calling for the creation of a network of national manufacturing innovation institutes.

Rensselaer was honored to be chosen to host the National Network for Manufacturing Innovation's inaugural workshop, "Designing for Impact I" at our Curtis R. Priem Experimental Media and Performing Arts Center (EMPAC). This national forum provided an opportunity for stakeholders from academia, industry and government to interact with and provide input to representatives from the Advanced Manufacturing National Program Office to shape the proposed NNMI.

Continuing with this on-going dialogue, Rensselaer is pleased to submit the attached comments in response to the NNMI Request for Information.

We look forward to continuing to work with the National Program Office on this initiative that is so vital to the future competitiveness and economic strength of our Nation.

I. Technologies with Broad Impact

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

We fully support the PCAST report recommendation of creating a national advanced manufacturing strategic plan which will be the basis for the selection of NNMI technology focus areas. The strategic plan should assess technology areas based on U.S. and global needs, and opportunities for global technology and market leadership. The needs will be assessed based on industrial sectors, such as aerospace, automotive, clean energy, pharmaceutical, biomedical, defense, electronics, lighting, building, etc. The opportunities will arise through fundamental innovations in academic, industrial, and government research in areas such as advanced materials, modeling and simulation, high performance computing, biomanufacturing, big data, advanced robotics, cyber infrastructure, etc. The NNMI's role should be to effectively and selectively infuse the needs with innovation to create new manufacturing paradigms and enterprises.

Currently, it does not appear that the National Institutes of Health (NIH) is an agency partner in the Advanced Manufacturing National Program Office. Since biopharmaceutical manufacturing and safety of biopharmaceutical products and their supply chains are so vital to the public health and manufacturing competitiveness of the U.S., Rensselaer believes that the NIH (and also the FDA) should be included as a partner in the NNMI/AMNPO effort and that NIH funds should be included in the Federal share of future NNMI Institute awards.

Biomanufacturing has the potential to address the need for greater efficiencies in drug development, and thus making better, safer, and less expensive drugs available to all Americans. This includes therapeutic proteins (such as antibodies and cell growth modulators), vaccines, and antimicrobials. Moreover, biomanufacturing is at the heart of routes to alternative fuels, safe infrastructure, regenerative medicine, and a host of other areas that improve the health and wellbeing of our nation.

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

Rensselaer has made significant co-investments together with federal and state funding in terms of research platforms and research personnel to foster and stimulate fundamental innovation, such as advanced materials, high performance computing, biomanufacturing, visualization, and others. Rensselaer also has significant experience in collaborating with industry, from startups to multinationals, to address real world needs leading to tangible impacts. We will target future investments to leverage the synergy between our strengths in the fundamentals with high impact industrial needs and commercialization opportunities, guided by the national advanced manufacturing strategic plan.

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

The performance of NNMI is best demonstrated through economic impact and creation of workforce pipeline. The most direct outcome would be increased industrial competitiveness in terms of revenue and jobs, driven by the innovation engine. Just as important is the creation of the culture of passion

for manufacturing, leading to a pipeline of enthusiastic, innovative, and well-trained manufacturing workers needed for the next generation of American manufacturing.

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

There are a number of successful state and international examples on economic impact assessment such as job creation/retention, revenue increase, start-up formation, IP generation. A key role of the institute is to provide access to a shared (national) platform or “ecosystem” for technology development, collaborative research, workforce development and technology transfer and commercialization. Therefore, assessment of the institute should emphasize the range and types companies (particularly small and medium-size enterprises) benefitting from the institute’s assistance, and the utilization and leveraging of the facilities and platforms of the institute. The assessment of the workforce pipeline role of the institute will be addressed in the response to question 20.

II. Institute Structure and Governance

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

The real opportunities for the NNMI program is to develop a public-private partnership that can aggregate demand for expertise and capital equipment and bring new partners together to address not only technical challenges but business model and supply/distribution chain management. The business model for the Institutes should facilitate the effective execution of this role. We envision the Institutes as independent non-profit organizations with participating industries contributing background expertise, technical challenges, and project funding, and academic partners providing broad technical expertise and innovative solutions. The Institutes offer equipment as well as permanent research, technical, and administrative staff to manage equipment and projects. The leadership team of the Institute should have a balanced representation from industrial and academic partners. The governing board should have representation from all major stakeholders, including member universities, community colleges, companies, government agencies and economic development organizations that comprise the Institute.

We also agree with the AMP/PCAST July 2012 report regarding IRS Revenue Procedure 2007-47 and believe that all NNMI Institutes should be granted a waiver from this Revenue Procedure for research conducted under the auspices of an Institute. This waiver would enable greater and stronger interactions between universities and industry.

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

Institutes should be focused on key areas of U.S. national economic strength or promising emerging technologies, but they must remain flexible enough to serve the many needs of diverse manufacturing sectors within a region. Therefore, although Institutes may be selected in particular topical areas, they could establish and leverage networks of distributed innovation support centers throughout a particular region and nationally with other NNMI nodes, since many manufacturing sectors have overlapping processes and needs (e.g., high performance computation).

Institutes should be centers of “co-investment”, meaning that academia, industry, government and economic development organizations should all invest in the center through funding or in-kind contributions. However, when determining the appropriate levels of cost sharing, consideration should be given to lowering the barriers for participation by smaller academic institutions and small and medium-sized companies.

The Institute should be located on or close to the lead institution, and should consist of several universities and colleges, a number of regional community colleges, and a consortium of companies within a particular industry up and down the supply chain. The universities and colleges would be chosen for their expertise in some specific segment of the focus technology. Small and medium sized companies (supplier network) and large companies (OEMs) should comprise the consortium. Building upon the established consortium, the Institute should provide a platform for participation by any interested U.S. manufacturer to increase national impact. For example, several centers at Rensselaer provide mechanisms for participation by interested industrial entities beyond the original founding partnerships.

The role of the Institutes is to drive innovation based on industrial needs and translate discoveries into products. Specific activities would include contract R&D for consortium members (with members being given preferential treatment and terms) and other companies, pursuit of state and Federal R&D funding for longer term projects, education and training of individuals from technicians to K-12 to Ph.Ds., incubating companies, commercializing technologies, engaging the venture network, and hosting workshops and conferences that foster discussion and collaboration and attract new participants.

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

The Institute should operate as an independent, non-profit corporation with a standard set of rules regarding financial and IP obligations, access and licensing. Institute partners would need to sign an initial “master” agreement that defines their engagement as an institute partner and separate agreements could be signed to facilitate specific industry/academia research engagements, licensing deals or IP agreements.

8. How should a network of Institutes optimally operate?

Each Institute should serve as a manufacturing “ecosystem” that turns discoveries into products, help grow manufacturing knowledge for U.S. companies, create new jobs and start-ups, and train/educate workers at all levels. To coordinate these Institutes, there should be an “NNMI Headquarters”, national program office or some other form of national governance structure that guides individual Institute activities to promote U.S. economic initiatives, facilitates interaction between Institutes for cross-cutting manufacturing initiatives, and increases the national impact of the network through aggressive strategic communications and public outreach. The Director and Co-Director of each Institute could serve on a national governing council to promote coordination, sound governance and best practices.

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

Many of the same “metrics” or performance measures discussed in the answer to Questions 3 and 4 are also applicable to assess the efficacy of the NNMI structure and governance. Nationally, metrics could include the number of total jobs in the U.S. manufacturing sector, U.S. manufacturing productivity, total economic output from the U.S. manufacturing sector and possibly an increase in export activities from the U.S. manufacturing sector. The national program office should convene “lessons learned” workshops to maximize the effectiveness of the individual Institutes and the Network. The overall goal should be to demonstrate that the Network’s effectiveness is greater than the sum of its parts.

III. Strategies for Sustainable Institute Operations

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

Ideally, there should be a large up-front investment from the Federal government with an equitable mix of funding (including “in-kind” from non-Federal sources) from academic and industrial partners. Levels of cost sharing should be determined with consideration given to lowering the barriers for participation by smaller academic institutions and small and medium-sized companies.

As time progresses, Federal funding could reduce while other funding sources could ramp up, eventually leading to self-sustaining Institutes. However, since advanced manufacturing is so vital to U.S. national and economic security – and since the Institute will always need base funding that provides operational continuity – a baseline Federal funding to provide some staff support and facility maintenance would be highly desirable. This also ensures that the government’s public policy interests remain reflected in the programmatic direction of the Institutes.

We also suggest setting up an incentive fund to be used to accelerate the most promising areas, and also a mechanism to phase out low-performing areas, based on the Institute’s annual review.

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

The initial investment by the Federal government is essential to establish organizational and physical infrastructure and staff. Over the course of the engagement (e.g., 5 – 10 years) the proportion of Federal support compared to other sources could incrementally decline as the Institute develops stable revenue streams from industrial membership, industrial projects, and royalty revenues. A sustained baseline funding would be helpful with staff retention and facility upkeep. The government should consider giving tax credits to industry participants to incentivize participation in the NNMI.

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

The primary measure that could lead to self-sustainability is the proportion of an Institute's operating budget that is provided by the NNMI program relative to other support from industrial partners. Ideally, this proportion could be reduced year after year to some minimum level guaranteed by the Federal government to maintain continuity and continuously align Institute activities toward national needs and goals.

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

The program could allow the established Institutes to assist domestic manufacturers that operate U.S.-based production plants and domestically headquartered manufacturers that operate international production plants.

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

It is imperative that the Institutes actively engage with and leverage existing local, state-wide and national manufacturing programs and networks. For example, New York State has many well-established and robust networks that serve to foster innovation and drive manufacturing competitiveness across the state, including:

- Regional Technology Development Centers (RTDCs)
- NIST-MEP centers
- Centers for Advanced Technology (CATs)
- Centers of Excellence (COEs)
- The High Performance Computing Consortium (HPC2)

An Institute should partner with these kinds of networks to attract participants, foster dialogue, disseminate knowledge, and deliver services. The Institute's board of directors should include representatives from these networks and organizations. The Institutes should also require all active participants to be members of relevant professional trade organizations and academic societies. (For example, in the composites manufacturing sector, participants should be members of SAMPE, American Society of Composites, American Composites Manufacturers Association, etc.) Furthermore, the Institute leaders and representatives should actively participate in society and organization conferences and the Institutes should serve as host venues for these conferences.

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

Many states have well established and effective economic development authorities and networks. In New York, NYSTAR and NYSERDA have both been highly effective in fostering public-private partnership leading to significant economic impact (New York's Centers for Advanced Technology or CAT program has \$5B in economic impact in the past decade). It is critical that the Institutes draw on the successful experience of these entities for the organization and operation.

The Institutes should actively engage with and leverage local economic development authorities and networks to maximize reach and impact. For example, an Institute could partner with these kinds of networks (economic development organizations, manufacturing roundtables, chambers of commerce, industrial development agencies) to attract participants, foster dialogue, disseminate knowledge, and deliver services. In addition, the Institute’s board of directors should include representatives from these networks and organizations.

Of particular significance to New York State, the Governor has established 10 Regional Economic Development Councils (REDCs) to drive economic development in specifically identified regions in the State. These councils are co-chaired by a member from industry and a university president. In fact, many of these regions have developed strategic plans that identify “advanced manufacturing” as critical to that particular region’s economic vitality and competitiveness.

An NNMI Institute in New York State should partner and work closely with these REDCs to ensure that the Institute’s activities are aligned with New York’s economic development priorities and incentives.

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

Many of the “metrics” that can be used to measure long-term competitiveness are also listed in the response to Questions 3 and 4, including:

- The number of new “discoveries” that are translated into commercialized or manufactured products as a result of the collaboration between academia and industry partners within the Institute.
- An increase in the number of new jobs – especially engineers, scientists and technicians – that are created as a direct result of Institute collaborations and participation.
- Increase in sales of new or improved products/services resulting from Institute activities as reported by consortium companies.
- An increase in new domestic start-ups or spin-off ventures created as a result of Institute activities.
- Research Leverage: An increase in the amount of R&D funding brought in by consortium partners and companies with Institute assistance.
- Repatriation Activity: The number of new domestic jobs created as a result of U.S. companies re-locating their manufacturing activities back in the U.S. or in the number of international companies opening up manufacturing facilities in the U.S.
- Number of new engineers, scientists and technicians entering workforce that are trained at universities, colleges or community colleges that are affiliated with the Institute.
- Number of patents and copyrighted works (e.g., software) generated from Institute activities

The national program office should consider how explicit national security issues – such as war fighting, export control, cybersecurity, raw materials resource independence, etc. – are manifest in the objectives, processes, and outcomes of the Institutes and Network.

IV. Education and Workforce Development

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

In most industries there is little consistency in, or sometimes a complete lack of, educational materials and curriculum to support workforce development. An Institute, in conjunction with appropriate industry organizations, professional societies and governmental agencies should standardize the curriculum, required technical knowledge and skills, degrees (A.S., B.S., M.S., PhD), and certifications (technician, post-graduate, professional licensure) required for that particular industry.

In addition, an Institute should pilot all educational efforts and freely disseminate information and their findings to U.S. academic institutions and companies through a web portal and through related conferences.

The Institute should champion national manufacturing-themed competitions, in the spirit of FIRST Robotics competition, to generate excitement and enhance visibility of advanced manufacturing.

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

This is a critical function of an Institute and any activities in this area should be “pulled” from or “driven” by specific industry needs. An Institute should work closely with its industry partners and regularly query these consortium members for what knowledge and skills are required for workers in specific industry sectors. With that information from its industry partners and Institute should develop training platforms, core facilities and curricula that serve the workforce needs of participant companies and enables their future success, growth and competitiveness.

The Institute must also continuously survey the graduates of participating educational institutions (at all levels in workforce) to determine strengths and deficiencies of the Institute’s educational initiatives.

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

It is imperative that the Institutes actively engage with and leverage education and workforce development programs at all levels from K-12 to Ph.D. programs. New York State has strong education and workforce development programs – both governmental, non-governmental, and community colleges – that serve to foster economic growth through the development of a highly-skilled workforce.

An Institute should partner with community colleges, workforce investment boards, apprenticeship programs and local school systems to ensure that these entities are Institute participants and are aligned with the current and emerging technical and industrial workforce needs. To ensure that this is a seamless dialogue, the Institute’s board of directors should include representatives from these workforce development networks and organizations.

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

The “metrics” or measurements to evaluate performance in this area would include:

- The number and percentage of Institute graduates who are employed in the industry sectors aligned with the Institute’s technology focus areas.
- The number of academic institutions that have adopted courses, course materials, curriculum, or educational materials from the Institute into their programs.
- The number of criteria proposed by the Institute that are adopted by academic degree accreditation agencies (e.g., ABET criteria for composites engineering programs).
- Surveys from companies employing Institute graduates about how well prepared they were for that industry and how they are contributing to the company’s commercial success.

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

Student researchers and post-docs from participating educational institutions should work collaboratively and side-by-side with industry partners on actual industry projects to provide solutions to industrial challenges. Institutes should create collaborative programs so students can work as interns or fellows within industry to gain experience and technical knowledge that can enhance their educational experience. Companies would be able to utilize these programs as pipelines to recruit and employ students upon graduation.

In addition, the Institute’s R&D findings and discoveries should help drive new courses, curriculum, degrees, certifications, etc. R&D and education inherently cross breed at academic institutions, i.e. industry’s needs drive research, and research discoveries translate to new educational approaches and topics.

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