



**Response to  
Request for Information on Proposed New Program:  
National Network for Manufacturing Innovation (NNMI)  
Docket No. 120418419-2419-01**

## **Introduction**

In this the 150<sup>th</sup> anniversary year of the Morrill Act of 1862, the Association of Public and Land-grant Universities (APLU) is pleased to submit this response to the Request for Information on the proposed new National Network for Manufacturing Innovation. The Morrill Act created institutions of higher education focused on the agricultural and mechanical arts. The place these institutions took in America’s agrarian economy is well-known.

The role of the land-grant colleges in engineering and manufacturing industries is perhaps less known, but a vital part of the land-grant tradition. Public research universities, including land-grants, today are playing a critical role in revitalizing manufacturing in the U.S., and helping to create a new era of *advanced* manufacturing, focused on making, and making *with*, high technology products, new materials, and innovative fabrication processes. University contributions to the revitalization of manufacturing can be seen across a spectrum of knowledge economy assets, from education programs that develop highly skilled talent for the new manufacturing workforce, to research and development of technologies for advanced manufacturing, to the renewal of communities through cultural and social contributions—making manufacturing centers great places to live and work.

Many of APLU’s member institutions stand ready to increase their role in this revitalization of American manufacturing. Our comments in response to this Request for Information demonstrate this readiness, and we look forward to continuing to help carve out the university role in manufacturing innovation.

## **Technologies with Broad Impact**

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

Selection criteria should be dynamic, to accommodate advances in technology and expertise and to meet the broad needs of manufacturers.

Some criteria to consider include:

- Likelihood that the technology will contribute to increasing the economic prosperity of the U.S., including areas where U.S. can be competitive or already has a lead (such as aerospace, information technology, etc.)
- Focus areas that are likely to support entrepreneurship, particularly those that support decentralized manufacturing
- Extent to which the technology helps address national needs
- Prospect for contributing significantly to the development of a new manufacturing infrastructure
- Disruptive potential of technologies—their ability to fundamentally change how business is done
- Potential of technologies to make incremental but important advances in existing products, processes, and platforms, in terms of performance improvements, cost reductions, mitigation of environmental impacts and economic and social value
- Opportunity to create collaboration between institutions of higher education, industry, and government
- Availability of regional expertise, from both industry and universities, which could be tapped to develop and support technologies that are “market-ready” through R&D or education and workforce development (the furniture manufacturing industry in North Carolina illustrates a good model; the development of Silicon Valley is another)

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

APLU member institutions are already investing in a wide array of technology focus areas by developing education and R&D programs around them. Our institutions train and update the skills of a majority of the nation’s engineers and we accept the responsibility of making sure skilled workers are available for manufacturing across the board. We want to work with industry and government to make sure to close current skills gaps as quickly as possible.

In particular, the following technology focus areas are emerging on the cutting edge of these programs:

- Nano- and micro-technology
- Nano-structured and light-weight materials
- Customized medicine and biomanufacturing
- Alternative energy development
- Digital and additive manufacturing
- Cyber-infrastructure
- Big data
- Modernization to Maintenance and Repair and Overhaul (MMRO)
- New manufacturing processes and machines

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

and

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

The expected impact of these strategies is the revitalization of manufacturing in the U.S. and renewed economic prosperity due to that renewed vitality. The best measure, then, would be economic wealth. However, measuring this kind of long-term outcome is difficult.

APLU and its member institutions have been working on the development a set of measures and metrics that can be used to describe university contributions to regional economies. APLU is developing a report on how the lessons learned in this initiative can inform efforts by NIST and other federal agencies to develop similar measures. A couple of broad lessons regarding measures and metrics are worth noting here:

- A. It is important to include measures and metrics that describe not only outputs and outcomes of individual organizations or collaborations, but also the contributions made to the development of an innovation ecosystem. Such contributions include the construction of social capital, expansion of networks, and identification of needed structures and processes for successful collaboration. “What gets measured gets done,” and measuring factors that contribute to the establishment of innovation ecosystems will help insure fertile ground for the sustainability of innovation outcomes.
- B. Because it is important to have measures of inputs and processes as well as outputs and outcomes, careful consideration must be given to how these factors fit together in a “logic model.” When the desired outcomes are far removed in

time from the activity to inputs and activities, a logic model is helpful to determine and illustrate how the identified activities and outputs lead to desired outcomes, changed behavior, and ultimate impact.

All of this is not to say that strategies should not include an appropriate set of evidence-based measures and metrics. These could include:

- Stories of manufacturing improvements (material, process, and systems)
- Partnerships
- Job growth
- Performance improvement of products
- Cost reduction of the products
- Reduction of environmental impacts
- Strengthening of the domestic supply chain
- Number of new industries created, growth of industries and universities served by the IMIs
- Number of jobs created and retained
- State-wide revenues generated
- New IP created
- Businesses attracted to region

Measures specific to university contributions to Institute technology activities might include:

- Connections between partnership activities and translational mission
- Number of programs that cater to strengths
- Student engagement
- Career success of students and graduates
- Funding for university research in manufacturing
- Quantity of researchers focused on manufacturing
- Quality of research and development in manufacturing including numbers of publications and citations of publication and number of patents
- Improved manufacturing employment and economic impact
- Quantity and quality of resulting intellectual property
- Quantity and quality of academic publications
- Stories of university industry collaboration that creates manufacturing technology and jobs

Refer also to report being prepared by APLU for NIST related to APLU's metrics effort.

## **Institute Structure and Governance**

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

and

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

We recommend avoiding complexity in developing business and governance models—as simple and streamlined a structure as is possible while insuring efficient and effective operations should be developed.

In general, the following should be considered when considering appropriate business and governance models:

- Governance and business models should be determined at the regional level—integrating with regional innovation ecosystems and regional development and innovation goals
- The business model should help to foster cultural shifts at universities and industries to enable collaboration towards shared IP, and higher technology readiness levels (TRLs)
- The model should represent an association of participants bound together by shared goals and vision
- Advisory boards should be independent and non-partisan, and should be used to support and guide decisions
- The Institutes should be separate legal entities with independent governing boards
- Advisory boards should include a business advisory group—including bankers/investors—and a technology advisory group
- To insure that Institutes can eventually stand on their own, it will be important not to have government organizations making the decisions or calling the shots
- The board should have fiduciary responsibility to stakeholders for Institute performance
- In *Building Better Boards: A Blueprint for Effective Governance* (2006, Jossey-Bass), Nadler and Nadler present five levels of board engagement, from “passive board” to “operating board.” The mid-level board in their rubric is called the

“Engaged Board,” and Institute boards should function at this level of engagement: providing insight, advice, and support to the CEO and management team, overseeing the CEO and Institute performance, judging and guiding management, and adding value to decisions by seeking outside expertise.

- The technology advisory group and business advisory group should have: no control over action of management - management not required to take or follow advice; the ability to expand credibility, resource access, perspective, networking

7. 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
- Return on member investment might come through intellectual property and licensing, but related obligations should be determined locally by the governing board, to reflect the promised value of each institute
- That said, standardization of business practices is key. Business needs certainty to deal with these organizations, and if each has its individual idiosyncrasies in dealing with industry they will not be effective. They need to be able to work seamlessly with industry because time to market for their ideas is crucial.
- Intellectual property should be owned by the employers (universities and companies) of the inventors.
- Commercialization, access, and licensing will be subject to the market for intellectual property.
- Funding will also be subject to the market—agreements will be reached when parties see value in the collaborative relationships fostered by the Institute.

*8. How should a network of Institutes optimally operate?*

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.

Examples of approaches to platforms for frequent sharing of information and lessons include institute directors meeting once yearly, and facilitation of sabbaticals for faculty and mid-level management at IMIs.

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

(See also response to items 3 and 4.)

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

**Strategies for Sustainable Institute Operations**

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

- Focus of initial investments should be on establishing infrastructure and social capital needed for long-term success.
- Both in-kind and cash contributions should be considered, as should a matching scheme.
- The Institutes should be launched by federal funding sources and other “set aside” priority funds established and administered in conjunction with government agencies and national laboratories.
- Federal funding should be continued until institutes reach a self-sustaining operational phase, and not stop at the launch phase.
- A phased plan for transitioning from federal funds to private and local public funds should be developed and implemented. The Nanotechnology Institute at University of Michigan provides a good example of a shared institute that is sustained by industry and university.
- The German Fraunhofer Institutes provide a good model for balancing federal and local funds.

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

The Institutes will need initially to be primarily supported through federal sources. Implementing over time a “pay to play” model will insure that other actors, including state governments, universities, and industry, make a commitment to the success of the institutes. As technologies and techniques supported by the institutes align with the regional and state priorities, there will be significant investment at public levels at that point. Local and national industry players will invest to the extent they see value returned in specific projects.

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

This does not appear to be a model that can be self-sustaining without either government or philanthropic support. Alternatively, a proprietary research institute (Bell labs and Sematech are examples) with partial government subsidy for research may be viable.

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

The key to further building the U.S. manufacturing system is productivity, rather than restraint of trade. Governments can (under GATT) and should facilitate research and favor their own country’s intellectual property.

The Network should also create standards and rules for information exchange.

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

Institutes should participate in other manufacturing-related learning networks and should be careful not to re-invent the wheel. Institutes could engage with others by contract on a case by case basis recognizing that engagement will occur to the extent there is a positive value proposition for each participant.

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



In the end, it is the policies of state governments that drive regional economic development. All aspects of Network and Institute governance and operations ought to recognize this. The level of financial involvement by state, regional, and local governments and institutions should be a significant indication whether the necessary level of commitment exists to develop the social capital needed to achieve institute goals.

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

(see also response to items 3 and 4)

- Even when measuring long-term economic security and competitiveness at the national level, it will be important to use regional statistics and measures.
- Traditional measures of economic vitality can be helpful here.
- Measures focused on competitiveness in terms of innovation should also be considered—see especially measures included in the State New Economy Index by the Information Technology & Innovation Foundation (ITIF).

## **Education and Workforce Development**

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

APLU member institutions are committed to providing education programs that advance the manufacturing workforce. Public research universities can partner with other sectors of higher education, including community colleges, regional comprehensive universities, and Predominantly Undergraduate Institutions (PUIs) to insure that all skill levels are addressed.

Key goals of Institutes should include development of the science of advanced manufacturing and integrating knowledge with design innovation—encouraging not just learning, but also invention. Working with both university and industry partners,

Institutes could promote and facilitate student engagement and career-long learning through a variety of mechanisms:

- Co-ops, internships, and externships
- Student research opportunities
- On-site education
- Broad access to information
- Provision of learning content at all levels via publications including on-line learning modules
- Input on university and industry training curriculum
- Use of facilities for experiential learning
- Taking an active role in the assessment of learning, especially as such assessment relates to career competencies

Consider the agricultural cooperative extension infrastructure as a way to gain a broad reach throughout the country, including rural areas.

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

Institutes could help universities and local industry quantify and qualify the “skills gap.” Clarity of needs created by this gap will be important to aligning university curricula with industry needs.

Institutes can help to establish and communicate learning objectives for both university curricula and industry training programs (including industry-led certification programs), and can serve as advisors on content, assessment, and credentialing.

Consider mentoring and team models that pull industry partners into the student learning experience.

Work with industry, the American National Standards Institute, and accreditors on additional certifications.

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

Institutes can provide a vital link and “match making” role between industry and universities. As part of this role, Institutes can help match real world experience opportunities to curriculum-based competency development.

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

(see also responses to items 3 and 4)

Some specific ideas related to assessment of Institute performance and impact on workforce development include:

- Establishing related knowledge and skills records (similar to medical records) for learners, perhaps maintaining and publishing these without personal information.
- Measuring job growth in related industries
- Counting degrees granted (although greater granularity may be needed and may be met by the knowledge and skills records idea)
- Counting quantity of advisors involved in workforce development

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

- By strongly integrating university programs and being inclusive with both universities and industries.
- By making facilities and equipment and human expertise to the workforce learners.
- By insisting that learning occur through a healthy balance of experiential learning, classroom learning and independent individual learning.
- By surveying industry regularly on employment needs, monitoring the skills gap, and working to close it.