

Comments submitted by the Massachusetts Institute of Technology to the Department Of Commerce, National Institute of Standards and Technology in response to Docket No. 120418419-2419-01d
Request for Information on Proposed New Program: National Network for Manufacturing Innovation (NNMI)

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

While the initial NNMI offering led by the Defense Department took essentially a “top down” approach, with the advanced technology focus pre-identified by the agency as “additive” manufacturing, there should be room for a more **“bottom up” approach** which encourages interested applicants to propose creative solutions to advanced manufacturing challenges of their choice. To satisfy the local and regional aspirations of the program, the NNMI solicitation or guidelines should set some broad criteria in at least some NNMI offerings which effectively provide a definition of “advanced” in the phrase “advanced manufacturing”, rather than pre-selecting the desired technology focus areas. This will **allow proposers to develop the strongest teams with the best chance for impacting and building on their regional manufacturing ecosystems**. To ensure that national needs are met, high-priority application areas and potential technologies of interest can be defined for the overall program and for individual solicitations.

This approach is generally consistent with the statement in the “Examples of Potential Focus Areas” section of the RFI. However, the RFI statement that the focus areas of various institutes should not overlap is overly strong. Many potentially relevant focus areas overlap significantly but are not duplicative. The final wording should be crafted so as not to exclude overlapping interests, as long as there is a sufficiently strong differentiator tied to regional strengths. Some overlap may encourage synergistic collaborations among institutes and strengthen the “network” aspect of the program.

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

The business models should be designed to **leverage the existing strong connections between universities and strong innovation ecosystems** which have developed in many regions of the country, but in which the manufacturing sector is rarely represented well. As noted in AMP Report¹ Recommendation #5, this will require consideration of how to overcome fundamental barriers impeding the engagement of small and medium manufacturing enterprises with research organizations and improving the access to capital at each point from startup to scaleup. Regional investors and state economic development agencies must be involved in developing and executing Institute business models if SME manufacturers are to be more fully integrated into these innovation ecosystems.

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

The institutes must serve two needs: national and regional. The progress and results of the NMMI's must meet national as well as regional needs, since the program as a whole aims at a transformation of manufacturing that produces national results. An Institute's governance structure should incorporate clear policies for **disseminating knowledge and results** learned from projects both within and beyond the performing region. Procedures should be developed for the incorporation of members beyond the original team, evaluation of progress, and reorganization or termination of projects with disappointing results. These procedures and policies should consider how to maximize the Institute's overall impact on U.S. manufacturing capabilities by sharing pre-competitive information widely while preserving proprietary information developed by individual project teams.

One aspect of governance that should not be overlooked is development and ongoing oversight of a **long-term strategy** in the selected advanced manufacturing technology. (See also Question 14). Strategic guidance and measurement of progress towards an Institute's strategic goals would be enhanced by a **collaborative advisory board** whose membership goes beyond the Institute partners, to obtain a national reach beyond the immediate region. The NMMI can be a convening entity for developing these technology strategies and coordinating them with a National Advanced Manufacturing Strategy (AMP Report Recommendation #1). The role of an advisory board with industry, university and government technology experts could be modeled on the role a "blue ribbon" committee of visitors plays in evaluating research programs at many agencies or academic departments at most universities. Coordinated national strategies guided by advisory boards providing a big-picture perspective would ensure that, individually and as a collective network, the national reach of the Institutes was maximized.

7., 8. What institute structure would be effective, such as financial and intellectual property obligations, access, and licensing? How should a network of Institutes optimally operate?

The institutes should **share best practices for management, drafts for intellectual property rights agreements, financial agreements, database structures**, etc. This need not be done in a proscriptive manner, but could be achieved via modifiable examples or templates. This will accelerate the commissioning of new institutes and the acceptance of new projects within an institute. Sample agreements are particularly valuable to participating SMEs and smaller academic partners, who often do not have in-house staff or expertise relevant areas.

The institutes should also develop provisions for networked sharing of information about members or customers (with their permission) and

materials, products, or processes they can provide or are interested in obtaining. This need not be done by collecting information in a central repository; rather, the network of institutes could encourage the use of standardized metadata which allows information maintained at each institute to be discovered and analyzed by other network members or outside users. The originator/owner of information should have final discretion as to how much information is disclosed to various kinds of users, but the network should encourage information providers to default to an open access policy.

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

The Institutes should engage broadly and leverage existing networks and programs wherever possible. One important aspect is **engagement with manufacturing R&D programs** and activities. To successfully translate emerging technologies into commercial products, the Institutes cannot operate as stovepipe sections in a linear development process. The partnership between industry, academic researchers, and state or federal agencies within each institution should be structured with bi-directional linkages between each partner. Then, for example, issues that arise in transitioning a particular process from Technology Readiness Level (TRL) 6 to 7 may stimulate new research on that process, outside of the institute itself, at TRL 2 or 3; conversely, the close collaboration with supporters and performers of more basic research may give the process developers inspiration for a novel solution directly applicable at TRL 7. Involvement in a series of such issues may help a participating agency identify the need for a new research program thrust earlier than they would have otherwise. Institute designs should specifically consider opportunities discussed in AMP recommendation #4, Empower Enhanced Industry/University Collaboration in Advanced Manufacturing Research, for example by promoting new models for interdisciplinary research among their academic participants and by incorporating provisions for rapid initiation of spinoff research projects into their partnership arrangements.

Another important aspect is **strategic engagement**. Each Institute's program should be more than a collection of tactics with which to solve readily identifiable problems and generate incremental improvements in a particular technology area or application field. Each program should be related to a strategy (existing, or developed by the Institute) that anticipates needs and projects 10-15 years into the future concurrently with addressing short-term needs. The strategic goals of the institute should be paired with success metrics and evaluated by an outside advisory board. (See response to Q6),

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

In developing education and training plans, Institutes should be encouraged to **consider newly available technologies for online and blended content delivery**. Courses using these technologies could be utilized both for training future workers and for offering current workers opportunities to learn new skills, with prospects for easily scaling to new sites as the focus area technology gains a foothold. Individual modules (rather than full courses) can also be developed to enhance existing workforce training programs with information on emerging manufacturing techniques, and to provide continuing education opportunities which bring professional engineers up to speed on new advances in manufacturing.

18 & 19. Insuring that workforce development efforts meet industry needs, leveraging and complementing existing education and workforce programs

Over several decades, a trend has emerged in which research universities eliminate manufacturing engineering departments and slowly remove manufacturing topics from most industrial engineering programs. One way the NMMI Institutes could help reverse this trend, allowing research universities to better serve the needs of industry, would be by encouraging NMMI Institutes to **forge links with comprehensive university masters degree programs** with a manufacturing focus. These programs could develop and provide Institute-related educational activities that **incorporate both technological and operational perspective in a professional engineering context**.

By supporting students in comprehensive industry-focused programs, as opposed to narrower research-based masters programs, the Institutes can help **develop industrial leadership in advanced manufacturing**, raise the level of professionalism among manufacturing engineers, and promote a positive image of engineers as innovation leaders. Students entering these programs are drawn to the notion that manufacturing is how technological advances and innovations become rooted in a nation's economy. These programs are generally **well-connected to industry manufacturing organizations**, rather than to industry R&D groups or advanced technology programs. This provides additional pathways for industry-university cooperation.

Individual institutes could develop direct ties with existing comprehensive masters programs (e.g., Master of Engineering programs at [MIT](#), [Berkeley](#), and the [University of Michigan](#), which blend technology studies with courses in operations or management). Alternatively, they could work with their university partners to develop new programs matched to regional strengths. Additional rationale for encouraging professional master's programs and linking students in those programs to the Institutes can be found in

Revitalizing U.S. Manufacturing to Capitalize on Innovation—Through Education.²

The institute networks should also consider **mechanisms for funding students enrolled in such programs**, perhaps involving service commitments. Commitments could be mandatory (as in the NSF/OMB Cybersecurity Scholarship for Service Program) or could be a basis for forgiving student loans. Most current US Government support for graduate students specifically excludes programs that do not have a core research focus. Direct industry support for these programs has proven to be difficult to sustain through the vagaries of business cycles, but pooled industry support through individual manufacturing Institutes or through the network of institutes should be encouraged as a contribution to a **highly visible national manufacturing fellowship or scholarship program** involving the NMMIs (and potentially other federally supported advanced manufacturing programs).

These suggestions are consistent with AMP Report Recommendations #11 and #12. Broadly speaking this would be one mechanism for ensuring that, as the NMMIs extend the university-government-industry partnership model beyond the pure research domain, highly qualified personnel can move smoothly from the university to industry to implement emerging advanced technology products, processes, and knowledge.

¹Note: References to the AMP report are to “Report To The President On Capturing Domestic Competitive Advantage In Advanced Manufacturing”, President’s Council of Advisors on Science and Technology, AMP Steering Committee, July 2012.

² Anthony, B.W, Hardt, D.E., "Revitalizing US Manufacturing to Capitalize on Innovation – Through Education" 119th ASEE Annual Conference, San Antonio TX, June 10-13, (2012) ([download here](#))

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