

Request for Information National Network for Manufacturing Innovation (NNMI)

At the College of Engineering at the University of California, Berkeley, we believe that advanced manufacturing has tremendous potential for spurring innovation, economic growth and job creation in the United States. Our experience collaborating with the Advanced Manufacturing Partnership (AMP) initiative has included serving on the AMP Steering Committee, leading the AMP Work Stream analysis and planning for Technology Development, and designing and hosting the December 5, 2011 Regional AMP conference.

Through our deep engagement with AMP and driven by our profound interest in maximizing the impact of this critical AMP effort, we have crystallized our thinking across the range of AMP-related issues and topics highlighted in this Request for Information (RFI). For the questions raised below, we have outlined our views and look forward to further discussion and engagement on these pivotal issues. On behalf of our entire Berkeley team, thank you for this opportunity to share our thoughts on this critical initiative for the United States.

Respectfully submitted,



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

Technology focus areas should be chosen after analysis that includes:

- **INDUSTRY IMPACT:** Maximizing breadth and depth of impacts across multiple, key U.S. industry sectors;
- **COMPETITIVE POSITION:** Leveraging strengths and competitive position of U.S. manufacturing in the global economy;

- **EMPLOYMENT GROWTH:** Improving the ability of the U.S. economy to effectively grow employment in key sectors such as defense, energy, health, transportation.
- **SHORT TERM & LONG TERM IMPACT:** The technologies selected would ideally show promise for both near term impacts as well as longer term additional impacts;
- **TECHNOLOGY READINESS LEVEL:** The technologies selected should be at a readiness level to transition quickly to commercialization without going through the full arc of basic research and feasibility development. Focus areas should be selected that underlie technology capabilities in terms of flexibility, quality, through-put, sustainability and competitiveness;
- **MARKET DEMAND:** Technologies whose “scale-up” are a low-risk for financial institutions and other investors

The process of selecting technology focus areas should include industrial, academic and government leaders and should be an inclusive process inviting opinions, using collective intelligence and building up consensus among participants. Criteria for prioritizing goals should be aligned against U.S. national security needs such as defense, energy, information communication technology, health and global market demand, U.S. readiness for commercial competitiveness and global technology readiness. It would be worthwhile to think about designated Institutes for each of the broad areas. This will reduce duplication of effort.

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

We are interested in the platforms of:

- Advancing Sensing, Measurement, and Process Control
- Advanced Materials Design, Synthesis, and Processing
- Visualization, Informatics, and Digital Manufacturing Technologies

Within a foundation based on:

- Sustainable Manufacturing

These are fundamental technology areas where advances will need to be made in order to make progress in sectors such as: aeronautics, transportation, renewable energy, bio-medical, and consumer electronics.

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

An increase in some or all of the measures indicated below would be a good benchmark to show that the Institute’s technology activities are assisting U.S. manufacturing.

Growth in the following areas:

- U.S. manufacturing competitiveness in specific sectors
- work force growth
- market shares
- exports
- investments in manufacturing infrastructure and the opening of new facilities
- ability to recruit/fulfill manufacturing employee positions
- participation from the financial/investment sector

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

The Institute's success should be measurable in ways such as: continued contractual research from industry and government, technologies that are commercialized, knowledge base transfer, U.S. manufacturing competitiveness in specific sectors, work force growth, increase in market shares, increase in exports, and investments in manufacturing infrastructure.

We suggest Institutes go beyond assessments such as number of start-ups, patents and faculty papers to examine indices such as: a decline in unemployment, revitalization of economically depression regions, reinvestment in industrial zones that also stimulate the supply chain in the region as a "multiplier effect" increase in productivity, increase in manufacturing output, increase in sales, and increase in market share over a reasonable period of time.

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

We would recommend a performance-related business model similar to the Fraunhofer Society or Sematech. The National Network of Manufacturing Institutes would receive funding both from industrial contract research and the public sector. As a consequence, the Institutes would operate in a dynamic equilibrium between application-oriented fundamental research and innovative development projects. IP issues would need to be completely revisited. For example, the Bayh-Dole statutes will have to be revisited with a comprehensive, rationalized and progressive IP policy.

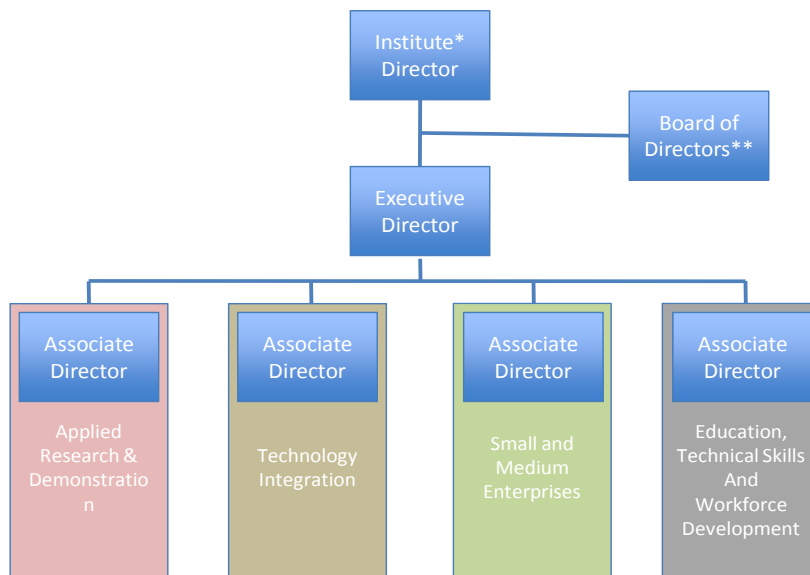
This model then scales the size of the Institute's budget largely on its success in maximizing revenue from commissions. This serves both to drive the realization of the Institutes strategic direction of becoming a leader in applied research as well as encouraging a flexible, autonomous and entrepreneurial approach to the society's research priorities.

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

It is our recommendation that the *Institutes* be coordinated by a non-profit led independent consortium linking manufacturers, educators, researchers and national laboratories. The Institute would be advised by an external Board of Directors composed of representatives from business, academic, financial and government organizations that support the Institute. Please see *Figure 1* below which illustrates this suggested model.

Figure 1: Proposed Governance Model

Institute Governance Model for non-profit led consortium



* Institute comprised of Industry consortium (two or more members), at least one major research university and/or national lab, participation of related SME's, and active participation by other regional universities and community colleges, and at least one venture capitalist to serve as an advisor

** Representing business, academic and government organizations supporting the Institute

The Institute's Board of Director's (BOD) will provide broad-based, external advice and guidance to the Institute leadership team (i.e. the Institute Director, Executive Director, and Associate Directors) on a wide range of programmatic issues. On the BOD will sit between 8 and 12 members with a broad manufacturing vision, expert knowledge of manufacturing services, and a record of manufacturing success. Meeting twice a year, BOD members will be appointed to staggered three-year terms. Approval of the annual budget of the Institute will be approved by the BOD in coordination with federal agencies. The BOD will advise the leadership team.

As noted above, the leadership team of the Institute will consist of the Institute Director, Executive Director, and Associate Directors of: Applied Research and Demonstration, Technology Integration, Small and Medium Enterprises and Education, Technical Skills and Workforce Development.

The management structure of the Institute has been designed for contractual research, education, broadened participation and knowledge transfer. Processes would be developed for an integrated, team approach to short- and long-range strategic planning and decision making. The appointment of the founding Institute Director, and the future appointments of subsequent Institute Directors, will be appointed by the Board of Directors. The founding Institute Director will be appointed for a three-year term and subsequent Directors will be appointed for five-year terms. The Executive Director will be appointed by the Director for a renewable three-year term. The Associate Directors will be leaders of the highest stature who will hold permanent positions in the Institute and where appropriate in a department at a collaborating college or university.

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

Membership structure:

A proposed corporate membership model would be an industrial affiliates program with a tiered membership category according to business size. This membership model would have 2-4 identified industry anchors. SME's will be included through industrial associations such as MANEX, the Corporation for Manufacturing Excellence. The annual membership fee proposed would start at \$5,000 (for start-ups) with tiers up to \$250,000. In-kind contributions would be equivalent to cash in this membership model.

Participation structure for intellectual property and licensing:

Intellectual property and licensing structures should ensure industry collaboration. Licensing or intellectual property considerations fall into various categories:

Inventions solely funded by membership fees

When a research project is funded solely by membership fees, all Industrial Members who are Institute Members at the time an invention is disclosed will receive a time limited, 90-day, first right to share patenting costs of such

invention on a prorated basis with all other Institute Industrial members participants.

Joint Participation in US Government Funded Research

When a research project is funded by a Federal/State government source and the Institute and an Institute Industrial Member are listed as co-participants, The Institute will notify Industrial Members that are sub-awardees on such a grant when inventions are conceived and first reduced to practice using funds from the grant. The Institute will offer to such Industrial Members who are members at the time of Invention Disclosure, a time-limited, 90-day first right to negotiate an exclusive or nonexclusive, royalty-bearing license or option to these inventions.

Research projects fully funded solely by Federal/State Government sources

Institute members' rights to intellectual property developed under these programs will be governed by the Institute or Federal/State policies in effect at that time. Institute members who are members at the time of Invention Disclosure will be provided a time-limited 90-day right to negotiate royalty-bearing licenses or options.

Industrial Member Solely Funded Research Project

If an industrial member pays the full cost to include salary and reasonable incidentals for the research projects, their rights to inventions shall be governed by the Sponsored Project Agreements.

Educational Institute-Funded Research

If a research project is funded solely by an educational institution, inventions or intellectual property shall go to that educational institution.

8. How should a network of Institutes optimally operate?

The ability of the Institutes to collaborate is an essential ingredient in enabling them to advance innovations into the marketplace. The Institutes should form internal and external cooperative alliances to assure the exchange of ideas it needs to maintain its competitiveness and penetrate new markets. This should include collaboration with

- Industry – The institutes should work with industry to devise manufacturing solutions to promote their market leadership.
- Sector specific associations and economic development alliances – The institutes would coordinate with regional, state and national policy and advocacy associations on their public policy agendas. Such organizations include the National Association of manufacturing, Bay Bio, the Innovation Task Force, as well as State labor & Workforce Development Agencies, and the State Workforce Investment Boards.
- Other Institutes – The Institutes should work in close association with one another. They should be flexible enough to form permanent alliances or pool their expertise in ad hoc interdisciplinary collaborative networks to address specific projects. The institutes should work together, collaborating in groups and alliances or pooling different skills in flexible structures as and when needed.

- Strategy meeting – The institutes should meet for workshops, tech transfer and management strategy periodically to share best practices and insure effective collaboration.

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

The funding streams based on the performance-related business model would assess effectiveness of driving innovation into the marketplace. If the budget breakdown once the Networks mature into self sufficiency is comprised of approximately 70% of funding through contract research derived from industry and publically financed research projects with an additional 30% of funding received from federal and state governments to support new research, then the Network structure is seeing positive industry results. If Industry is continuing to provide investment and leadership to the Network in order to increase innovation in manufacturing through concrete applications, then the model is balanced. This funding model of success will also apply to the governance of the Network. If the Network is able to remain fluid to respond to different industry and innovation results through the vision of the governance, and industry continues to be at the forefront in both investment and leadership, then the Network will be a success.

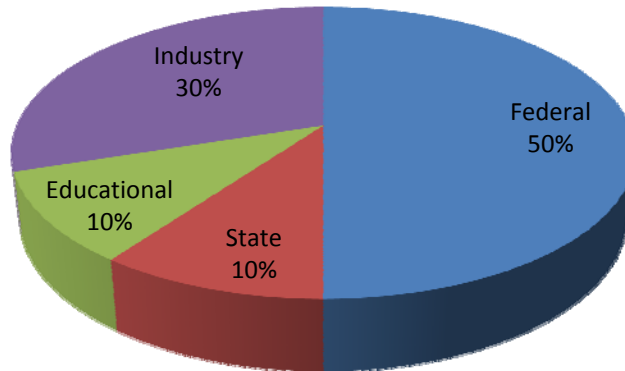
10. How should initial funding co-investments of the Federal government and others be organized by types and proportions?

Initial federal funding of the Institutes would be used to set up the infrastructure and staff of the Institute. Matching funds from industry would leverage support for research application development. The initial federal funds would phase out over time. Contract research from industry partners or specific government projects would then serve as the major funding with additional application-oriented basic research funding from government agencies for technologies that hold high promise for the future.

Another revenue stream would be from venture capital funding and banking institutions to assist with scale up of new manufacturing innovations.

An initial funding model example might be:

Initial Institute Funding Model



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

The Institute would receive funding both from the public sector in the form of federal or state support of application-oriented basic research (approximately 30%) and through contract research earnings either from industry or government sponsored projects (roughly 70%). As a result of this funding blend, the Institutes would operate in a dynamic equilibrium between application-oriented fundamental research and innovative development projects.

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

In the proposed performance-based business model the proportions of the funding received would reflect the progress of the Institute towards being self-sustaining. As the proportions change from the initial federal, state, industry and educational institute funding to establish the Institute towards an ultimate mix of 30% funding from the public sector and 70% funding through contract research.

Economy, technology and education can also serve as sources of revenue. For example, UC Berkeley's Masters of Engineering program could benefit from using Institute resources to couple candidates with industry to develop innovative capstone projects. This would be a further revenue stream for the Institute.

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

Actions that would improve domestic manufacturing facilities while maintaining consistency with our international obligations could include:

- Revisiting IP Laws within the US
- Up-front engagement of financial institutions and end stream consumers (for example Utilities in the Energy Sector) in the technology evolution and manufacturing process
- Technology transfer
- Job placement
- Educational courses
- Summer internships
- Meetings at the institute for domestic, foreign-domestic and international partners.
- Assisting local companies with startups or evaluating new technologies
- Short courses/executive education for their staff
- Expertise consulting with focus on partners
- Visiting Industrialist/Venture Capital Fellows

The Institute's association with UC Berkeley's academic faculty with its well known international ties will help support consistency with international obligations.

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

The Institutes should be closely aligned with other manufacturing related programs and networks. They should collaborate and work with The National Science Foundation-sponsored Engineering Research Centers and other Centers of Excellence, as well as other national laboratories when appropriate. Standard and Industry organizations and networks should also be engaged. The National Institute for Standards and Technology has many collaborators and could help facilitate engagement with related programs and networks.

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

We recommend that Institutes work very closely with the state and local economic authorities. Economic authorities would be brought in on a regular basis to help define the region's education and technological needs. The Economic authorities would be a resource to highlight needs at a regional or state level that need addressing. Economic development agencies could bring their ideas for workforce development as well as any feedback to the Institute. Regional Economic Development partners would also help to engage local manufacturing companies and networks. The Institute would be responsive to any large initiatives at the State level.

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

Measures that could assess Institute contribution to long term national security include:

- energy minimization,
- use of earth abundant materials,
- locally sourced materials,
- reduction of reliance on foreign energy sources.

Competitiveness measures include:

- innovation in design is adopted into manufacturing
- help with onshoring to compete in broader markets with broader workforces.

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

One of the major functions of the Institute would be technology transfer at all educational levels. The knowledge and skills acquired by students while participating at Institute programs will enable them to transfer this knowledge to take up positions of responsibility outside the Institute.

The specific education goals of the Institute would be to:

- Train an engaged, skilled and diverse technical workforce by providing a pipeline from high schools to secondary school to college
- Increase the number of students who select the study of STEM fields, including manufacturing and increase attendance at university and graduate programs by :
 1. providing research opportunities with support structures at the undergraduate level;
 2. providing opportunities for community college students to study at – and ultimately transfer to a major research university;
 3. introducing pre-college students to concepts and career options in manufacturing and building partnerships with local schools and teachers;
 4. developing educational and curriculum opportunities for K-12 teachers, with a focus on middle, high school and community college instructors.

Our integrated approach – allowing for ongoing assessment and correction – focuses on both resource building and structured training and support at the pre-college through post-graduate levels. The Associate Director for Education, Technical Skills and Workforce Development, in consultation with others at the Institute, would facilitate faculty and other PhD-level research careers, and help create a skilled technical manufacturing workforce.

The Institute facilities would be used for special courses, internships and summer programs for workforce development at the K-12, junior college, technical school and college level for both students and faculty.

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

We propose that the business model include, as a key position within the Institute, an Associate Director for Education, Technical Skills and Workforce Development whose focus would be on workforce development. The Associate Director would develop educational and industry training needs and craft programs that meet the developing technological needs in the area to increase the labor force. The Associate Director would also assess any un-filled industrial positions within the region and work closely with state and local economic development authorities, and community and technical colleges to develop relevant coursework to fill the need.

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

An excellent way to leverage and complement other education and workforce development programs would be to offer programs on these topics between the institutes. Programs would include co-teaching courses, information transfer back and forth, and on-line educational programs for serving the needs of clients that are covered by different NNMI's. A further way would include developing a robust mentoring program that would bridge industry, faculty and student mentoring

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

Measures that could assess Institute performance and impact on education and workforce development include:

- job placement statistics for trained Institute 'graduates'
- decrease in unemployment rates in the area,
- ability of companies to compete in the area and
- local development agencies ability to get companies to site here due to a well skilled employee base.
- ability of work force to advance, with career ladders,
- ability of our programs and affiliated universities to reflect areas of institute priority.
- recruitment of people from junior and technical college to four year degree programs and then onto graduate or advanced degree programs within the Institute.
- attracting researchers, graduate students and faculty from educational institutions to conduct research in the Institute

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

Using the innovations that take place through the R&D activities of the Institute, educational courses would be constantly updated to reflect the most recent Institute technologies as they develop. Instructors from all levels of education would have access to the Institute for summer programs to learn new technologies along with their adjoining skills, management and instrumentation needs that could then be taken back to their institutions through knowledge transfer.