NNMI Workshop

Designing for Impact II: Workshop on Building the National Network for Manufacturing Innovation

Cuyahoga Community College
Cleveland, Ohio
July 9, 2012

Summary

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Acknowledgment
Thank you to all who participated in *Designing for Impact II: Workshop on Building the National Network for Manufacturing Innovation* held July 9, 2012, at Cuyahoga Community College's Corporate College East in Cleveland, Ohio. This document summarizes the dialogue discussions that took place during the workshop. A complete list of participants is provided in Appendix A.

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Preface

In May, 2012, the Advanced Manufacturing National Program Office (AMNPO) issued a formal request for information (RFI) on a new public-private partnership proposed by President Obama: the National Network for Manufacturing Innovation (NNMI).

Published in the Federal Register[1] and posted on the AMNPO's Advanced Manufacturing website,[2] the RFI seeks ideas, recommendations, and other public input on the design, governance, and other aspects of the proposed network.

In addition to the RFI, the AMNPO is soliciting input through regional workshops. On July 9, 2012, the National Network for Manufacturing Innovation (NNMI) hosted its second *Workshop on Building the National Network for Manufacturing Innovation.*[3] The workshop was held at Cuyahoga Community College's Corporate College East in Cleveland, Ohio. 253 participants attended the event.

The workshop hosted four separate dialogues on the following topics:

- Dialogue 1: Technologies with Broad Impact
- Dialogue 2: Institute Structure and Governance
- Dialogue 3: Strategies for Sustainable Institute Operations
- Dialogue 4: Education and Workforce Development

There were two teams of facilitators to host each dialogue topic, and multiple dialogue sessions were held simultaneously in the morning and the afternoon. In all, sixteen sessions were held over the course of the day (four separate sessions on each individual dialogue topic). The results of the sixteen workshop dialogues are summarized in this document.[4]

The facilitators were instructed to encourage individuals to express their ideas, but they were not seeking consensus on any of the dialogue topics. The summary provided below does not reflect a group consensus. Rather, this document provides a summary of the main points that were discussed during the dialogue sessions.

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[1] https://www.federalregister.gov/articles/2012/05/04/2012-10809/request-for-information-on-proposed-new-program-national-network-for-manufacturing-innovation-nnmi

[2] http://www.manufacturing.gov/amp/nnmi.html

[3] The first workshop was held April 25, 2012, at Rensselaer Polytechnic Institute in Troy, New York.

[4] All sixteen dialogue discussions were transcribed. In addition, at the beginning of each session, workshop participants were given forms with space to respond to the dialogue questions. Completed forms were submitted at the conclusion of each dialogue session. Furthermore, at the end of the day, workshop facilitators reported the main points that were covered in each dialogue session.

Executive Summary

A strong manufacturing sector is vital to the overall health of our economy. And yet, over the past decade, the United States has lost nearly 1 in 3 of its manufacturing jobs. The trend toward offshore manufacturing directly impacts the nation's ability to compete when it comes to innovation.

To address this challenge, President Obama announced a proposal to create a National Network for Manufacturing Innovation made up of up to 15 Institutes for Manufacturing Innovation around the country. The National Network for Manufacturing Innovation (NNMI) will bring together industry, universities and community colleges, federal agencies, and regional and state organizations to accelerate innovation by investing in industrially-relevant manufacturing technologies with broad applications.

The July 9, 2012 workshop in Cleveland, Ohio provided an opportunity to engage stakeholders in discussions on four key aspects critical to the effectiveness of NNMI:

- Institutes for Manufacturing Innovation (IMI) Focus Areas
- IMI Structure and Governance
- Strategies for Sustainable Institute Operations
- Education and Workforce Development

Workshop participants responded enthusiastically to the proposed NNMI and engaged in a lively discussion on all four dialogue topics.

In the dialogues on IMI focus areas, participants offered broad criteria to be used when selecting the focus areas, including technologies that address a national need, issues too big for an individual entity to tackle alone, and technologies that can best leverage the domestic supply chain. Small and medium-sized businesses noted their difficulty in accessing cutting-edge modeling and simulation tools, sensors, and verification and validation methods. Appendix C provides a comprehensive list of the specific technology focus areas suggested by attendees.

The dialogues on structure and governance focused on the importance of maintaining a certain level of flexibility when developing the IMIs so they can be nimble enough to adapt to changing industry needs. At the same time, attendees emphasized the importance of developing a consistent IP policy and legal framework (i.e., contractual vehicles, legal forms, and guidelines) so members can work seamlessly across multiple Institutes. Participants suggested many models that could be used for benchmarking good practices in structure and governance and these are provided in the detailed summary below.

The importance of benchmarking was also noted during the discussions on strategies for sustainable institute operations. Participants urged NIST to study relevant models in order to effectively capitalize on the best practices of other institutes. Attendees also noted that issues surrounding intellectual property rights and royalties should be defined from the

outset, as these financial incentives and rewards will help the Institutes sustain themselves.

The sessions on education and workforce development drew a number of ideas designed to engage the k-12 age group through hands-on activities; e.g., creating fab labs at the IMIs or bringing 3D printers into schools. On the topic of displaced workers, several attendees were drawn to the idea that the Institutes could partner with DoD to provide training opportunities in manufacturing for returning military personnel; in effect, creating a “GI Bill” for manufacturing service.

This quick summary provides just a small sampling of the hundreds of ideas that were put forward during the sixteen sessions in Cleveland, Ohio. A comprehensive overview of the dialogues is provided below.

Dialogue 1: Technologies with Broad Impact

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

Workshop participants identified the following criteria to be used when selecting technology focus areas:

- Technology focus areas should have broad applications across multiple industries; e.g., lightweight structures
- Technologies that fulfill an existing or emerging market need
- Technologies should have strong market potential, TRL of 4-7, and an ability to get to market within a 3-5 year time frame
- Technologies should be enabling, with transformational potential; i.e., with the ability to disrupt the status quo or cause an industry to shift its technology base
- Technologies that leverage existing, underutilized U.S. manufacturing infrastructure and/or leverage a domestic supply chain (so they are less likely to be taken off-shore)
- Technologies that address a national need; e.g., energy, defense, national security
- Technologies with the ability to scale up successfully
- Technology areas that address challenges that cannot be taken on by industry due to the high cost of development
- Technologies that use an open innovation architecture so that companies can take a basic enabling technology and build on top of it (much like the software community has done)

When selecting criteria for technology focus areas, workshop participants focused on the need for IMIs to address both short-term market needs and long-term strategic goals. Participants noted that the IMIs should build on existing manufacturing consortia and infrastructure. Above all, the technology areas must be cross-cutting, widely adaptable, and driven by industry needs.

Models:
Case Western Reserve University uses **Appreciative Inquiry** ideas, methods, and materials that help organizations discover what works well in a system and how best to build upon that success. This model may be useful for anticipating where manufacturing is headed, which could in turn drive decisions for selecting technology areas.

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

The technology focus areas noted most frequently by participants were sensors; modeling/simulation software; composites; advanced materials; and nanotechnology. For a complete list of technology focus areas that were specifically identified by participants, see Appendix B.

More generally, participants pointed out the need for IMIs to address challenges faced by small and medium-sized companies; namely, scaling up and gaining access to modeling and simulation capabilities. In conjunction with modeling and simulation, small and medium-sized enterprises (SMEs) also need access to verification and validation (v&v) processes and metrology. By closing the loop with v&v and metrology, companies are better able to understand their raw materials, lower scrap rates, move rapidly from prototype to product, and streamline the supply chain.

Models:
The National Center for Manufacturing Science offers a suite of modeling and simulation tools. Learn more at: http://www.ncms.org/index.php/portfolio/advanced-modeling-and-simulation/

The National Digital Engineering and Manufacturing Consortium launched a pilot program in the Midwest to support regional modeling, simulation, and analysis. Learn more at: http://www.compete.org/publications/detail/1654/a-framework-for-a-regional-modeling-simulation-and-analysis-midwest-pilot-program-for-the-manufacturing-supply-chain/

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

To demonstrate that IMIs assist U.S. manufacturing, participants suggested the following measures:

- Number and quality of new or re-shored manufacturing jobs
- Number and quality of new partnerships (collaborations) and number of applications of the technologies (touchpoints)
- Number of jobs created in manufacturing, global market share of exports, and improved trade balance
- Use of new methods and processes offered by the IMIs
- Improvements not just in TRL, but Manufacturing Readiness Level; i.e., innovators better understand the needs of manufacturing companies and their production requirements/constraints
- Membership surveys, industry surveys
- Infusion of technologies into the marketplace (tracked with a process similar to NASA's "mission use agreements")

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

Participants suggested that various measures could be used to assess the performance and impact of the IMIs. The suggestions were divided into two categories: measuring the

performance of the IMIs themselves and measuring the success of the IMIs' technology transfer efforts.

Measuring success of IMIs:

- Member retention
- Investments made by private industry and venture capitalists
- Sustainability of NNMI based on industry support
- Positive peer review of R&D progress and achievements
- Number of citations in literature
- R&D expenditures and participation of SMEs
- Global recognition of NNMI as a model

Measuring technology transfer data:

- Number of products returning to the U.S. that were previously manufactured off-shore
- Ability of new products to accommodate the supply chain and establishment of domestic supply chain companies
- Amount of funding attracted to the region for manufacturing
- Number of new products commercialized both within the region and outside the region
- Number of new technologies that become profitable over a 5-year initial lifespan
- Percentage of IP developed from TRL 5 to TRL 8
- Number of new patents filed
- Number of new startup companies based on Institute's portfolio
- Number of licenses generated from IMIs
- Number of NNMI graduates who stay in the area to benefit the region

Models:

RapidTech (http://www.rapidtech.org/) supports industry and education at all levels, particularly in the adoption of rapid technologies to increase global competitiveness. This could serve as a model for NNMI.

Dialogue 2: Institute Structure and Governance

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

Several participants suggested the importance of studying existing business models so as not to reinvent the wheel. In particular, the following models that could be used for benchmarking were noted:

- Fraunhofer-Gesellschaft (http://www.fraunhofer.de/en.html), the largest organization for applied research in Europe
- Sematech (http://www.sematech.org)
- National Science Foundation Engineering Research Centers (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5502&org=EEC)
- EWI (http://ewi.org)
- National Nanotechnology Initiative (http://www.nano.gov)
- IMEC (http://www.imec.org), an organization to improve the productivity and competitiveness of Illinois' small and mid-sized manufacturing firms
- Custom IMD Program (http://www.customimd.eu) developed an interactive platform for the design and rapid production of customized implantable prostheses
- Pennsylvania Life Sciences Greenhouse Initiative (http://www.newpa.com/build-your-business/start/assistance-for-early-stage-technology-companies/pa-life-sciences-greenhouse)
- Sandia National Labs (www.sandia.gov)
- Oak Ridge National Labs (http://www.ornl.gov)
- National Center for Manufacturing Sciences (http://www.ncms.org)
- Colorado Association for Manufacturing and Technology (http://www.camt.com)
- UNC-Charlotte Center for Precision Metrology (http://cpm.uncc.edu)
- Metals Affordability Initiative (http://www.wpafb.af.mil/news/story.asp?id=123215272)
- 503C non-profits

It was suggested that the Institutes remain flexible, not prescriptive, in developing business models for the IMIs; for example, some IMIs may be vertically integrated while others may be a consortia of peers. At the same time, the legal frameworks (e.g., contracts and agreements) and IP policy across the Institutes should be consistent so businesses can interact seamlessly among the multiple IMIs. The business model will need to evolve due to the transition from federal funds to private sector funding. It was also suggested that the Institutes could bring in a large anchor industry and university partner to generate momentum in the early stages. One participant suggested that academia and government labs could work on retainer so that industry can pull in the appropriate R&D experts on an ‘as needed’ basis.

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

Multiple participants noted the need for consistency among the Institutes (in terms of forms, legal framework, etc.) so members can fluidly move between the Institutes as needed. They also recommended that NNMI develop and analyze a matrix of successful models to guide the process of establishing successful governance.

The following governance models were put forward:

- Board of Directors and Operating Committee (two tiers of governance)
- Private sector advisory board, ideally one that would represent the entire supply chain
- Council of IMI directors to share best practices, fundraising strategies, and partnering opportunities
- Develop a legal structure in advance with predefined agreements, forms, guidance on IP ownership, etc.
- Tiered fee structure to enable member companies to select the most appropriate level of engagement (the fee structure may also determine access to IP)
- Holacracy (http://www.holacracy.org) takes the principles, ideas, and emerging mindset articulated by many cutting-edge thought leaders, and instills them in the actual structures and processes of the organization
- NASA Space Grant consortia (as a model)

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

Many participants felt strongly that low barriers to entry for all stakeholders would be ideal; i.e., cut red tape, streamline forms, standardize legal documents, etc. Too many deals fall apart due to frustration over administrative burdens and barriers. It will be important to develop win-win scenarios for industry, academia, and government entities regarding IP rights, commercialization, information security, non-disclosure agreements, royalties, etc.

A fee-for-service R&D model could be considered. Representatives from small businesses noted that a pay-to-play membership would potentially be cost-prohibitive for small businesses and startup companies. A delayed payment model and/or flexible licensing model that varies depending on the size of the company could potentially address this challenge. “In kind” contributions could also be used to alleviate costs for industries to participate. The IMIs may also establish user fees (paid by those outside the consortium) and member fees (paid by members of the consortium).

As for specific models of membership and participation structure, the following programs were suggested:

- Fraunhofer (http://www.fraunhofer.de/en.html)
- NSF I/UCRC (http://www.nsf.gov/eng/iip/iucrc)
- VWI (http://www.vwiinc.com)
- NDEMC (http://ndemc.ncms.org/index.php/category/ndemc)
- Pooled IP models: Institute controls maturation and licensing of all IP, with varying rights to each constituent based on investment in the Institute
- Companies can donate IP to the Institute to pursue commercialization
- Limited exclusive licenses can be set for all members, then after a certain time limit has expired, non-exclusive licenses can be offered for fees
- Smart idea contests: Institutes could fund 5-10 smart ideas per year for startups to show proof of concept and technology demonstrations; the Institute can own 5% of the new company

8. How should a network of Institutes optimally operate?

The Institutes should be flexible, growth-oriented, and responsive to changing needs in industry. At the same time, they should adopt consistent contractual vehicles, forms, and guidelines to establish trust with multiple institutes.

One participant noted that technology roadmapping may be a valuable exercise to help NNMI make optimal technology investment decisions by identifying critical technologies and technology gaps, while also identifying ways to leverage R&D investments.

It was also noted that the Institutes should share pre-competitive information and research results with one another and with the public. This could be done through an annual conference, annual technology showcase, and via the website. Members could also form self-assembled teams to work on proprietary projects.

The Institutes should proactively seek out opportunities to apply the entire network's capabilities toward a significant challenge.

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

Several measures to assess effectiveness were addressed:

- Assess growth in number of member companies, technology transfer successes, venture capital raised, and new IP for small companies
- Survey stakeholders and organizations served
- Evaluate number of post-doctoral fellows and graduates' readiness for workforce
- Track use of IMI equipment, uniqueness of IMI facilities
- Track number of projects completed and amount of time it takes for technologies to work through the pipeline

- Track NNMI website metrics; e.g., views, downloads, etc.

Dialogue 3: Strategies for Sustainable Institute Operations

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

Multiple workshop participants noted the important of studying successful models so NNMI can build upon these programs. Comments on initial funding co-investments were as follows:

- 2/3 R&D, 1/6 industry, 1/6 educational outreach
- 50% equipment and facilities, 30% students and training, 20% strategic hires
- Follow the 80/20 rule, which dictates that no more than 20% of funds should be devoted to overhead
- Use existing infrastructure in the U.S. so as to avoid investing more funds in bricks and mortar
- IMIs should solve existing challenges that a single entity would not or could not solve singlehandedly
- Partially fund part-time sabbaticals that enable industry to work in academia and vice versa
- Ask for machines/equipment to be donated by industries
- Each large co-member may be given the opportunity to bring in one small company

Several participants expressed concern about the NNMI plan to phase out government funding after a specified period of time.

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

The Institutes have a better chance to become self-sustaining if they can achieve early wins through demonstration projects. In addition, issues of IP and royalties should be defined from the outset, as these financial incentives and rewards will help the Institutes become self-sustainable.

It may be useful to develop an advocacy program to aid the Institutes in becoming self-sustaining. Several suggestions were put forward to help guide NNMI on arrangements that could help the IMIs become self-sustaining:

- Collect membership fees
- NNMI could develop a scale to handle co-investment; e.g., the less a company invests, the more IP is kept by the Institute
- Companies could pledge equity funding
- NNMI keeps a percentage of licensing revenue and royalties from IP (low enough to keep industry interested but enough to provide funds for the Institute)

- "Home run" clause: if industry makes a certain amount of money, they pay a lower percentage

Models for co-investment:

- The National Nanotechnology Initiative (http://www.nano.gov) provides numerous case studies that could be instructive for NNMI
- Fraunhofer was again suggested as a useful model
- STAR Agency for Science, Technology and Research (http://www.a-star.edu.sg)

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

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. Measures to assess the progress of an Institute could include the following:

- Growth in the number of industry members over time, particularly small and medium-sized businesses
- Number of early member organizations reinvesting in IMIs
- Robust IP and licensing revenue
- Number of individuals coming out of IMIs to enter industry jobs
- Growth in new partnerships developed through NNMI
- Development of new products and/or processes
- Ratio of the Institute's income as compared to recurring expenses
- Success of member organizations
- Number of alumni giving back to the organization

If NNMI is looking to create a structure that is similar to Battelle (http://www.battelle.org) or the Southwest Research Institute (http://www.swri.org), it would be valuable to examine their metrics.

13. 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. For new IP being developed, if it is manufactured abroad, then the Institute might charge higher licensing fees. In addition, the IMIs could offer right of first refusal for domestic manufacturing.

Workshop participants 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. It was also suggested that the NNMI support DoD and DOE work.

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

Manufacturing programs and networks should be engaged in the following ways:

- Help companies overcome and eliminate bottlenecks in the supply chain
- Help companies move from TRL or MRL of 4-7 to 8-10
- Co-develop workshops, conferences, and joint projects
- Identify partners to solve multi-disciplinary challenges

Some workshop participants 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. NNMI could support programs that provide benefit and absorb funding from programs that are not producing results.

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

IMIs could offer a tax rebate or other tax incentives to promote collaboration with state and local economic development authorities. State and local match funding may also be appropriate. The state and Institute should have a strong partnership to create a strong strategy toward cluster building and incubators. The IMIs may need to be aware of micro-competition at the local/state level and take measures to address this. 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 participant suggested that a formal process be established to allow states to discuss their needs with the Institute. In the same way that clinicaltrials.gov brings together clinical trials all in one place, NNMI could provide a similar one-stop shop/clearinghouse for initiatives in manufacturing. A searchable database could help people identify initiatives relevant to their needs and avoid duplication of efforts.

16. 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:

- Institutes create new markets, techniques, products (e.g., could be measured by awards)
- Institutes address and overcome pain points in industry
- More technologies are manufactured in the U.S.

- More technologies are developed for federal acquisition programs (DoD, DOE, NASA, etc.)

One participant suggested that a challenge program could be established through DARPA with a focus on national security. In addition, IP licenses could be limited for domestic use.

Dialogue 4: Education and Workforce Development

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

Workshop participants noted that young people do not have a strong sense of what a career in manufacturing can mean in this day and age. Furthermore, school counselors and parents of students may have negative connotations associated with manufacturing. A strong and compelling public relations campaign – not unlike the Army's Go Army campaign – can help raise awareness for advanced manufacturing as an attractive career opportunity. The campaign should clearly define 'advanced manufacturing' so all stakeholders are clear about the definition and the breadth of the jobs: engineering, production, marketing, sales.

Along these same lines, several attendees noted that men and women returning from military duty and attempting to re-enter the workforce may be prime candidates for training in manufacturing jobs. The Institutes could partner with DoD to provide training opportunities for this demographic; i.e., create a "GI Bill" for manufacturing service.

Workshop participants provided several concrete examples of the ways that the Institutes could support advanced manufacturing workforce development at all levels. The comments focused primarily on k-12 education and specific examples are provided below.

- Bring 3D printers into schools. Young children can use the technology to create Lego blocks. Older students can create more sophisticated objects.
- In addition to bringing manufacturing into schools, also bring the schools into manufacturing. The Institutes could develop on-site fab labs that would allow students to experiment with engineering tools and equipment.
- Organize student visits to companies and laboratories and encourage companies to sponsor competitions and workshops
- Offer free online training/courses (based on the model of Khan Academy, Udacity, etc.)
- Gamification: use video games for recruiting; e-badging for Institute activities
- Educate children early – ideally before 7th and 8th grade – so they do not track out of pre-algebra and other courses that are required for STEM careers
- Gender differences should be acknowledged when designing activities for students; e.g., consider the appeal of designing an electronic toothbrush vs. a gearbox for an automobile
- Develop a "skills pyramid" based upon future industry needs that portrays the skills developed in k-12, vocational schools, post-secondary education, the Institutes, and private companies
- Expand science, technology, engineering, and mathematics (STEM) to include the liberal arts by appealing to creativity
- For college age students, internships are crucial to career exploration

- Pull together a “road show” to share with other educational programs
- Collaborate with local science museums

Models – to inspire future leaders in manufacturing:
Dean Kamen *FIRST* (http://www.usfirst.org/) is an excellent program to inspire young people to be science and technology leaders. This can serve as a model for NNMI.

Boy Scouts of America Learning for Life PreK-12 Programs (http://www.learningforlife.org/) allow youth to get experience in the field of engineering; e.g., they offer a Composite Materials Merit Badge (http://www.boyscouttrail.com/boy-scouts/meritbadges/compositematerials.asp).

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

As new technologies enter industries that require manufacturing, new sets of skills are required. The Institutes need to take the pulse of regional industry needs and ensure that lower skill workers are getting the training they need to enter middle skill jobs. The focus should be on unemployed, underemployed, and displaced workers, as well as returning military personnel. Furthermore, students do not necessarily have the ‘soft’ skills needed to succeed in business: project management, teamwork, etc.

Master’s Degree programs can be developed at regional universities to address emerging needs. As a case in point, Case Western now offers an M.S. in wireless health (http://engineering.case.edu/node/183). This program was created to address international growth in the industry and a need for experts who understand health care, wireless communications, biomedical instrumentation, clinical studies, information technology, persuasive psychology and innovation management.

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

The NNMI could leverage and complement other education and workforce development programs by benchmarking best practices. The following organizations were noted as models:

- TechShop: a membership-based workshop that provides members with access to tools and equipment, instruction, and a community of creative and supportive people so they can build the things they have always wanted to make.
- U.S. Department of Labor workforce development programs
- The Society of Manufacturing Engineers (http://www.sme.org/) offers videos to make engineering exciting (http://www.youtube.com/user/pmcsmeef#p/u.); ASM International offers contests and camps for students

The Institutes could each establish a library so members can easily learn about complementary education and workforce development programs. Industry partners could publish information that details the types of skills they would like to see in their current and future employees and the IMIs. IMIs could bring in high-profile speakers and develop seminars/programs that piggyback on regional events. They could also establish an Office of Workforce Development Advisory Council to ensure that industry, academia, and government labs are collaborating and supporting one another in education and workforce development. Similarly, the Institutes could partner with jobs centers to establish training pathways for displaced workers. They could also engage vocational/technical schools, skilled trade organizations, trade unions, and apprenticeship programs.

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

To measure the Institutes' impact on education and workforce development, workshop participants offered the following suggestions:

- Use demand-driven metrics rather than supply metrics; e.g., number of employers who hired new workers, duration of employment, on-the-job performance, etc.
- Conduct assessments of industry partners to determine employer satisfaction
- Measure numbers of student placements in industry
- Measure increase in courses offered by the IMIs (ideally courses that are free and open to all) for high school, college, and continuing education students
- Conduct five-year follow-up on career advancement, wages
- Assess at what level k-12 students engage in STEM and manufacturing studies and, conversely, where they disengage and lose interest
- Use ABET outcome evaluations

Workshop participants noted the importance of publicizing the impact of the Institutes, to demonstrate their value to stakeholders and voters.

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

Industry participants pointed out that they have good success using internships, co-ops, and apprenticeships as a way to prepare their workforce. Teacher/faculty externships were also proposed. The Institutes could also offer open houses to allow interested potential members to view capabilities.

The Institute could offer continuing education units and training focused on specific employer needs. They might also offer a prize or award for completing an NNMI project.

One participant suggested that industry members could direct their research-oriented challenges to the consortium and academics could bid on these projects. This would

enable academics to conduct research for publications, while simultaneously enabling industry to provide seed training and find solutions to existing challenges. This could help bridge the gap between pure research and production.

Models – to prepare the workforce:
Teaching hospitals connect industry with educators and provide students opportunities for real-world experiences. Can this model be adapted for manufacturing?

Appendix A: List of Participants

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Christian Zorman
Case Western Reserve University

Gregory Zucca
Cuyahoga County Department of Development

Appendix B: July 9, 2012 Workshop Agenda

7:30 am **Sign-In and Continental Breakfast Opens**

8:30 am **Call to Order**
Ramon (Ray) Lugo III, Director, NASA John H. Glenn Research Center

Plenary Session

Welcoming Addresses
Cuyahoga Community College
Susan Muha, Executive Vice President, Workforce & Economic Development Division

Case Western Reserve University
William A. "Bud" Baeslack III, Provost and Executive Vice President

NASA
Lori B. Garver, NASA Deputy Administrator

Keynote Addresses
Built to Last – The Economic Basis for Advanced Manufacturing
Jason Miller, Special Assistant to the President for Manufacturing Policy
National Economic Council, White House

Initiatives for Advanced Manufacturing
Patrick Gallagher, Under Secretary of Commerce for Standards and Technology
Director, National Institute of Standards and Technology

Framing the Challenge
Mike Molnar, Director of the Advanced Manufacturing National Program Office

Why Manufacturing Matters to Ohio – A State Perspective
The Honorable Sherrod Brown (D), Senator, State of Ohio

10:25 am **Break**

Workshop Period I
10:45 am **Designing for Impact Dialogues**

Featuring:

- *Technologies with Broad Impact*
- *Institute Structure and Governance*
- *Strategies for Sustainable Institute Operations*
- *Education and Workforce Development*

Lunch Program
12:00 noon **Lunch and Networking**

Industry Perspectives – A Panel of Regional Leaders
Featuring:

- Rebecca Bagley, President and CEO, NorTech *(moderator)*
- Albert Green, CEO, Kent Displays, Inc.
- Raj Harricharran, Vice President and Product Line Manager, Battelle
- Kenny McDonald, Chief Economic Officer, Columbus 2020
- Tom Stimson, Vice President of Technology Advancement, The Timken Company

Workshop Period II
1:55 pm **Designing for Impact Dialogues**

Featuring:

- *Technologies with Broad Impact*
- *Institute Structure and Governance*
- *Strategies for Sustainable Institute Operations*
- *Education and Workforce Development*

3:10 pm **Prepare Dialogue Team Reports**

3:25 pm **Break**

Concluding Session
3:45 pm **Report Out and Next Steps**

Mason Peck, NASA Chief Technologist
Mike Molnar, Director of the Advanced Manufacturing National Program Office

4:30 pm **Adjourn**

Appendix C: Dialogue 1 – Technology Focus Areas

Additive 7
Autonomous robotics 2
Advanced materials 9
Batteries
Bio-inspired manufacturing/biotechnology 3
Carbon nanotubes
Chemical
Coatings (rugged, low cost) 4
Composites 10
Design tools 3
Digital manufacturing 2
Energy/sustainability 4
Fiber
Fuel cells 2
Fluid power/pneumatics 2
Fresh water technologies
Healthcare
High precision machining 3
Industrial processing 2
Metals fabrication, processing, forging, joining 7
Metrology 6
Nanoscale/nanotechnology 8
Net shape 2
Off-shore wind
Optics
Organic electronics
Pharmaceuticals
Precision forming 2
Precision machining
Sensors 13
Thermal processing
MEMS
Modeling/simulation software 11
Wide bandgap 2