Comments submitted by

Robert G. Wilhelm, PhD

Vice Chancellor for Research and Economic Development

Executive Director, Charlotte Research Institute

Professor of Mechanical Engineering & Engineering Science

UNC Charlotte | 316 Cameron Hall

9201 University City Blvd. | Charlotte, NC 28223

Phone: 704-687- 8428 | rgwilhel@uncc.edu

uncc.edu | research.uncc.edu
|www.CharlotteResearchInstitute.com

Technologies with Broad Impact

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

a. Designing for impact. This is the name the NPO is using for the workshops leading up to the formal request for proposals. Presumably the intent is to make sure the NNMI institute network has maximum impact on the US economy, including reversing the trend of "offshoring" manufacturing jobs, recapturing jobs already lost through "re-shoring", recapturing and preserving the wealth generated by manufacturing, creating new jobs for US workers, and making sure that a sufficient pool of highly trained workers exists to support the jobs to be created. Any proposed institute must be judged against these goals, and must demonstrate that the institute's activities will have broad impact on the US economy, not just contribute to a particular government agency's mission or program. Justification of a particular technology focus based on how it will benefit a current agency program or mission should raise significant concerns about whether the proposed institute will achieve the NNMI goals, or is just a different mechanism for funding the agency's program agenda. While institutes constituted this way might be quite beneficial to the agency or program, it is almost certain that they would have little or no lasting impact on US manufacturing.

b. Concentrate on things that are hard to do. We live in a global economy. There are many manufacturing activities that create commodity products, or are themselves commodity activities.

In this kind of manufacturing, you basically only compete on price, and inevitably have low profit margins. Pretty much anybody can do this stuff, with relatively low cost equipment and unskilled or low skilled labor; and there will always be a long list of countries and people willing to work for less than it costs to support a family in the US. Therefore, we need to concentrate on manufacturing activities that require and reward application of new advanced technologies and specialized knowledge; things that are much harder to come by and maintain in third world and developing countries. Any successful institute proposal should focus on manufacturing sectors where innovation, advanced technology, and specialized knowledge are keys to success. Note that this is not necessarily the same thing as "high tech". iPads and smartphones are undoubtedly high tech, but assembling them is not.

c. Hang on to what we already have. We still have a large manufacturing sector in our economy. Let's not let those activities disappear as other product sectors already have. Make sure that companies already manufacturing here have the technology, knowledge, and trained workforce to remain competitive in a global market. Just because a manufacturing sector is currently healthy, or uses traditional processes that seem well established; doesn't mean it will be here forever. If there are manufacturing sectors that are currently doing well enough to be able to compete successfully in a global market, let's make sure those companies continue to be competitive by supporting technology and workforce development that will enable continued success. Therefore, we advocate examining the US manufacturing sector and evaluating the contribution of widespread manufacturing processes such as machining, forming, casting, molding, etc. to products produced currently here. Institutes must be formed to support the most important existing manufacturing technologies. Let's make sure we don't lose the jobs and factories we already have before we bet too much money on the next "transformational technology" that may never overcome its current barriers; and even if successful will take many years and a huge investment by industry before its impact is felt in the economy.

d. Avoid gambling on the "next big thing". NSF, DARPA, ARPA-E, NASA, etc. are already focused on developing the next generation of technology and knowledge. The NNMI institutes must not be co-opted into this activity. The Pilot Institute, focused on additive processes, is in fact trying to do this; hoping that these additive technologies can be developed sufficiently that they might actually have widespread impact on employment, US-based manufacturing activity, and the US economy. It will be great if additive manufacturing develops into a high-impact manufacturing technology, but nonetheless it is still a big gamble. At the current moment, it is undeniably a niche technology with low penetration and impact; and will require a great many fundamental technological challenges to be overcome in order to become an important and widespread manufacturing technology. Any proposed institute should demonstrate that its focus is economically significant ***right now***, and not be based on predictions about how incredible and transformative it will be a few years down the road when researchers finally figure out how to make it all work. It actually may be preferable to have institutes focused on somewhat 'boring' or mature processes and sectors. The Fraunhofer network has institutes dedicated to very mature

technologies and processes like machining, forming, etc. They are vibrant, successful, and help greatly to make Germany a manufacturing powerhouse. While the Fraunhofers are far from perfect, an NNMI network that turned out just like the Fraunhofers would still be a huge success.

Therefore, an important criterion to be considered is the current state of deployment of the institute's focus technology in the US manufacturing base. Processes that are widespread within the base should be given priority over new processes that "show promise" for revolutionizing manufacturing. A widely held, and mistaken, point of view is that so-called "mature" manufacturing technologies are not worthy of additional investment. However, in fact these technologies and processes are constantly evolving and improving and becoming more efficient, often with the result that the availability of cheap labor is no longer a meaningful consideration in location of facilities. Instead, the availability of highly skilled labor and access to suppliers with advanced capabilities is now the deciding factor. It is critical that we maintain and increase our technological advantage in these mature technologies in order that we not lose these jobs and industries.

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

High precision manufacturing, manufacturing of large-scale components and systems.

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

Number of persons who received specialized training at the Institute, and who subsequently found skill-appropriate work. Number of successfully completed industry-funded projects.

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

Amount of co-investment by industry, number of companies that participate in institute activities, number of new patents filed, number of new companies formed to commercialize Institute technology.

Institute Structure and governance

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

Institutes must be independent legal entities, rather than run as part of a larger entity such as a university or business. Only through this independence with the institutes be able to focus on their mission of

technology development and transfer and training, rather than on what they contribute to the goals of the managing organization.

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

Institutes should be organized as independent, not-for-profit, corporations whose mission is to provide research, technology services and specialized training to companies in the USA. The Board of Directors that effectively "owns" the institute and is responsible for its strategic focus and directions should be composed of representatives from the companies, universities, and community colleges that have made substantial and ongoing investments in the institute.

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

Membership should require payment of annual dues that are used to support technology development activities decided on by the members or their representatives. Results of these activities, including intellectual property, should belong to the institute with all current members having a non-exclusive royalty right to practice it in their operations.

8. How should a network of Institutes optimally operate?

Sharing of best practices regarding contract management, IP, business development, specialized training models, etc. The Network, if it is a legal entity, may be able to act as a source or supplier of some services that will be required by all institutes; such as IT services, software licensing and sharing, legal services, etc., and gain some economies of scale in doing so.

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

Confidential feedback from member Institutes. Convene an independent external evaluation committee bi-annually to conduct a comprehensive evaluation.

Strategies for Sustainable Institute Operations

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

Government funding should be used primarily to establish the technological capacity of the institutes in the form of state-of-the-art equipment and instrumentation relevant to the institute focus, along with the trained personnel necessary to operate the equipment and provide unique services to members and clients. In the initial years, it should also be used to partially support the initial costs of hiring and employing scientists, engineers, technologists, and others with specialized training who are required to enable to institute to begin to provide the services expected by its members. It is expected that as the institute matures and develops a wide base of members and client companies, personnel costs would transition to funding from membership dues, fee-for-service activities, and participation on competitively funded grants and contracts.

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

It must be made clear in the business plan for the institute that the initial investments are intended to be used to fund start-up costs and acquisition of the necessary personnel, equipment and instrumentation. The ongoing business plan must show a clear and realistic path towards income streams that are sufficient to cover its operating expenses.

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

Yearly analysis of the institute's books should show what proportion of the ongoing operational expenses of the institute are being covered from income streams other than federal government funding under the NNMI program. This percentage should show steady increase over the initial years.

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

Virtually all large manufacturing corporations have a world-wide presence; and it can be difficult to meaningfully distinguish whether a company is "domestic" or "international". Institutes should focus on interacting with companies that have a "significant" manufacturing presence in the United State.

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

Institutes should demonstrate outreach to the larger community and nation in order to maximize their impact. This could include participation in technical societies, on standards boards and committees, or in local educational activities. Collaboration with other programs and networks may also increase effectiveness in influencing federal, state, and local policies that affect the manufacturing climate in the USA.

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

Institutes should become centerpieces for economic development by assisting existing companies in their region to strengthen and grow, and by serving as magnets for the attraction of new companies and facilities to the region.

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

Do the institute's activities directly contribute to our ability to obtain critical products and systems that support our national defense and societal infrastructure from within our borders?

Education and Workforce Development

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

Each institute must have in place a comprehensive plan for education and training of an appropriately skilled workforce that ranges from entry level shop floor associates to mid-career engineers and technologists. In addition, each institute must have in place partnership agreements with workforce training agencies, K-12 schools, community colleges, and universities to insure that the full spectrum of education and training needs in the region can be addressed.

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

Institutes should conduct annual surveys of companies in their region to determine skills gaps and workforce needs, and demonstrate how their offerings and activities respond to those needs.

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

Each institute should demonstrate that it maintains an ongoing interaction with other agencies and programs in its region, and develops a comprehensive understanding of the types of programs available in order to minimize duplication and competition.

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

Tracking of both initial employment placement, and long term career path of persons who participated in institute educational and training programs should be expected.

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

Institutes must have strong partnerships with colleges and universities in their region. In particular, institutes should be able to demonstrate that their academic partners have very significant strength that is relevant to the institute's focus. Specialized programs should be encouraged that allow students to be employed on institute projects while pursuing their degrees. This will enable one of the most efficient forms of technology transfer, e.g. hiring of students who have worked on the research or development project during their education.