From: Anne.Englander@sematech.org [mailto:Anne.Englander@sematech.org]
Sent: Tuesday, September 20, 2011 10:04 PM
To: amtech
Cc: Richard.Young@sematech.org; Anne.Englander@sematech.org
Subject: AMTech Comments

Attached please find our comments submission, per your call for comments on how to best structure a new public-private partnership program, the Advanced Manufacturing Consortia Program.

Please feel free to contact us if you have questions or would like further information.

With best regards,

Anne Englander
Director, Corporate Relations
SEMATECH
(518) 649-1193

SEMATECH Response to Request for Information National Institute of Standards and Technology: Proposed New Program AMTech

A Consortia Model to Enhance the Advanced Manufacturing Ecosystem and Accelerate Job Creation in the U.S.

The U.S. has had a long track record of creating new technologies and new products, but the relatively recent decline in the United States' competitive capability in manufacturing and its implications for the overall economy have led to the call from the President's Council of Advisors on Science and Technology (PCAST) for a refocused effort to ensure America's future leadership in advanced manufacturing. PCAST has cited the need for a new mechanism to focus on strengthening the complete innovation ecosystem and its ability to generate economic growth and prosperity in the U.S. In its effort to define what is needed, PCAST has pointed to the success of the SEMATECH consortium, which created an industry-government-university partnership that was instrumental in restoring U.S. leadership in semiconductors, secured a critical national industry, enabled the growth of U.S. based manufacturing, ultimately achieved a self-sustaining industry program, and has become the often-cited and emulated model for creative collaboration.

NIST's solicitation for an Advanced Manufacturing Technology Consortia (AMTech) program is a significant and timely response to PCAST's call for restoring and expanding the United States' competitive position in the changing global economy, and the more recent creation of the Advanced Manufacturing Partnership. From our vantage point at SEMATECH, we resonate very strongly with several key components of NIST's proposed new public-private partnership program, since there are such clear parallels with our own experience as a ground-breaking consortium:

- The focus on pre-competitive enabling manufacturing technologies
    - SEMATECH's mission has been to focus on pre-competitive or non-competitive R&D – cooperatively setting standards, building infrastructure, assuring that key components (tools, materials, processes) are in place when needed by industry – always with an eye toward improving manufacturability and accelerating commercialization.
- The need to develop roadmaps of critical long-term industry manufacturing research needs
    - SEMATECH has been a key creator and long-time supporter of the International Technology Roadmap for Semiconductors, and more recently, the effort to create a national solar PV (CIGS) roadmap; we concur in the critical importance of aligning strategic planning, forging common priorities, and directing research to the critical technologies required to support the innovation roadmap.
- The ability to fund key research by universities, government laboratories, and U.S. businesses
    - Through SEMATECH, members leverage resources, and cooperatively fund and conduct R&D projects at selected universities, businesses (device, equipment, material, and software manufacturers), and U.S. National Labs, to fill key gaps in R&D/manufacturing infrastructure.

    - SEMATECH's primary focus is on early development; we pull university research into the mainstream, and work with partners throughout the supply chain to accelerate technology innovations into manufacturing solutions.
- The creation of the infrastructure necessary for more efficient transfer of technology
    - The SEMATECH consortium has created and evolved its methodologies for efficient and effective technology transfer, including member assignees (member company personnel who serve on assignment to SEMATECH, to conduct R&D and transfer knowledge back to the member companies), secure/interactive websites, and public conferences/workshops.
- The critical support for research and development in advanced manufacturing, with a goal of strengthening long-term U.S. leadership in critical technologies and creating long-term economic benefits
    - The SEMATECH consortium is unique in its focus on the entire innovation spectrum – the entire research-development-manufacturing continuum – with a portion of the program portfolio devoted specifically to productivity improvements and cost reduction in advanced/future manufacturing. SEMATECH realizes that without this end-to-end focus, the intertwined development of product and process innovation cannot be maintained since it depends on intimate interactions with manufacturing. SEMATECH has frequently observed how technology innovation – cutting edge ideas and processes – has been inspired by ideas from mature manufacturing technology.
    - Through its successful consortium model – bringing together industry, government, and university partners to leverage resources, and share cost/risk – SEMATECH has made significant contributions to U.S. industry in terms of industrial competitiveness and job creation.

We would suggest that given these significant similarities in objectives and approaches, SEMATECH provides an excellent and appropriate model for NIST's Advanced Manufacturing Technology Consortia program.

Given the level of funding NIST proposes for AMTech, we would offer several potential approaches for NIST to consider in scoping the AMTech effort.

1. One option would be task an existing collaborative enterprise such as SEMATECH to lead the AMTech consortia program, and direct the implementation of the "coordination and advanced planning" stage outlined by NIST. Funding would be dedicated to determining national technology/manufacturing R&D priorities (assessing where, across the comprehensive spectrum of current, emerging, and disruptive technologies, specific consortia would address the grand challenges in conducting long-term R&D and achieving broad commercial potential); with NIST, conducting consortia proposal review and selection (based on both technical and economic merit); helping to organize selected consortia (assisting with start-ups, providing models for engagement, proven business and management practices, etc.); and assisting the consortia in developing technology R&D roadmaps to align their technology segment, prioritize technology options, and guide in program selection. The individual consortia would make the ultimate decisions as to scope, objectives, membership criteria, funding/cost sharing, etc., based on the agenda they wish to accomplish; it would be important to retain flexibility, as opposed to

being overly prescriptive, and to challenge widely held perceptions about government involvement, by leveraging the SEMATECH experience as to ways to learn from programs that worked and insights on what needs to be done.

2. A second approach would be to focus efforts and funding on consortia that would drive enabling technologies that could be used across multiple industries, such as the development and production of advanced nanomaterials common to enabling MEMS/NEMS, sensors, alternative energies, and bioscience applications – each being a potential area for user-driven consortia (vs. "horizontal" consortia comprised of competitors). A consortium of non-competing users would cooperate to develop generic technology for multiple applications in different industries; applications could be worked in parallel and help drive generic technology development, so that the technology transfer gap could be significantly narrowed. In this view, the consortium would adopt the SEMATECH approach of bringing together experts and industrialists from a wide range of disciplines that would choose the problems requiring fundamental advances, and articulate the solutions and how they address the needs of the consortia members.
3. Another approach would be to focus on a single area, perhaps a grand challenge such as U.S. energy independence, in which the consortium would help drive the development of concrete compelling solutions that would have long-term economic and environmental benefits. The need for energy independence – through a comprehensive approach to energy generation, storage, and use – is driving the demand for innovative disruptive technologies. If the U.S., especially with the help of collaborative programs such as AMTech, creates these new technologies that are in demand around the world, we will help reverse our trade imbalance and create a strong manufacturing base for export. Over time, we could deploy the $162B per year we are currently spending on importing energy to instead developing new, disruptive energy technologies and manufacturing them here at home, for both national and global markets. At SEMATECH we see the incredible promise of renewable energy, and have already started to extend our consortia experience in this direction, with the creation of the U.S. Photovoltaic Manufacturing Consortium (PVMC), which is an industry-led consortium – an extension of the SEMATECH model – for cooperative R&D among industry, university and government partners to accelerate the development, commercialization, and manufacturing of next generation solar photovoltaic (PV) systems. Through its programs and advanced manufacturing development/prototyping facilities, PVMC will be a proving ground for innovative, disruptive solar technologies and manufacturing processes. PVMC represents an important national effort, and it is worth exploring whether there is synergy between its objectives and NIST's goals for AMTech.

In all of these options, it is critical that the consortia pursue revolutionary, as opposed to evolutionary, technology objectives. Instead of focusing on incremental advances within clearly defined fields, the SEMATECH consortium approach is to identify and invest in game-changing, disruptive technologies that span several disciplines. Innovative ideas can spawn entire new industries, built on robust R&D and a strong manufacturing base. The adoption of disruptive technologies allows companies to leapfrog existing industry solutions, open up new markets, and create new revenue opportunities. Moreover, the rapid adoption of disruptive technologies levels the playing field, changes the competitive landscape, and strengthens the innovation ecosystem,

removing cost barriers and providing the U.S. with a competitive advantage in a global marketplace.

Regardless of NIST's decisions concerning the scope of AMTech, we believe the SEMATECH model can be leveraged in several ways to meet the goals of this new program. SEMATECH was conceived by industry and government to stop and reverse the exodus of the semiconductor industry from the U.S.; the mission was ultimately successful, and SEMATECH has continued to evolve, adjusting to a dynamic industry and a dynamic world and economy, for the last quarter century. Our experience over that time tells us that the following are required to be successful:

- In any emerging/disruptive technology sector, a U.S. prototyping capability is needed to supplement R&D and bridge to manufacturing – that is, a manufacturing development facility (or facilities) that provides researchers and companies with the capability to test and prove out innovative technologies and manufacturing processes, either collaboratively (e.g., as part of a consortium program) or as part of a proprietary program or fee-for-service arrangement.
- Collaboration with, and alignment of, a U.S. supply chain is needed to provide insight and guidance on the strategic investments required to achieve consortia goals; suppliers' direct engagement in collaborative R&D fosters innovation and accelerates progress toward commercialization. This is what Pisano and Shih have identified as the development of the industrial commons. ("Restoring American Competitiveness", HBR, July-August 2009)
- An efficient allocator of R&D funding is required – a consortium model provides a precompetitive mechanism to bring the industry together, prioritize and narrow technology options, reduce the risks of technology R&D, and maximize return on investment, to assure that funds are driven to productive applied research resulting in the acceleration of advanced manufacturing. It is difficult to evaluate long-term R&D programs, or adapt to rapid changes in technology. In these circumstances, the informed judgment of a combined cross-functional team of experts in a consortium is a better method of allocating R&D funding than a simple analytical model based on arbitrary assumptions when data or even reasonable estimates do not exist.
- A bridge between innovative research and funding/commercialization (e.g., across the Valley of Death), through a consortium model that spreads benefits/risk across all stakeholders, working with universities to pull critical research into the industry mainstream, working with industry to reduce costs/risks and accelerate precompetitive technology and process development, and working with government to realize the potential for economic benefit and job creation.
- Building and sustaining links to international partners is required. Industries are global; U.S. firms rely on global suppliers and have operations abroad, while many international firms make significant contributions to the development of U.S. innovation and manufacturing. Participation in the consortia needs to be tied to the firm's willingness to link their U.S. technology innovation to domestic manufacturing, rather than being determined by the location of their headquarters. To develop solutions which will be globally competitive, a consortium must have engagement with the global supply chain, especially in areas such as standards

setting, establishing common roadmaps, and providing access to critical materials and equipment sets.

- A consortium must have an effective structure and methodology allowing collaborative, pre-competitive work while maintaining the integrity of the contribution of consortium members' IP and enabling the continuation into the competitive phase.
- A consortium is a collaborative effort that leverages resources; by combining both public and private resources, the consortium can expand the scope of its programs, investigate multiple technology options, and produce higher quality solutions, thereby multiplying many times over the undertaking that any single entity could afford.
- A successful consortium must have the trust and confidence of the federal government, private corporations, and researchers/idea generators to provide the framework for, and realize the benefits of, our next generation of innovation-driven manufacturing. Trust and confidence comes from experience; the SEMATECH model has evolved with proven success in fostering technology innovation, reducing the costs of R&D, enabling advanced manufacturing, and creating high wage jobs.

Ideally a NIST-funded consortium would become a trusted partner of the government, to more efficiently leverage not only the wealth of R&D conducted by our country's universities and businesses, but also the federal government's own vast knowledge and expertise, which remains largely separate from, and un-integrated with, industry/university R&D. The AMTech consortium or similar initiatives would benefit from a closer relationship between R&D conducted in private industry and R&D carried out by the federal government though its hundreds of labs/research centers and one hundred thousand researchers.

An industry-facing consortium such as SEMATECH could be the link between the government, its agencies and the private sector, to facilitate technology transfer and the appropriate sharing of information and research, to accelerate the progress of critical R&D in key technology areas. SEMATECH's consortia style would be beneficially employed in common areas of research across the various federal departments and agencies, depending on the technical focus of the funded consortia. A natural outgrowth of this kind of consortium engagement would be a more advanced use of technology to connect related research and researchers to one another and to the needs of the industry, perhaps in the form of a data base of federally funded R&D. A transformational data base and retrieval system such as this would result in more effective and efficient technology transfer, reduced R&D redundancies and cost, and more targeted research.

We applaud NIST for its vision for the AMTech program. Such public-private initiatives – that focus on investments that are too large for any single company or organization, and too long-term for companies that need to realize immediate ROI – are critical for the United States. In addition to our country's strong universities and venture capital system, we as a nation must nurture disruptive technology development and robust manufacturing, if we are to build the infrastructure for sustainable growth and leadership in the global economy.

For additional information, please contact Richard Young, SEMATECH Vice President of Manufacturing Technology (richard.young@sematech.org) or Anne Englander, SEMATECH Director of Corporate Relations (anne.englander@sematech.org).