NY I-BEAM
NEW YORK INSTITUTE for
BIOMIMETIC ENGINEERING &
ADVANCED MANUFACTURING

National Network for Manufacturing Innovation (NNMI) RFI Response

Proposal: New York Institute for Biomimetic Engineering and Advanced Manufacturing (NY I-BEAM)

Respondent: The Solar Energy Consortium (TSEC)
434 Old Neighborhood Road
Kingston, New York 12401
Tel. 845.336.0100
Fax:845.336.4030
Primary Contact: Ben Klein, Director of Outreach and Education, Editor
Tel. 845.336.0100
Email: bklein5050@gmail.com

TSEC, its university, industry and economic development partners in the Center for Global Advanced Manufacturing (CGAM), and the New York State Energy Research and Development Authority (NYSERDA) propose the establishment of the New York Institute for Biomimetic Engineering and Advanced Manufacturing (NY I-BEAM). The Institute's objectives will be the commercialization of university-based Biomimetics research and the development of bio-inspired solutions to advanced manufacturing and energy challenges through industry-directed Research and Development (R&D).

The developing disciplines of Biomimetics and Biologically-Inspired Engineering deploy the engineering design strategies of the natural world to enhance existing and devise new manufacturing, biotechnical, energy management and sustainable design solutions to industrial challenges. Biomimetics research generates a growing set of cross-cutting technologies with impacts on materials science, manufacturing process efficiencies, energy resource management, product development, biotechnical innovation and systems design and control.

Below, schematic representation of bi-directional biomimetics research process:

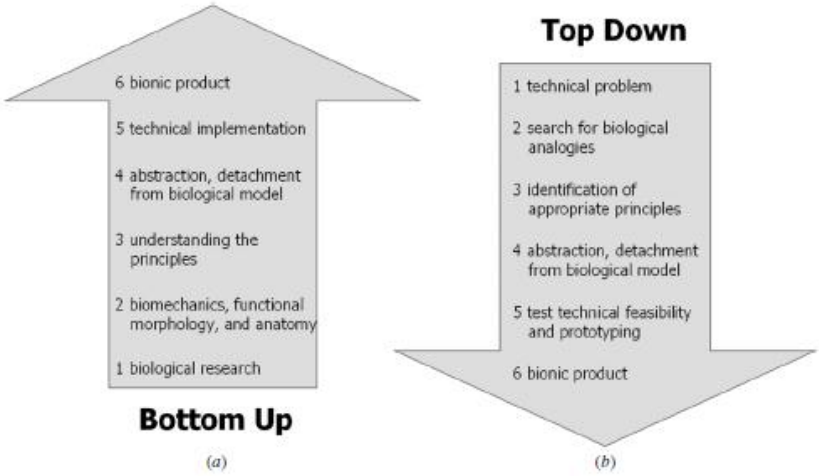


Figure 5. Process sequences in biomimetic research. (*a*) Bottom-up process of biomimetics (biology push). (*a*) Top-down process of biomimetic research (technology pull).

RFI Comments

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

Institute technology focus areas will need to be selected based on the nature and breadth of impact their projected R&D programs are likely to have and the ability of proposed institute components to realize R&D program objectives. Such impact may include providing manufacturing process/materials/design consultation to other NNMI institutes. Focus areas like Biomimetic Engineering, which require multi-disciplinary inputs and address multiple categories of Federal Advanced Technology investments (Advanced Materials, Production Technologies Platforms, Advanced Manufacturing Processes, Data/Design Infrastructure) are more likely to have transformational impact across a wide spectrum of manufacturing/ education/ workforce development domains.

Promising synergies between Biomimetic Engineering and Additive Manufacturing exemplify the kind of leverage which can be achieved through implementation of the NNMI strategy. The ability to create structures with complex internal architectures may turn out to be additive manufacturing's key advantage - companies producing artificial joints, aviation components and other products are already beginning to take advantage of this capability to extend the performance range of their technologies. Nature, over millions of years of evolutionary pressure, has perfected this engineering strategy. The internal structure of natural materials, characterized by hierarchical organization down to the sub-cellular level, determines their properties. A minimal number of basic building blocks in plants, for example, give plant tissues of various types a remarkably wide range of performance capabilities ranging from tropic responses to stimuli to compressive strength.

Additive Manufacturing software informed by biomimetic principles effectively opens the door to a world of material architectures with physical properties tuned exquisitely to performance requirements (synthetic "diatoms" made of copper indium

gallium diselenide; nano-composite joint replacements with the internal structure of Haversian bone; building envelope components of glass manufactured at ambient temperatures which transmit daylight deep into buildings and so on).

Other equally promising applications to cyber-physical systems design and manufacturing process optimization, for example, offer the potential for developing Smart Grid, sensor network and robotic control systems modeled on colonial insect algorithms and carbon-sequestering construction materials.

NY I-BEAM will seek close collaboration with other institutes in the NNMI network to optimize the institute's impact on manufacturing innovation.

Question 8. How should a network of Institutes optimally operate?

Inter-institute communications will be critical to the success of the NNMI network. Tele-conferencing links between institutes, regular exchanges of reports, personnel visits, annual conferences etc. should be part of NNMI network planning. Communications at this level will accelerate the commercialization of innovations produced by individual institutes and expand their innovation portfolios.

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

A portion of institute funding should be reserved as matching funds for industry-sponsored research projects. Such projects could be structured as competitive "challenges", offered to (university) research networks complete with challenge descriptions, available funding and time-frames within which R&D milestones (proof-of-concept, prototype, beta-test etc) must be achieved.

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

Community colleges are the logical delivery channel for workforce development programs and should be an integral part of institute organization. Systematized contact between training providers and industry - through forums, surveys and hiring projections - will ensure that workers are being trained appropriately and, most critically, that jobs are available for them once they have been trained. Institute and industry personnel can also participate in the design and delivery of courses relevant to institute operations.

Institute partners must also take active roles in providing educational enhancement to primary and secondary schools. Programs which include class presentations, guided tours, internships for older students and instructional presentations for educators should be an integral part of institute program planning.

Lastly, apprenticeship programs which place high school graduates, college students, veterans and under-employed workers with industrial partners should be added to institute educational portfolios, leveraging state apprenticeship program resources where possible.

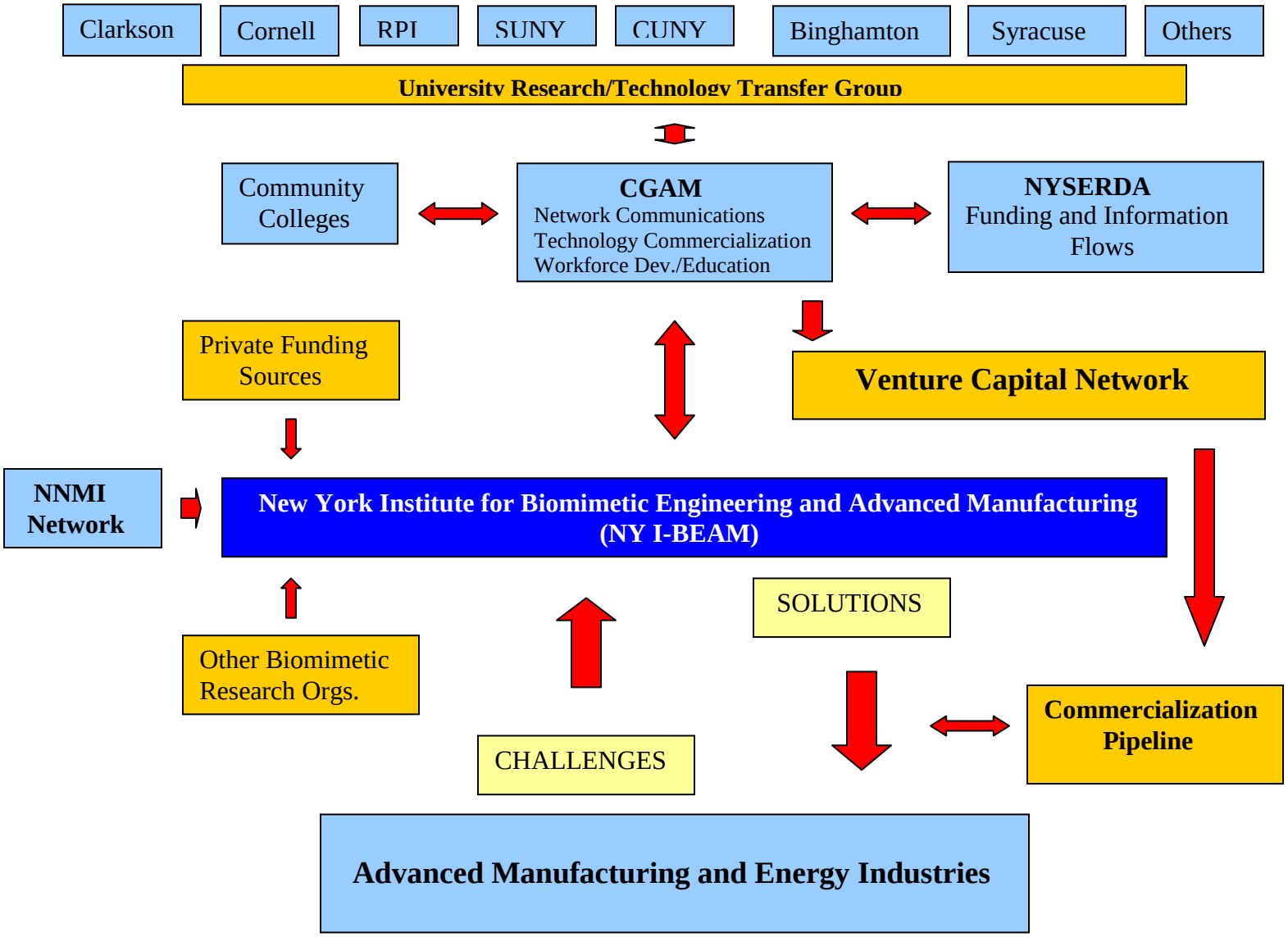
TSEC, lead organization for this proposal, is incorporated under the Not-For-Profit Corporation Laws of the State of New York for charitable, scientific and educational purposes as permitted under Section 501(c)(3) of the U. S. Internal Revenue Code. TSEC is funded by the U.S. Department of Energy through 2012; its mission is to build the sustainable energy sector of New York's economy and ensure the State's global competitiveness by catalyzing market transformation and technology commercialization, by advancing energy research and development and by educating the public. TSEC fosters scientific research and technology development through the provision of funding, facilities, personnel and support for application and design research, pilot manufacturing and related activities. TSEC also works in partnership with state, regional, county and local governments and economic development organizations to attract and grow renewable energy-related companies in New York State.

Leveraging the engineering expertise of its staff and manufacturing partners and its long-standing relationships with partner universities, community colleges, NYSERDA and venture capital investment groups, TSEC and its project partners, as NY I-BEAM, will: identify materials, process, efficiency and product challenges faced by its industrial constituency and connect manufacturers to appropriate university research capacity; assist university partners with technology commercialization of Biomimetics research; mobilize venture capital and other financial resources to facilitate this work; and, through collaboration with other NNMI insitutes, accelerate the development of the nation's advanced manufacturing sector.

The project team is strategically positioned to carry out this work. TSEC, representing 100+ industrial members and 6 universities, has overseen the development of the New York Renewable Energy Cluster (NYREC), one of only 18 such clusters in the world. CGAM, representing over 100 more manufacturers, additionally comprises the Council of Industry, serving manufacturers since 1910; the Hudson Valley Technology Development Center (HVTDC), one of New York's Manufacturing Enterprise Partnership (MEP) centers; and the State University of New York Institute of Technology (SUNYIT). New York State is richly endowed with universities which receive some $4 billion in R&D funding each year; NY I-BEAM will draw upon the intellectual property (IP) and research assets of a thriving community of university-based Biomimetics investigators. NY I-BEAM will also draw on the support of NYSERDA, which disburses more than $500 million each year to finance a wide array of energy-related research, commercialization and deployment initiatives.

Partners in the present proposal envision the establishment of a robust and dynamic technology institute comprising advanced manufacturers and engineers, university and community college researchers and educators, venture capital resources and technology commercialization specialists working, through the application of Biomimetics R&D, to increase the global manufacturing competitiveness of the State, the region and the nation. In the process, NY I-BEAM will create new career pathways for STEM students, durable and rewarding manufacturing jobs for the state's citizens and a more competitive and sustainable manufacturing sector.
See Proposal Flow Chart below:

PROPOSAL FLOW CHART



NY I-BEAM OBJECTIVES: "Commercialization of Biomimetic Research and Bio-inspired Solutions to Manufacturing and Energy Challenges"