Report Calls for "Transdisciplinary" Research and Collaboration Between Academia and Industry

A new report by the American Academy of Arts and Sciences calls for increased integration across academic disciplines and increased coordination between academia and industry to help solve societal problems and maintain the United States' competiveness in science and technology in a global economy.

The report, *Advancing Research in Science and Engineering (ARISE) II: Unleashing America's Research and Innovation Enterprise*, released 1 May, states, "The challenges facing society—from climate change to fossil fuel dependency to providing adequate food for a growing population—are immense, urgent, and intimately connected. With proper coordination, science and technology are poised to help solve problems at this level of complexity and importance."

The new study was cochaired by Venkatesh Narayanamurti (Benjamin Peirce Professor of Technology and Public Policy and professor of physics at Harvard University) and Keith Yamamoto (vice chancellor for research, executive vice dean of the School of Medicine, and professor of cellular and molecular pharmacology at the University of California, San Francisco). The committee included scientists and policy leaders from government, academia, and industry.

The first ARISE report, *Advancing Research in Science and Engineering: Investing in Early-Career Scientists and High-Risk, High-Reward Research*, was released by the American Academy of Arts and Sciences in 2008.

ARISE II recommends going beyond interdisciplinary research to what it calls "transdisciplinary" research. According to the report, "the term *interdisciplinary*, which implies a space *between* disciplines, fails to convey the potential for integration." The report explains, "Perhaps *transdisciplinary* better captures the extent of integration required: it is the dismantling of disciplinary boundaries, rather than ad hoc collaborations, that could transform the scientific enterprise and deliver the potential to address previously intractable problems."

Report cochair Narayanamurti told *Eos* that "the nature of research has changed big time." He added that to address societal problems such as energy and climate change, "we want a much deeper integration between some of these disciplines."

As examples of transdisciplinary work, Narayanamurti pointed to research centers including Harvard University's Center for Biological Engineering and the Department of Energy's (DOE) Energy Innovation Hubs and Energy Frontier Research Centers, as well as DOE's Advanced Research Projects Agency-Energy (ARPA-E) program, which provides funding to early stage research in energy technology.

New transdisciplinary centers would not replace traditional academic disciplines but rather would supplement them, Narayanamurti told *Eos*. "There are some things which work very well and some things which don't work so very well." In government, "things like the National Science Foundation, basically they are functioning as they should," he said. The report's recommendations apply to the mission-oriented agencies, such as the National Institutes of Health and Department of Energy, he said.

Narayanamurti noted that the research enterprise will change over time, with different small-scale experiments in transdisciplinary research happening at different institutions. "You don't change science and technology overnight. We need to have a culture change over a period of time," he said.

The report's recommendations for promoting transdisciplinary research include calling for institutions to develop and foster a "knowledge network" that enables investigators from different disciplines to identify opportunities, establish collaborative efforts, and focus disparate expertise and approaches on problems of common interest; expanding education paradigms to model transdisciplinary approaches; expanding support for shared core research facilities; and ensuring that appointments and promotion policies recognize, support, and reward contributions to collaborative and transdisciplinary research.

Narayanamurti noted that the way science funding is awarded along disciplines, the way researchers are rewarded, and the silo-style organization of some institutions can "actually inhibit that kind of collaborative work."

In addition to promoting transdisciplinary work, the report calls for increasing collaboration between academia and industry. The report's recommendations include establishing one or more "grand challenges" that will motivate alignment, cooperation, and integration of efforts and approaches across academia, industry, and government; developing and implementing new models for research alliances between academia and industry; enhancing permeability between industry and academia at all career stages; and setting new priorities for the technology transfer function between academia and industry with the explicit goal of maximizing exchanges of knowledge, resources, and people.

To meet the goal of encouraging industry to support collaboration with academia on long-term research, "there's no one model; many different models needed to be tried," Narayanamurti said. One incentive could come through reforms in research and development tax policy. "We must really encourage industry to actually fund this longer term work," he said. In addition, university leaders must work with industry leaders to establish these collaborations.

The report also includes an appendix focusing on the global science and engineering enterprise and the need for immigration policies that attract talented scientists to the United States and for government policies that provide incentives for corporations to develop and maintain research and development jobs in the United States.

The committee plans to work with policymakers and stakeholders to encourage them to begin implementing the recommendations. "Some of it is happening naturally—there are some forward thinkers—but much more needs to happen," said Narayanamurti.

The report is available at http://www.amacad.org/arise2.pdf.

—Ernie Balcerak, Staff Writer