An analysis of public policy issues and how they affect MRS members and the materials community...

Organizing R&D for the 21st Century: Accelerating Innovation with Limited Resources

Increasingly, research and development (R&D) policymakers around the world are struggling with a dilemma. How does one effectively apply limited resources to science and technology in a world where the global application and impact of new knowledge is increasing so rapidly? Such powerful changes as the emergence from 50 years of the cold war, our entering the information age, and the globalization of human activity are widely acknowledged to be creating a transition as profound as the move from the agricultural to the industrial age. These changes require us to address tomorrow's key challenge: R&D must respond to the powerful drivers of change while maintaining the stability of vision required to sustain a robust research infrastructure.

Engaging the scientific community in a dialog on these issues was a key purpose of the National Science Foundation/Department of Energy Workshop, "Organizing for Research & Development in the 21st Century,"* held on April 24–26 in Washington, DC. Acknowledging the daunting title, organizers Peter Eisenberger (Columbia University) and Mike Knotek (Washington State University) suggested the more modest objective to workshop participants of proposing actionable "experiments" for government and universities to try. The three sectors—universities, federal laboratories, and industry—would be partners in such experiments.

To understand the situation further, the entire system is worth considering—the science and technology enterprise. For the federal investment in R&D to be maintained in times of flat or reduced budgets, a strong case of benefit to the public must be made. The investment argument implies the benefits need to be assessed in terms of societal need, not just need by the performers. However, the trend in current U.S. government policy is to focus simply on requiring clear goals and measures, something that is exceedingly challenging in the world of research. This approach alone is unlikely to form the basis of a new organizing principle for R&D, and may even be detrimental to the performance of research.

What is needed rather is a broader approach, or as Lewis Branscomb (Harvard University) and others refer to it, both a research policy and an innovation policy (see "CPC Project Provides Recommendations for Technology Investment" on page 12). Much of the current debate seems really to be about innovation and how to optimize the system in order to accelerate the innovation process. The route to addressing R&D in the public interest is through innovation focused on addressing societal needs such as personal and national security, economic security, education, health, energy security, and the quality of life. The path to innovation has changed from the old linear approach to concurrent, interactive, seamless approaches that intertwine R&D. Thus new "experiments" must focus on accelerating innovation with similar resources while maintaining our robust and flexible research enterprise.

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Many of the ideas for experiments being proposed to better organize for the 21st century build around improving current methods for planning, prioritization, partnerships, education, and cross-disciplinary activities. The need for maintaining a strong research enterprise remains since individual investigators and depth of understanding within a discipline are prerequisites for strong teams and multidisciplinary activities. But while these attributes are necessary, they alone are not sufficient for an efficient R&D system for the 21st century. Partnerships between the three sectors—universities, federal laboratories, and industry—will be critical. Not only do partnerships and interdisciplinary activities increase one's ability to work at the interfaces where rapid progress often occurs, they speed the diffusion of knowledge, a process which is critical to accelerating innovation. Peer review must remain a fundamental principle for research policy, but processes to address cross-disciplinary interactions and the more rapid diffusion of knowledge will play an increasing role in judging the value of research performance.

If the science community and policymakers can come together to address science policy from the broader systems perspective, it may well be possible to find a new set of guiding principles. Rather than asking the R&D community to start by prioritizing science objectives in an assumed linear model, the approach would be reversed. Government policymakers would work to establish a broader set of societal objectives. These objectives would in turn be supported by setting overall science and technology goals aimed at maintaining a robust research community, creating new knowledge, increasing the value of science to the public, and solving societal problems. An innovation policy would be established to effectively address these goals, measure progress, and continuously improve. Guiding objectives, such as accelerating innovation with limited resources, would be agreed upon and progress measured. At the same time a research policy would focus on maintaining a highly creative, interconnected, and flexible science infrastructure that would feed the innovation process. Needs would stimulate new directions in science. The science community would prioritize goals within the various disciplines of science to support these needs. At the same time the strength of a diverse science infrastructure in the search for new knowledge would be maintained and the highest standards in the performance of that quest would be sought.

A long-term policy requires a long-term perspective, even within a rapidly changing world. Debates about basic and applied research will not get us there, but thoughtful analysis on ways to maintain a robust research base while accelerating innovation with limited resources will surely help.

Many people are considering these national science policy issues. Materials researchers understand firsthand the interplay of research and innovation, discipline-focused and multidisciplinary activities, and individual investigator and partnership approaches. Materials researchers are well-positioned to take up this debate and I encourage the community to do so.

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*A proceedings of the NSF/DOE Workshop will be posted on the Internet at http://pmi.princeton.edu.