

**APRU Annual Presidents Meeting  
California Institute of Technology  
Panel on “Economics and New Leadership:  
What Do We Expect from Universities?”  
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**Let me first say that I have been involved in science and technology-related issues—including those concerning research universities—for most of my career:**

- **First Assistant Secretary of Commerce for Technology Policy**
- **Assistant Director of International Affairs and Competitiveness at the White House Office of Science and Technology Policy**
- **As a program director at NSF**
- **And, now, as President of the Council on Competitiveness**

**Over this career, I have seen a transformation of global science and technology.**

**Of course, at the end of World War II, Vannevar Bush’s report to President Truman—*Science the Endless Frontier*—recommended that the Federal government take responsibility for promoting the flow of new scientific knowledge and developing scientific talent by funding basic research at universities.**

**This research and talent, coupled with proper incentives in areas such as taxes and patents, would then strengthen industrial research.**

**This vision has underpinned America’s science and technology effort ever since.**

**But the global environment for science, technology, and innovation has changed—dramatically.**

- **R&D capabilities overseas have risen rapidly, driving a global dispersion of innovation.**

- The number of innovator nations with some cutting-edge capacity is growing every year.
- New centers of R&D and innovation are springing up outside the traditional R&D centers—for example, the biomedical clusters in Singapore and the Rhône-Alpes Bio Cluster in France.
- Countries as diverse as Brazil, Lithuania, and India are building their own innovation hubs and moving into high-value commercial activities.
- Emerging economies are increasing their share of foreign direct investment in high technology and R&D.
- And, business enterprises are globalizing their R&D and innovation assets.

**Increasingly, America has no lock on global leadership in science and technology.**

- In 1960, the United States accounted for 69% of global R&D.
- The U.S. government alone accounted for 45%.
- U.S. government R&D—particularly defense R&D, which accounted for about one-third of global R&D—drove science and technology worldwide.
- But, by the turn to the 21st century, the U.S. share of global R&D had declined to 33% and the U.S. government's share to less than a tenth—even as U.S. government R&D investments nearly doubled in real terms.
- **Today, two-thirds of global R&D is performed somewhere other than the United States.**

In addition, the large corporate labs of the 20<sup>th</sup> century that worked at the frontiers of science and technology have given way to corporate research efforts designed to achieve shorter term returns and to address more immediate market needs.

**These changes have increased the importance of U.S. universities as a source of research and technology for the private sector innovation that is imperative for U.S. economic growth, jobs, and wealth creation.**

**I believe many U.S. universities have been slow to respond to this need.**

**First, many academic researchers have been reluctant to adopt a more market-oriented posture, even though they have been urged to since passage of the Bayh-Dole Act in 1980.**

- **Academic researchers are often unresponsive to industry needs because they are focused on traditional scientific objectives.**
- **They need to take greater interest in the needs of business and the marketplace, and**
- **They need to understand the constraints under which the private sector operates**

**These perspectives are vital to timely and smooth transfer of research results and technology from academia to the private sector. But...**

**Challenges arise when the generators of new knowledge and technology are in universities, and the users are in industry.**

**This arrangement creates a time-consuming technology transfer gap, as new science and technology are pushed out of the academic sector, and then industry has to figure out what to do with it.**

**In its assessment of the National Nanotechnology Initiative, PCAST identified the limited dissemination of knowledge, skill, and expertise in nanotechnology as a continuing barrier to the commercialization of cutting edge ideas that come out of the lab.**

**PCAST said that the main way nanotechnology know-how and ideas are transferred from universities to industry is when students are hired by existing companies or start new ones.<sup>1</sup>**

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<sup>1</sup> The National Nanotechnology Initiative: Second Assessment and Recommendations of the National Nanotechnology Advisory Panel, President's Council of Advisors on Science and Technology, April 2008.

**Instead of just waiting on a new hire or new start-up, how do we create a broader and better ongoing flow of timely and useful knowledge and know-how from universities to industry?**

**Also, R&D results and technology that emerge from academia are often too immature to attract financing for further development—contributing to the valley of death problem. Can universities do more to mature the technology they develop?**

**In addition, there are significant cultural differences between universities and businesses that impede collaboration.**

- **For example, the time horizons at universities are incompatible with the fast pace of innovation in the private sector.**

**I think the allocation of U.S. research funds is emblematic of the divide between industry and our research universities:**

- **About 6% of academic research is funded by industry, about \$2.3 billion (in 2007).**
- **But, that \$2.3 billion represents a mere 1% of industry's more than \$220 billion in R&D spending (in 2007).<sup>2</sup>**

**This 1% should be considered in the context of three things:**

- 1) Constraints limiting growth in Federal R&D investment, the traditional source of academic R&D funding;**
- 2) The soaring level of industry R&D investment in recent years; and**
- 3) The increasingly target rich R&D environment.**

**These conditions suggest the value of academia diversifying its sources of support for an expanded research effort.**

**I realize universities want research sponsors who do not place conditions on their research. But productive industry-university collaboration will require a process of accommodation.**

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<sup>2</sup> NSF data in constant dollars.

If U.S. universities cannot bring themselves to some accommodation of industry, there are a growing number of universities overseas who would gladly do it.

**Second, multidisciplinary fields are important sources of future innovation.** For example:

- Nano-biology
- Bioinformatics
- Agro-energy biotechnology
- Biomaterials (melding design, fabrication, and the life sciences)
- Biomimicry

In addition, many of today's **grand global challenges**—from food and water shortages, to energy and climate change—are complex and cut across disciplines.

Numerous barriers impede cross-disciplinary and multidisciplinary research within the academic community:

- Single-discipline organizational structures
- Reward systems
- Too few academic researchers collaborating with disciplines other than their own
- Relatively small size of most grants
- Traditional peer review
- Publication practices
- Career paths within academia

No matter how excellent they may be, small single-discipline R&D projects are too small in **scale and/or scope** for many of today's research challenges and opportunities for innovation.

Federal funding has also been slow to respond to more complex science, technology, and innovation scenarios, and to the need for more multidisciplinary approaches.

- For example, only about 5% of NSF's investment in research goes for its research center programs, which are the principal means by which NSF fosters interdisciplinary research.

**Third, there is a disconnect between the training many scientists and engineers receive, and how they will ultimately work in the real world.**

Many research universities train scientists and engineers as if they were going to work in an academic research setting.

But, the vast majority of individuals whose highest degree is in science and engineering DO NOT work at a 4-year college or university—in fact, less than one in ten do.

- 59% work in the private sector.
- 33% of those with doctorate-level science and engineering degrees work in the private sector.

The needs and working environment in the private sector are very different than in the academic research environment:

- Entrepreneurial skills are valued in business broadly.
- And such skills are vital for science, engineering, and technology professionals who start-up a high-tech business. Scientists and engineers with brilliant ideas need the business and management skills for successful commercialization and business growth.
- Scientists and engineers who work in the business sector operate in fast-paced, highly goal-driven environments.
- They must understand the connection between their R&D projects and the business bottom-line.
- And they must learn to communicate their ideas to non-technical people such as financial professionals.
- Scientists and engineers need to recognize that—in the private sector—science and technology are business issues first and foremost.

**Finally, more disciplines must be prepared to contribute to technology and innovation.**

**Today, the development of many innovations relies on a cadre of professionals that goes beyond scientists and engineers—including designers, artists and entertainers, service and business model experts, market researchers, IT workers, social scientists, and others.**

**Yet, universities generally do not offer learning environments that bring these fields together with traditional science and engineering, even though increasingly no one organization or discipline has all the necessary resources for high value innovation.**

**I think some significant changes at universities are overdue. But managing major change will require building the expertise and establishing an institutional process for managing change and organizational innovation.**

**Recognizing the economic potential of future technologies and how the global science and technology enterprise has transformed, the Council on Competitiveness launched the Technology Leadership and Strategy Initiative to design a new public-private partnership to support America's future technology leadership. We plan to:**

- **Map the technology landscape of the 21st century: how, where, why, and in what do private sector leaders choose to invest?**
- **Chart the most promising frontiers of technology and sources of competitive advantage**
- **Benchmark U.S. and global technological capacity and deployment**
- **Identify barriers to being a first-mover in frontier technologies**
- **Design a national policy strategy to leverage public and private technology investments**

**Certainly, the role of universities will be part of this important dialogue.**