

Keeping U.S. Industry Competitive in the Global Economy

Louis J. Lanzerotti and Arthur K. Reilly

Introduction

Innovation and new technologies are universally understood to be critical to continued United States competitiveness in the global marketplace. Questions such as: Is the U.S. sufficiently supporting basic research? Has the relationship between industry and academia been negatively impacted by global competitiveness? Do trade statistics tell the complete story about U.S. high-tech competitiveness? are legitimate concerns and of critical national importance. *Science and Engineering Indicators (Indicators)*, a compendium of quantitative measures of the state of the U.S. science and engineering enterprise, is compiled and published every two years by the National Science Board (Board), the 24-member policy oversight board of the National Science Foundation and a science policy advisory board to Congress and the President.

In its review of the 2008 Indicators, elaborated in a policy companion piece “Research and Development: Essential Foundation for U.S. Competitiveness in a Global Economy,” the Board identified several concerns related to U.S. industrial competitiveness, including data on the status of basic research in the U.S. data on high technology manufacturing and trade, and measures of intellectual property and innovation. Data compiled for *Indicators 2008* indicate a worrisome decline in the federal government’s commitment to academic research. Moreover, there is substantial evidence in the data for an increasing communications gap between the two fundamental performers of U.S. science and engineering research and development (R&D)—industry and academe--such that academic researchers may be considerably less aware of major research challenges facing U.S. industry and companies may no longer be able to readily tap the expertise and facilities of the university community.

“Input” Indicators

Quantitative data on R&D inputs and outputs paint an ambiguous picture of trends in U.S. global competitiveness in science and technology. R&D funding trends show that since 1980 industry support for R&D in this country has exceeded federal support: from near equality in about 1980, today about two-thirds of U.S. R&D is funded by industry; more than a quarter is currently funded by the federal government. However, the composition of industrially-funded and federally-funded R&D is quite different: industry has focused heavily on development, in keeping with the competitive environment of the global economy today, where there is a premium placed on how well a business performs over the shorter term. The federal government, on the other hand, is the most important source of funding for academic R&D and basic research—research for which gains generally are realized in the long term, if at all.

This situation is particular cause for concern looking ahead in time. Even while industry funding for academic research has been declining in share, for the first time since the

early 1980's federal support for academic R&D has also declined in real terms. Furthermore, federal support is expected to further decline in the years beyond the *Indicators* reporting period based on recent congressional budget actions. These trends are especially troubling since industry depends upon sustained federal support for basic research, especially in academe. An increase in federal funding is needed to return the U.S. back to a path for real growth in basic research.

“Output” Indicators

In *Indicators 2008* and in the accompanying policy companion piece, the Board also discussed “output” metrics. Output indicators do not necessarily directly measure national innovation, but they do shed light on how patterns in the nation's system are changing. Such metrics can thus raise concerns for policy makers about some of the trends and their possible implications. A measure of intellectual property that raises special concerns is the number of industry-authored basic research articles in peer-reviewed journals, an indicator of the participation by U.S. industry scientists and engineers in the basic research community. Over the last decade or so, participation by industry authors declined by about 30 percent, and the decline was especially large in some fields, such as physics. The decline may reflect the impact of the competitive global environment on the priorities for industry scientists and engineers; that is, the level of effort required to publish in a journal may not be a cost-effective use of the time and effort for an industrial researcher.

Nonetheless, participation by industry in the basic research community serves a critical function in conveying to academic researchers the problems that industry finds important. Muting this communication may reduce attention by academic researchers to pressing industry challenges.

Impacts on U.S. Competitiveness in Science and Technology

The above discussion raises a dual concern. First, that federal funding for basic academic research provides the new knowledge for industry to improve and create new technologies. Second, government, industry and academe should be equipped with mechanisms that stimulate dialog and information sharing. Interchange between industry and the academic community substantially benefits both—academic researchers learn about the important issues in science and technology from the perspective of U.S. industrial organizations, and companies learn about research and networks of academics that can allow them to benefit from academic R&D.

A related issue is the need for appropriate metrics to track the impacts of the globalization of high technology industry on U.S. economic competitiveness. Patents, publications, export data, high-tech revenues, and R&D support provide some suggestive indicators. However, these, even taken together, are less than perfect measures of the current status and long-term prospects for U.S. global economic competitiveness in high technology, and these measures sometimes support conflicting conclusions. This is

especially true in a global supply chain in which, for example, U.S. innovation can result in products being fabricated in other countries for export in yet a third country. The products would never cross a U.S. border; therefore they would not be counted as U.S. exports even though the primary value may have been the result of U.S. intellectual property and may be counted in U.S. high-tech revenues.

Implications for Action

Though a range of measures of the competitiveness of U.S. science and technology show continued U.S. global leadership, the latest volume of *Science and Engineering Indicators* raises some concerns about long-term U.S. competitiveness in high technology industries and about our ability to monitor important trends in the global economy. To improve data for decision making regarding the U.S. economy, the Board urges federal statistical agencies to develop and enhance metrics that allow the tracking of manufacturing and services in high technology industries in the global economy.

Indicators showing a declining commitment to funding academic research by the federal government, particularly in the face of a lessening U.S. industry commitment to basic research, are especially disconcerting. In view of the growing importance of federal funding of academic research to the global competitiveness of U.S. high technology industries, the Board urges in its recent companion piece that the federal government reverse the decline in federal funding for academic research, especially basic research,

Finally, and importantly, there is evidence of a growing disconnect between the two main performers of U.S. science and engineering R&D—industry and academe--and a likely decline in opportunities for synergy between these two sectors in identifying and attacking industrial problems that require the generation and application of new knowledge. The Board recommends all sectors work to increase communication between academic and industrial science and engineering so that knowledge generated through U.S. investments in R&D can be efficiently applied. Only through concerted collaboration among sectors can America effectively tackle current and future challenges for global competitiveness in high technology industries.

Louis J. Lanzerotti is currently a Distinguished Research Professor in the Department of Physics at the New Jersey Institute of Technology, Newark. He retired in 2002 after 37 years at AT&T/Lucent Technologies Bell Laboratories. He received a B.S. degree in engineering from the University of Illinois and A.M. and Ph.D. degrees in physics from Harvard University. He was appointed to the National Science Board in 2004 and has served since 2006 as Chair of the Board's Subcommittee for *Science and Engineering Indicators*.

Arthur K. Reilly is Senior Director, Strategic Technology Policy at Cisco Systems. He is Cisco's principal representative to global and national technology policy activities, including the UN International Telecommunications Union and the UN Commission on Science, Technology and Development. He is the chair of the US Council on International Business' Information and Communications Technology Policy Committee.

Mr. Reilly has a B.S. degree in Electrical Engineering from Virginia Polytechnic Institute and State University. He also has a Master of Engineering (Electrical) degree from Cornell University. The President appointed him to the National Science Board in 2006. Among other NSB efforts, he has served as a member of the Subcommittee for 2008 *Science and Engineering Indicators*.