U.S. Research Universities–Globalize or Face Demise?

Although the effects of globalization have revolutionized corporate behavior, they are only beginning to affect the thinking, and much less the policies, of U.S. research universities. It is something that should be embraced, rather than resisted.

William R. Schowalter
Princeton University

The forces of globalization have been with us for a sufficiently long time so that eyebrows are no longer raised when statements such as, "Globalization is the 21st century equivalent of the Industrial Revolution," are made. Nearly every human endeavor has been affected by forces described in Thomas Friedman's "The World Is Flat." Examples include the response we get to toll-free calls, as well as to factory closings caused by the need for a corporation to manufacture components abroad in order to remain competitive.

In contrast to the tectonic-plate scale of rearrangements seen in the manufacturing and service industries, operation of the major U.S. research universities has proceeded without corresponding upheavals. Will the resistance to change, a trait well known among some of the best research universities, be their undoing in a globalized world? What does the future hold for them?

A case can be made that such permanence reflects an unwillingness to change. But many will concede that permanence is one of the factors that made "prestigious" universities seem so prestigious. However, permanence should not be mistaken for excellence. The purpose of this article is to ask whether that resistance to change will hold the universities largely impervious to globalization and, if so, whether U.S. universities will retain their positions of prominence. My opinion is that unless U.S. universities embrace globalization as a new opportunity, they will, within a generation, find themselves among the also-rans of the world's research universities.

In 2003, Goldman Sachs (*Global Economics Paper No. 99*) published a scenario in which, by the year 2050, Asia could dominate the world's economic landscape. China would have the highest gross domestic product (GDP) among all nations, followed by the U.S. and India. Considering China's burgeoning $2-trillion economy experiencing double-digit growth over the last four years, the scenario is quite plausible.

Evidence that the stirring Asian giants are already affecting the academic research landscape is not hard to find. An example is found in AIChE's own flagship research publication, the *AIChE Journal*. Considering the origin of articles published during the first five months, respectively, of 1990, 1995, 2000, 2005 and 2006, two interesting results emerge. First, the *AIChE Journal* has been a truly international journal for a long time, and it is now dominated by papers from abroad. Second, the number of papers from China and India is growing rapidly, both in absolute terms and relative to the total number of articles published (Table 1).

Will the pipeline of talent to the U.S. run dry?

It is well known that graduate research in engineering and science in the U.S. is fueled by students from abroad, with well over 50% of our graduate students coming from other countries. Is this flow of talent likely to cease? I do not think so. However, I do believe that, barring major political upheavals, our ability to attract top students from abroad will be severely tested within the next decade.

According to enrollment data compiled by the

"My opinion is that unless U.S. universities embrace globalization as a new opportunity, they will, within a generation, find themselves among the also-rans of the world's research universities."

Engineering Workforce Commission (www.ewc-online.org), declines in bachelor's and master's degrees will be evident when data for 2005–2006 become available. In addition, in spite of the fact that doctoral degrees set a new record in 2004–2005, enrollment data indicate that a decline in numbers of doctoral degrees should begin by about 2010.

It is important to examine the data in an international context, as well. The number of bachelor's degrees awarded in the U.S. in 2004–2005 (76,000) was almost the same as in 1984–85 (78,000), the record-setting year. To provide a comparison, China, Japan and South Korea awarded about 170,000 bachelor's degrees in 1984–1985. By 2001–2002, their combined total increased 150% to 420,000. Doctoral degrees in engineering awarded by U.S. universities increased 115% from 1984–1985 (3,400) through 2004–2005 to 7,300. Doctoral degrees awarded in China, Japan and South Korea in 1984–1985 (1,700) increased by 580% through 2001–2002 to 11,000. The fraction of master's degrees awarded to foreign nationals by U.S. universities has been slowly declining from the maximum reached in 2002–2003 and is now 43%. For doctoral degrees, the fraction continues to increase and was 61% in 2004-2005. However, both China and India have ambitious plans to upgrade advanced education in engineering and science. Given a huge population base of over two billion people, a small increase in the fraction of talented young people pursuing research careers will result in very large changes in the global talent pool. It will be important to U.S. universities to have access to this pool and to provide competitively attractive means to do so.

Given today's global atmosphere, the U.S.' historical stronghold on recruiting the best candidates for PhD and post-PhD education will face stiff competition, particularly from Asian universities. The increased competition will occur not only at the student level, but also for talented faculty members at all levels.

Table 1. Papers published in the *AIChE Journal* during the first five months of selected years.*

Year	1990	1995	2000	2005	2006
% Foreign Papers	36	36	51	56	65
% from China and India	5	3	4	9	9
% from China and India among Foreign Papers	12	8	8	17	13
Number of papers from China & India	4	4	4	13	16
Total Number of Papers	88	139	103	137	184

*In cases where coauthors were from the U.S. and from abroad, assignment was based on some combination of the location at which the work was performed and the source of its support.

Globalization can enrich research universities

Today's globalized society argues for institutional strategies that will not only prevent damage to U.S. and other Western universities, but will allow them to thrive in a globalized society. Those strategies can take several forms, three of which are briefly described below. Each possesses its own set of advantages and potential problems.

Branch campuses abroad. In the engineering arena, perhaps the most visible example of this approach has been the experience of Georgia Tech in France (www.georgiatech-metz.fr). Since 1990, Georgia Tech has maintained a campus in Metz, in the Lorraine region of France. Established originally as a base for undergraduates wishing to study abroad, the program has grown to the point where graduate degrees are offered in selected engineering disciplines, and collaborative research programs have been formed with several European Union universities.

A clear advantage of the branch campus model is the degree of control maintained by the home institution. But that fact implies a lack of parity with organizations and individuals in the host country. This asymmetry, if not managed carefully, can lead to competition, rather than collaboration, at a local level.

Alliances. These are bilateral (or perhaps larger) memoranda of understanding (MOUs) between institutions where each party perceives a clear advantage to collaboration. Typically, both instruction and research collaboration are incorporated into the MOU. To date, because of the parties' unrealistic expectations and insufficient mutual commitment, only a small fraction of these agreements has had a meaningful impact on the participating institutions.

One example of an alliance is the joint PhD program between the departments of chemical and biomolecular engineering at the Univ. of Illinois at Urbana-Champaign (UIUC) and the National

Univ. of Singapore (NUS; www.chee.nus.edu.sg/educational_program/AnnOnNewIntake.html). Although institutional in terms of its structure, the program relies on self-generated collaborations between faculty members in the two departments. Graduate students from both institutions are cosupervised and are in residence in both countries over the course of their study and research.

Perhaps the most ambitious example of an alliance has been the Singapore-MIT Alliance (SMA-1) (web.mit.edu/sma/index.htm), which was initiated in 1998, and has recently been extended and broadened (SMA-2) to include the possibility of dual graduate degrees between MIT and NUS or Nanyang Technological Univ. (NTU). Primary themes in SMA-2 include materials, computational engineering, manufacturing, systems biology, and chemical and pharmaceutical engineering.

SMA-1 enabled graduate courses at MIT to be experienced by Singapore students. Much of the teaching was done in real time, meaning that one group attended class in the evening and the other in early morning. This mode of instruction continues in SMA-2, but a strong emphasis has been placed on research collaboration.

SMA has been in existence long enough to provide several clues about the ingredients essential to a successful alliance. A long-term commitment from the top of both organizations is crucial. Other criteria include: clearly defined financial and other contributions from both institutions; buy-in from a significant fraction of the faculty in those departments involved in the alliance; clearly defined milestones and assessment criteria; and sufficient authority vested in individuals designated at each institution as responsible for the alliance.

Alliances can support an institution's efforts to profit from globalization. If a U.S. university is a committed participant in research projects, some portions of which are conducted in parts of the world where an increasing number of talented engineers and scientists are available, a connection is possible with those who might be unable or unwilling to enroll at a U.S. university. Alliances also provide an important means to leverage the strengths of partner institutions. In addition, by working directly with indigenous institutions, those organizations should not feel threatened and can indeed benefit from the long experience with graduate education and research associated with many Western universities.

Networks. This refers to a particular type of multilateral arrangement. A recent example is the Global Enterprise for Micromechanics in Molecular Medicine (GEM4; www.gem4.org), an activity launched in late 2005 . The impetus for GEM4 came from a three-party collaboration among researchers at MIT, Institut Pasteur in Paris, and the National Univ. of Singapore to study the effects of malaria on the physical properties of cells. The vision of GEM4 is to create an entity that "belongs" to no single university, but has financial and in-kind buy-in from all members. Today, GEM4 has 13 member institutions from 5 countries and is attracting funding from government and philanthropic agencies.

In conclusion

Globalization is with us. It is a wave that we must ride, rather than resist. Although the effects of globalization have revolutionized corporate behavior, they are only beginning to affect the thinking of U.S. research universities. We are on the cusp of a rapid and deep change in this situation.

Successful adaptation to globalization will require broadened definitions of what it means to be a "member" of a university community. This brings into question such issues as loyalty, financing, and intellectual property rights. Eventually, even the sacred ground of tenure might be impacted.

Change can be hard, both for individuals and for organizations. Nevertheless, if U.S. universities are serious about retaining leadership positions through the 21st century, some of the core principles will require modification. It will be necessary to move from rhetoric to action.

For further discussion, read the source article in *AIChE Journal*'s Sept. 2006 issue on pp. 2998-3004.

William R. Schowalter is professor emeritus in Engineering and Applied Science at Princeton Univ. (A-220A Engineering Quadrangle, Princeton, NJ 08544, Phone: (609) 258-3553; Fax: (609) 258 0211; E-mail: schowalt@princeton.edu; Web page: http://chemeng.princeton.edu/people/schowalter.shtml) and senior advisor to the President of the National Univ. of Singapore. Formerly, he was dean of the college of engineering at the Univ. of Illinois at Urbana-Champaign (UIUC). Schowalter's research interests lie in fluid mechanics, especially as it applies to the processing of polymer melts, polymer solutions, and colloidal dispersions. He received a BSChE from the Univ. of Wisconsin, Madison, and MS and PhD degrees in chemical engineering from UIUC. He is also a Fellow of AIChE and a recipient of the Institute's William H. Walker Award.

ACKNOWLEDGMENTS

This paper has benefited from the suggestions of too many people to name individually. They are affiliated with the National Univ. of Singapore, the Singapore Agency for Science, Technology and Research, MIT, Princeton Univ., and the Univ. of Illinois at Urbana-Champaign.