JOHN A.ARMSTRONG

University Research: New Goals, New Practices

The end of the Cold War and the increased international competition among national economies is forcing a shift in U.S. priorities, and with it a reevaluation of the rationale for federal support of university research. Since the end of World War II, the government has funded nonmedical research primarily for its expected contribution to the development of advanced military technology necessary to the nation's security. Many have suggested, and I agree, that government should refocus its support for research on means of strengthening the nation's welfare and economic competitiveness.

In considering this shift, we should keep in mind that the lion's share of the responsibility for deficiencies in our industrial performance rests with failures in the private sector, failures of strategy, investment, training—failures, in short, of management. These will not be cured, or even helped, by more research. Trying to cure poor indus-

John A.Armstrong is IBM vice president, science and technology. This article is excerpted from a longer paper on research and competitiveness that will be published in the spring issue of *The Bridge,* the magazine of the National Academy of Engineering.

trial performance with *more* university research is like getting helpers while pushing on a rope. Although it is an issue, and deserves attention, poor technology transfer from the university or national labs to industry has not been a major cause of our competitiveness problem. And there are only a few sectors, notably computer software development and perhaps biotechnology, where rapid technology transfer from university labs can have a significant short-term effect anyway.

There is some danger, therefore, that society at large as well as faculty and administrators will *overstate* what universities can contribute (because they are trying to maximize support) and will consequently do foolish things to the university. One unpleasant consequence that I worry about is that as people articulate the rationale that we support research because it contributes to commercial competitiveness, there will be tremendous pressure for universities to behave as if they can and should be contributing to competitiveness *in the short term*. I think it is fair as well as accurate to say that universities lack deep understanding of products or markets, have no responsibility for development or manufacturing, and tend to overestimate the importance of science in technological competitiveness. They may also underappreciate the value of incremental engineering improvements. Improved understanding in all these areas must exist before universities can play a more effective role in contributing to civilian technology competitiveness.

Strategic change

I suggest that there are a number of ways in which we can improve the rate of return on society's investment in university research without fundamentally harming the ability of universities to create new knowledge and explore new pathways. But these changes must be made in the context of a wholly improved process for moving rapidly from new knowledge to new products—albeit an improved process where most of the improving has to be done in the private sector. Among the areas where constructive change is feasible as well as desirable, I will discuss four:

Improvements in the training of scientists and engineers to enable them to be more effective and enthusiastic participants in the process of R&D exploitation, with a heightened interest in and respect for the intellectual challenges of manufacturing. A prerequisite for the transformation of training is cultural change in the university. We need to work on abolishing the academic "pecking order," which I and others perceive as a serious impediment to the rapid application of new knowledge. We should help western culture to get rid of, once and for all, the intellectual hierarchy in which "pure" is somehow better than "applied," in which physics is better than chemistry, both are better than engineering, and the discipline and intellectual content of manufacturing are hardly valued at all.

Reforms in step with changing times can enable universities to enhance their contribution to the nation's well-being.

The truth is that Nature knows nothing of these distinctions. And they interfere mightily with making use of knowledge to solve problems that arise in making new products and processes work. How often have I heard my colleagues say, "That's not research" when asked to work in a new way, or "That's the engineer's job…I had the new super-bright idea," or "I'm a physicist, and I'm really not interested in the intersection of physics with materials or process science?" Such narrow views of a scientific career are a serious barrier to technological progress.

Innovation in the modes of interaction between universities and industry. In addition to the reexamination of the results of the training given in our research universities, there is room to improve—from the university and the industry sides alike—the quantity and the quality of mutual interactions.

There are, of course, sabbaticals, adjunct professorships, summer visits, and other such programs already in place. But it is still

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the case that a Ph.D. engineer with five years of experience in industry has a much better grasp of the two worlds—university and industry—than does his or her thesis professor. This asymmetry may be explainable, even understandable, but it works against a national ability to move swiftly from concept to product.

Indeed, I believe major benefits to competitiveness would result from a national program that aimed at greatly increasing the flow of university faculty and industrial scientists and engineers in and out of each others' institutions. The existing opportunities for such interactions are few and even these are undersubscribed—on both sides, and for the same reason: Close acquaintance with the "other" community is believed to be wasted as far as one's "real career" is concerned. The industrial culture does not think that its success is enhanced by having its best people on assignments to universities, and, conversely, young academics do not believe that a year's stay in industry helps much either with tenure or with obtaining research grants and contracts.

As things stand now, both parties are correct and behaving rationally in the local culture. What we need to work on as a country is understanding that the success of our separate communities—industrial and academic—is dependent in part on our *collective* success. A sense of urgency about this interdependence is what might well make possible the institutional changes on both sides that would make greatly increased interaction possible. A national initiative to stimulate such a rethinking could be a good idea. It ought to be analogous in prestige to the Presidential Young Investigator program, although different in content in obvious ways.

A rationalization of the policies of universities with respect to intellectual property. Questions about intellectual property policies in academia are often raised in the context of the unwelcome restraint on rapid publication that sometimes accompanies industry-sponsored work with proprietary overtones. But in my experience, this issue of withholding of publication until a patent application is filed can be dealt with by prior agreement on the time limit within which an application must be filed and by careful attention to this schedule on the part of faculty inventors and the concerned patent attorneys. An industry complaint is that academic patent policies do not usually take into account the fact that different industries have developed very different strategies and practices in their own use of intellectual property.

Consider the differences in practice between the electronics and computer industries on the one hand and the chemical and pharmaceutical industries on the other. In computers and electronics, the primary use of patents is to ensure freedom of action. Most large companies are extensively cross-licensed with each other. Exclusive licenses are few. The key is not ownership, it is access. In the chemical industry, however, a patent on a new material is used to ensure that the patenting company can have the exclusive right to bring the new material to market and to earn a financial reward.

Consider the implication for industry/university collaborations when universities model their patent practices on those of the chemical or pharmaceutical industries. As an example, when IBM research or development labs undertake to do joint studies with university colleagues, to the scientific benefit of both parties, we are met time and again with university policies that insist on the university having ownership of any jointly produced patents and, moreover, with the aggravating claim that we should pay royalties to use work we have jointly created and funded. We insist on royalty-free, nonexclusive licenses to work we have done jointly, but many universities persist in applying to IBM and other computer and electronics companies policies that make sense only in the chemical or bioengineering worlds.

Our approaches to patent protection differ in other important ways. In large companies, individual inventors usually have no first-order stake in the financial consequences of their inventions. They assign their rights to the company. Faculty members, in my experience, sometimes think of patents in terms of the possibility of getting rich, in much the same way as folks play the lottery—and with as much statistical hope of success.

However that may be, these differences constitute a real impediment to cooperation in important cases and need to be discussed. I hope for university patent policies that are flexible enough to deal with the range of practices that are normal in industry.

A reexamination, in some cases, of university conflict-of-interest policies and guidelines. I realize fully that I am venturing into treacherous waters by raising the issue of conflict of interest. Earnest thought has already been given to these matters in most research universities, and there are policies in place to avoid and/or regulate difficult cases. To the extent that there is about to be a much greater emphasis on rapid commercialization of research results, issues of appropriate behavior and rules governing real or potential conflicts will probably need reexamination also. This point is reinforced by the very wide differences in the guidelines for conflict of interest already in place in various universities. They cannot all be appropriate.

U.S. university research is an area of national competitive advantage. But evolving political and economic conditions provide an opportunity for universities to contribute to the country's well-being in additional ways. They should do so by cultural evolution that preserves their current strength.