A New Social Contract for Research

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Wilhelm von Humboldt, founder of the University of Berlin in 1809, did the most to spread the notion that universities are places of research. Their sole job had been to give students a broad education and to prepare them for careers in church or government. Humboldt argued that professors should be scholars and researchers as well as teachers. Over the next hundred years, Humboldt's idea spread to universities everywhere. The world over, universities became centers of scientific advancement and intellectual ferment.

During World War II, the US government offered large contracts to some universities to engage faculty and students in questions helpful to the war effort. The practice was institutionalized with the creation of the National Science Foundation in 1950 and the Advanced Research Projects Agency in the early 1960s. Based on a report in 1945 by Vannevar Bush of MIT called *Science, The Endless Frontier*, the legislation founding the NSF in effect established a social contract under which the government would pay scientists to engage in research of their own choosing on the understanding that significant benefits would come back to American society in the forms of military security, public health, and economic prosperity. In the 1980s, the objectives of federal support for university research were expanded to include international competitiveness and National Grand Challenges, leading to the Human Genome Project, the Manufacturing Initiative, and the High Performance Computing and Communications Program. These new federal programs involve big monies; in 1993, for example, $800 million were allocated to high performance computing, over half of which flowed to universities. After many years of generous government support for sponsored research, universities have made research a centerpiece of their public identities and offer faculty sure rewards for success at sponsored research.

The American university system has become the envy of the world. The ubiquitous, well-funded research programs are a major factor in this success. Many foreign students come with scholarships from their home countries, in the expectation that they will help their home countries on their return. "Exporting" US higher education has become such a big business, that some economists believe it actually cancels much of the balance-of-payments deficit.

Yet something has happened to tarnish the image of research in universities. Despite its many successes, two major problems with academic research carry considerable weight among federal lawmakers, who question whether the massive spending on research produces the value claimed by the Humboldtian and Bushian adherents. One is the "publish or perish" syndrome. In the past half century, nearly every university has adopted the practice of tenuring or dismissing a new faculty member within six years; in the context of the near-universal quest for a research reputation, most junior faculty are induced into a mass frenzy to publish papers in prestigious journals, a habit many retain for life. Much of this research is mediocre or of no consequence. About 2 million scholarly papers in science and engineering are published each year by 72,000 journals; the vast majority of these papers are read by a few hundred people at most; in most disciplines well over half the papers are never cited by another author. The "publish or perish" syndrome has devalued the original purpose of research in the university --- education. The second problem with academic research is that it does not confirm to the linear model envisaged by Bush: ideas are born to researchers and wend their way through a pipeline of development, production, and marketing before becoming consumer products. Authors Bruno Latour and Stephen Kline, among others, have shown that the real processes of innovation are much messier, full of feedbacks and chaotic disturbances involving many players. It is maddeningly difficult to prove that an innovation actually began with a researcher; too many other people are involved.

The kinder critics of academic research say that publicly-supported research should be limited to the professors who are genuinely good at it. The sharper critics say that research should be banished from universities. Neither of these will happen; but there will be a major restructuring of the nature and role of research in education.

Columbia University Professor Eli Noam has argued forcefully that the Internet and digital library are making the university library and local community of scholars obsolete, while at the same time, e-mail, phones, fax machines, and jet airliners have made it easier for faculty to establish stronger loyalties to national professions than to local institutions. Information technology therefore threatens the university as historically constituted and lays the foundation for the new university.

The 50-year-old social contract about research has come to an end. What will replace it? Even as a German university gave birth to the modern research university, a German research institute may have discovered a formula for research in the 21st century. Dennis Tsichritzis, the Chairman of the German research institute GMD, is interested in innovations: shifting the standard practices of a community of people so that they are more effective at what they do. He proposes that we regard research as a path to innovation. The modern research university is hampered by a belief that the discovery of new ideas is the only path. There are at least four processes leading to innovation:

1. Generating new ideas. Powerful new ideas shift the discourse, in turn shifting the actions of those practicing the discourse. Research consists of formulating and validating the new ideas. It places a great deal of emphasis on originality and novelty. The scientific publication process aims to certify originality and novelty through peer review.

2. Generating new practices. A teacher inculcates people into the practices of a new discourse. Research consists of selecting, clarifying and integrating the principles relevant to the practices. It places a great deal of emphasis on understanding that produces competence.

3. Generating new products. New tools enable the new practices, producing an innovation; the most successful are those that enable people to produce their own innovations in their own environments. Research consists of evaluating and testing alternative ways of building a tool or defining its function. It places a great deal of emphasis on economic advantage.

4. Generating new business. Successful firms continually improve their business designs. Research consists of testing markets, listening to customers, fostering off-beat projects that explore notions defying the convential wisdom, and developing new narratives about people's roles and identities in the world. It places a great deal of emphasis on market identity, position, and exploring marginal practices.

Although Tsichritzis does not explicitly mention the fourth kind of innovation, he clearly practices it in his leadership of GMD.

The first two kinds of research are done primarily in universities, the last two primarily in companies. The third kind is most common in industry R&D and is occasionally encountered in university-industry collaborations. Most innovations familiar to the public have come directly from the third kind of research and indirectly from the first.

The second kind of research is often overlooked or downplayed, yet it plays an extraordinarily important role in developing individual and corporate competencies. Many faculty are highly competent practitioners of this kind of research. Through their scholarly work they investigate questions, compile results, integrate their findings, bring clarity to a subject, generate new interpretations, and offer the new narratives needed for others to understand the subject. They produce popular articles, books, simulators, tools, and software. By participating in the research process, writing scholarly papers, building software, and attending conferences, they stay sharp, teach students competent investigative practices, and maintain credibility as experts knowledgeable about the leading edges of technology or thought.

In the academy, the first kind of research is by tradition accorded the greatest prestige; those most successful at it receive the highest honors. Yet not everyone is good at it; others try mightily but succeed only occasionally. In time, tradition will give way to economic reality. As universities adapt to shrinking federal funding for basic, "curiosity-driven" research, the first kind of research will be performed mostly in well-equipped labs by those who are genuinely good at it: the creative thinkers, mavericks, off-beat inventors, trouble-makers, and others with a talent for finding answers to basic questions. The second kind of research will rise in stature because it will be directly tied to the educational mission of the new university. The third kind will become more popular as universities come to grips with their own entrepreneurialism, discovering that they can realize income by helping businesses with their directed R&D, and discovering that this kind of research attracts students.

University research will be restructured, broadened, and enriched, but not eliminated. The research mission is too deeply ingrained into the university's ethos.

READINGS

In *Science in Action* (Harvard University Press, 1987) Bruno Latour differentiates between "ready-made science" and "science in the making" to show the cacaphony, controversy, and chaos that litter the trail to scientific truth. In *Conceptual Foundations for Multidisciplinary Thinking* (Stanford University Press, 1995) Stephen Jay Kline demonstrates that the processes of innovation are highly nonlinear and punctuated by many feedbacks and hiccups; he casts doubt on the notion that most innovations began as ideas began in researchers' minds.

Andy Grove's account of his leadership of Intel in *You have to be Paranoid to Survive* (1996) reveals much about the processes of research and innovation in a successful high-tech company.

Not normally given to comments on university research, *The Economist* (24 August 1996, page 14), said that the "publish or perish" syndrome is devaluing education by taking faculty energy away from teaching. Much of what faculty have accomplished is mediocre.

Eli Noam gave his views on the demise of the university in a commentary for *Science* magazine in October 1995 and again for *Educom Review* in May/June 1996. He spoke specifically about the way information technology is undermining the traditional assumptions of the university.

I have written several articles exploring some of these themes. You can find them in the *Communications* of ACM: (1) "Educating a new engineer," December 1992; (2) "Designing new principles to sustain research in our universities," July 1993; and (3) "The university's next challenges," May 1996. See also "Business Designs for the New University" in *Educom Review*, November 1996.

The material here is excerpted from my essay about the future of the university, "How we will learn," which appears in *Beyond Calculation: The Next 50 Years of Computing* (Copernicus, 1997).

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