

# Electronics and the Dim Future of the University

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By now, everybody knows about it—about the tremendous advances in computer networks as tools of inquiry; about the free communication links among researchers around the world; about the loss of stifling organizational hierarchy and coercive governmental controls; and about the ethic of sharing information instead of commercializing it. Technology, it seems, has created a new set of tools for academic endeavors, strengthening and enriching the existing research environment.

Parts of this exciting scenario are indeed coming true. Yet to conclude that the global academic village is all gain and no pain (beyond perhaps the need to protect against a few immature but creative youngsters) would be naïve. True, communications technology will link the information resources of the globe. But as one connects in new ways, one also disconnects the old ways. Thus, while new communications technologies are likely to strengthen research, they will also weaken the traditional major institutions of learning, the universities. Instead of prospering with the new tools, many of the traditional functions of universities will be superseded, their financial base eroded, their technology replaced, and their role in intellectual inquiry reduced. This is not a cheerful scenario for higher education.

Scholarly activity, viewed dispassionately, consists primarily of three elements: (i) the creation of knowledge and evaluation of its validity; (ii) the preservation of information; and (iii) the transmission of this information to others. Accomplishing each of these functions is based on a set of technologies and economics. Together with history and politics, they give rise to a set of institutions. Change the technology and economics, and the institutions must change, eventually.

## The Old Direction of Information Flows

Information institutions started about 5000 to 8000 years ago when, at different places around the world, priests emerged as specialized preservers and producers of information. Collectively, they were also the

primary information storage medium of their societies. Because reliance on individual and group memory to transmit information across time and space was inefficient, recording methods emerged. Writers had to be trained, and schools emerged. Writing, in turn, led to the establishment of formal information-storage institutions. Under the Assyrian king Assurbanipal (668 to 627 B.C.), the royal library in Nineveh stocked over 10,000 works. Documents were arranged by subject such as law, medicine, history, astronomy, biography, religion, commerce, legends, and hymns, each in a separate room in a compound. Wise men congregated there to use the information and to add to it. No doubt they also argued among themselves and were surrounded by disciples. Thus, knowledge and inquiry were already being organized along lines strikingly similar to today's university departments.

This model—centrally stored information, scholars coming to the information, and a wide range of information subjects housed under one institutional roof—was logical when information was scarce, reproduction of documents expensive and restricted, and specialization low. It became also the model for the most formidable of knowledge institutions of antiquity, the Great Library of Alexandria. At its peak, the library amassed nearly 700,000 volumes. Less recognized is its role as a graduate university. From the beginning, Ptolemy I Soter and his librarian, Demetrius, recruited some of the foremost scholars of the Hellenistic culture, such as the geometrician Euclid, to what was called the "museum." These scholars were surrounded by disciples and apprentices. Again, the pattern was similar. Scholars came to the information-storage institution and produced collaboratively still more information there, and students came to the scholars.

## The New Direction of Information Flows

This system of higher education remained remarkably stable for over 2500 years. Now, however, it is in the process of breaking down. The reason is not primarily technological; technology simply enables change to occur. The fundamental reason is that today's production and distribution of information are undermining the traditional flow of information and with it the univer-

sity structure, making it ready to collapse in slow motion once alternatives to its function become possible.

Most branches of science show an exponential growth of about 4 to 8% annually, with a doubling period of 10 to 15 years. As an illustration of this trend, *Chemical Abstracts* took 31 years (1907 to 1937) to publish its first 1 million abstracts; the second million took 18 years; the most recent million took only 1.75 years. Thus, more articles on chemistry have been published in the past 2 years than throughout history before 1900.

The response of organizations to the increased volume of information has been to improve processing capabilities by various means, such as better education, larger staffs, internal reorganization, and investment in technology. The main strategy, however, has been to increase specialization. As the body of knowledge grows, fields of expertise evolve into ever narrower slices.

The inexorable specialization of scholars means that even research universities cannot maintain coverage of all subject areas in the face of the expanding universe of knowledge, unless their research staff grows at more or less the same rate as scholarly output, doubling every 5 to 10 years. This is not sustainable either economically or organizationally, nor would it permit the existence of smaller-sized elite universities. As a result, universities no longer cover a broad range of scholarship. They might still have offerings in most of the major academic disciplines (whatever that means), but in only a limited set of the numerous subspecialties. For the same reason, many specialized scholars find fewer similarly specialized colleagues on their own campus for purposes of complementarity of work. Instead, scholarly interaction increasingly takes place with similarly interested but distant specialists, that is, in the professional rather than the physical realm.

None of this is new, of course. But as the information-induced pressures of specialization have grown, so have the means to make the invisible college the main affiliation. Air transport established the jet-setting professoriate. Even more so, electronic communications are now creating new electronic scholarly communities in response to the elementary need for intellectual collaboration. Ironically, it is the university that pays for the network connectivity that helps its resident scholars to shift the focus of their attention to the outside world—or, in the jargon of electronic communications, to join virtual communities in cyberspace. As this happens—and we are only at the beginning of convenient technology—the advantage of physical proximity of scholars in universities declines steeply.

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The second function of the university is the storage of information. It has been said that a university is as strong as its library. But here, too, considerations of economics and technology change everything. As the production of scholarship increases exponentially, so does the cost of acquisition and reference. For example, in 1940 an annual subscription to *Chemical Abstracts* cost \$12; in 1977 it was \$3500; and in 1995 it was \$17,400. As comprehensive library collections have become unaffordable, electronic alternatives have become powerful in their storage capacity, broad-ranging in content, and efficient in retrieval. Therefore, universities are gradually shifting from investment in the physical presence of information to the creation of electronic access. It is a logical response and undermines the fundamental role of the university as the repository for specialized information. Soon the combination of laptop computer and phone line will serve this function as well—and often better—anywhere, anytime.

The third function of the university is the transmission of information, its teaching role. It is hard to imagine that the present low-tech lecture system will survive. Student-teacher interaction is already under stress as a result of the widening gulf between basic teaching and specialized research. And the interaction also comes with a big price tag. If alternative instructional technologies and credentialing systems can be devised, there will be a migration away from classic campus-based higher education. The tools for alternatives could be video servers with stored lectures by outstanding scholars, electronic access to interactive reading materials and study exercises, electronic interactivity with faculty and teaching assistants, hypertextbooks and new forms of experiencing knowledge, video- and computer-conferencing, and language translation programs. While it is true that the advantages of electronic forms of instruction have sometimes been absurdly exaggerated, the point is not that they are superior to face-to-face teaching (though the latter is often romanticized), but that they can be provided at dramatically lower cost. A curriculum, once created, could be offered electronically not just to hundreds of students nearby but to tens of thousands around the world. It would be provided by universities seeking additional revenues in a period of declining cohorts, though probably not at first by elite colleges, which guard their scarcity value.

Already, electronic distance education is available for a wide range of educational instruction through broadcast, cable, online, and satellite technologies. Such forms of instruction appeal to motivated students with full-time jobs, family obligations, limited mobility, distant locations, and needs for

specialized courses. An example is the Agricultural Satellite Network (AgSat), which allows two dozen agricultural colleges to exchange their course offerings and “reduce duplication.” Such efforts at cost reduction are not likely to be welcomed by the beneficiaries of low-tech teaching, the university faculty, which finally defines the mission and structure of its institutions and is as resistant to change as any other profession.

In any event, the ultimate providers of an electronic curriculum will not be universities (they will merely break the ice) but rather commercial firms. Textbook publishers will establish sophisticated electronic courses taught by the most effective and prestigious lecturers. At present, tuition fees at private universities are nearly \$50 per lecture hour per student, not counting most of the public and philanthropic support that universities receive or the opportunity cost of students' time. With such Broadway show-sized prices, alternative providers will inevitably enter the electronic education market. Today's students, if they seek prestigious jobs or entry-restricted professions, usually have no choice other than to attend university. However, this is a weak and mostly legal reed for universities to lean on, and is only as strong as their gatekeeper control over accreditation and over the public's acceptance of alternative credentials. When this hold weakens, we may well have in the future a “McGraw-Hill University” awarding degrees or certificates, just as today some companies offer in-house degree programs. If these programs are valued by employers and society for the quality of admitted students, the knowledge students gain, and the requirements that students must pass to graduate, they will be able to compete with many traditional universities, yet without bearing the substantial overhead of physical institutions. It is likely that commercial publishers will assemble an effective and even updated teaching package, making the traditional curriculum at universities look dull by comparison, just as “Sesame Street” has raised the expectations of pupils for a lively instructional style. Already available on video is the “Greatest Lectures by America's Superstar Teachers,” distributed by a company advertising itself as “your own private university, staffed exclusively by a ‘dream team’ of America's best lecture professors.” Degrees are granted by the all-electronic International University College, affiliated with the big cable TV company Jones Intercable. The same company also offers courses on its Mind Extension University channel that receive credit by the degree programs of several dozen colleges.

Commercial providers will offer primarily mainstream undergraduate and professional education. At the same time, some of

the invisible colleges of interlinked specialists will be transformed from a wide-openness that is unmanageable, into more structured virtual departments that may offer graduate credentials, specialization, socialization, and apprenticeship, thus weakening these roles of the universities, too.

Of course, another reason to attend a university is to participate in a rite of generational passage into adulthood, and its associated social networking. While this is an important aspect of university experience, it could be replicated in other ways—as it was in the thousands of years preceding mass college attendance—and often in more attractive locations and climates.

If the university's dominance over higher education falters, its economic foundation will erode. In these times of budgetary squeezes, most universities will not be able to compensate for tuition losses by increased public funding. The role of the private sector will have to grow in order to fuel and maintain the existing system. Yet private donations are likely to decline, if anything, with the university's reduced central role in research and teaching and with increasing disillusionment about the ability of higher education to solve society's problems.

## The Impact on the University

The problems affecting universities will not be uniform. In the area of teaching, the most negative impact will be on mass undergraduate and professional education and on highly specialized and advanced fields. Least affected will be contact-intensive programs such as selective and tutorial-based liberal arts education (especially if they are backed by healthy endowments), as well as skill training that requires hands-on instruction and feedback, and small but stable fields of graduate study that are not lucrative for commercial providers.

In the area of research, least affected will be fields that do not experience substantial growth and specialization, and where researchers share a strong core. (They will be financially squeezed, however, by the loss of cross-subsidies from previously grant-rich parts of the university.) Most affected will be highly specialized research, where keeping up to the minute is critical. This is not to say that research requiring teams and shared equipment will not necessarily be located on campus, but it will be connected primarily to other units elsewhere in academia, industry, and government. The university will then exist as a sort of office park of semiautonomous units, each a soft money tub on its own bottom. The administration of universities is then likely to be even more decentralized than today, and partly run from a distance by telecommuting staff and specialized subcontractors.

## The Future Role of the University

In presenting this bleak scenario for the future of the university, it is easy to appear as yet another dismal economist or technological determinist, and to invite a response reaffirming the importance of quality education, academic values, the historic role of education in personal growth, and the human need for freewheeling exchange. Such arguments are correct, may make one feel good, but are beside the point. The question is not whether universities are important to society, to knowledge, or to their members—they are—but rather whether the economic foundation of the present system can be maintained and sustained in the face of the changed flow of information brought about by electronic communications. It is not research and teaching that will be under pressure—they will be more important than ever—but rather their instructional setting, the university system. To be culturally important is necessary (one hopes) but, unfortunately, not sufficient for a major claim on public and private resources. We may regret this, but we can't deny it.

This scenario suggests a change of emphasis for universities. True teaching and learning are about more than information and its transmission. Education is based on

mentoring, internalization, identification, role modeling, guidance, socialization, interaction, and group activity. In these processes, physical proximity plays an important role. Thus, the strength of the future physical university lies less in pure information and more in college as a community; less in wholesale lecture, and more in individual tutorial; less in Cyber-U, and more in Goodbye-Mr.-Chips College. Technology would augment, not substitute, and provide new tools for strengthening community on campus, even beyond graduation. In research, the physical university's strength lies in establishing on-campus specialized islands of excellence that benefit from the complementarity of physical proximity. This requires the active management of priorities, and a significant unbundling of the credentialing, teaching, housekeeping, and research functions. In the validation of information, the university will become more important than ever. With the explosive growth in the production of knowledge, society requires credible gatekeepers of information, and has entrusted some of that function to universities and its resident experts, not to information networks. But to safeguard the credibility of this function requires universities to be vigi-

lant against creeping self-commercialization and self-censorship.

The threats to universities may not appear overnight, but they will surely arrive. People often overestimate the impact of change in the short term, but they also underestimate it in the long term. They recall that earlier promises about the potential of broadcasting as a tool of distance education failed to materialize, and they now believe that even a vastly more effective interactive medium will meet the same fate, forever. Yet the fundamental forces at work cannot be ignored. They are the consequence of a reversal in the historic direction of information flow. In the past, people came to the information, which was stored at the university. In the future, the information will come to the people, wherever they are. What then is the role of the university? Will it be more than a collection of remaining physical functions, such as the science laboratory and the football team? Will the impact of electronics on the university be like that of printing on the medieval cathedral, ending its central role in information transfer? Have we reached the end of the line of a model that goes back to Nineveh, more than 2500 years ago? Can we self-reform the university, or must things get much worse first?