

2. KEYNOTE ADDRESS

James Duderstadt, University of Michigan

The goal of this symposium is to bring together experts from an array of constituencies, including both producers and users of STM publications, to look at some of the technical changes that have occurred in electronic publishing, and how they influence decisions to publish or not; to identify the needs of the science, technical, and medical (STM) publishing enterprise itself as users of journals; to understand the responses of both the commercial and not-for-profit STM publishers; and to examine a very broad spectrum of proposals and activities underway that are attempting to respond to the needs of the community with these new technologies.

A major focus of this symposium is to look at business models and to try to establish the degree to which they address many of the challenges and concerns. During the discussions it is important to keep in mind the ongoing developments in the scientific enterprise itself, stimulating in part, and being stimulated by, this kind of scholarly communication.

How is electronic publishing affecting the practice of scientific research—the communication of research results to scholars and others, perhaps including the public; the curation of data and evaluation of research; and archiving of results? The challenge is to identify the issues and problems that the STM community needs to control and resolve if it is to exploit the remarkable opportunities presented by this very rapidly evolving technology and also cope with the challenges it presents.

The current situation can perhaps be described as a chaos of concerns, with the continuation of some disturbing trends that have evolved over the last couple of decades. Access to STM information is increasingly expensive, and in some cases restricted. And yet, the amount of information generated at research institutes continues to grow.

Journal subscription prices continue to escalate, yet university library budgets fail to keep pace, particularly in these days of economic challenges at both the federal and state level. The price inflation in electronic publication resources, estimated to be running at approximately 10 percent per year over the past decade,¹ has continued to run well ahead of the consumer price index. But even more dramatic has

¹ See Barbara Albee and Brenda Dingley. 2003. "U.S. Periodical Prices—2002," American Library Association,

been the increase in the pricing for reference tools, increasing as much as 600 percent over the print cost of bound volumes. To these challenges should be added the growing complexity of dealing with various financial models and the licensing schemes that provide access.

It is clear that these new technologies have created very fundamental changes in the production, management, dissemination, and use of all kinds of information. If one were to categorize very simply the two camps of concerns, on the part of the publishers the critical question is, How many copies of work will be sold or licensed if networks make possible planetwide access? And the nightmare, of course, is that the answer is only one. One document can be replicated time and time again, to not only serve, but perhaps collapse, the entire marketplace.

On the other side, the nightmare to consumers is that in our efforts to preserve the marketplace, we will put in place an array of technical and legal protections that reduce access to what should be a public good, society's intellectual and cultural heritage.

There are a lot of reactions and counter-reactions at the university level. The first reaction is a budgetary one. University libraries simply cancel many subscriptions. In some cases this is mandated by limited resources. In other cases it is an effort to get the attention of the publishing industry, although what cancellation generally does is simply drive up the costs even further for the remaining subscriber base.

In other instances, we have seen rebellion at the grassroots. Editorial boards have protested against the commercial publisher journal prices and have resigned and moved to less expensive publishers in scientific societies. The complexity and shifting from a first-sale approach characteristic of paper to licensing have caused a good deal of experimentation.

There are many other variants. One approach is reminiscent the way that dissertations used to be generated from the university microfilms collection, as an edition of one. That is, to begin to make it acceptable that there may only be one physical copy of a document but have the ability to reproduce that from an online copy, at the user's expense.

Another interesting approach that is emerging involves the open source or open-access strategy.

The success of the open software movement through Linux, the Apache Web server, and similar technology has given rise to a number of related open-access initiatives, such as the Open Knowledge Initiative and the MIT OpenCourseWare project. These initiatives focus on developing new financial models for the open distribution of scholarly materials, perhaps by building charges for dissemination into research grants that generate the information in the first place. This is not only consistent with the traditions and values of academia but also reinforces the definition of the university as a public good, an issue that university leaders are increasingly worrying about these days, when the rest of society tends to look at us more as a market commodity.

In summary, advances in digital technology are producing radical shifts in our ability to reproduce, distribute, control, and publish information. Yet, as these advances become more a part of scientific activity, they tend to run headlong into the existing practices, policies, and laws that govern traditional publishing.

The issues are complex, in part, because the stakeholders are so many, so varied, and with different agendas. People who fund research want to see that the information is advanced and made available to the public. The authors, editors, and reviewers do not charge for their labor. They are motivated to contribute to the public good, but of course they also have other rewards, not the least of which is tenure. Publishers, as intermediaries, although they do not pay for content, do add significant value and provide the work in published form. Libraries, similarly, are intermediaries. They provide access to the users of STM content. They pay the subscription fees, but they usually do not charge for providing access. And, of course, the end users either pay for personal subscriptions or obtain the resources free through libraries.

There are several more general issues that need to be considered. First, is the changing nature of science and technology research. As pointed out in the recent National Science Foundation (NSF) report, *Revolutionizing Science and Engineering Through CyberInfrastructure*,² the process of knowledge creation itself—experimentation, analysis, theory development, and forming conclusions—is increasingly occurring entirely in the digital world. That has caused a shift from the sequential process of research,

² National Science Foundation. 2003. *Revolutionizing Science and Engineering Through Cyberinfrastructure: Report of the National Science Foundation Blue-Ribbon Advisory Panel on Cyberinfrastructure*, Arlington, VA, January.

publication, validation, and dissemination to more of a parallel flow model that is interactive, in which the process of publication and distribution actually becomes almost the process of research itself. The key point of the report is that distributed network computing technology is providing a new kind of infrastructure for federating people, information, computational tools and services, and specialized facilities into virtual organizations—so-called collaboratories or grid communities or, as the Europeans call it, e-science, a cyberinfrastructure. The vision put forth by this NSF report is to use this infrastructure to build ubiquitous and comprehensive digital environments. Such environments will become interactive and functionally complete for research communities in terms of the people, data, information tools, and instruments, and that operate at unprecedented levels of computational storage and data transfer capacity. Part of the aim is to trigger the necessary public and private investments to create this cyberinfrastructure. Nevertheless, many elements of it are already in place, and it will significantly change the nature of scholarly activity, including scholarly publication.

The reality today is that electronic publishing is becoming the dominant mechanism for publishing and reading scholarly materials. It opens vast possibilities, of course, but it challenges existing practices and principles, including the way in which we handle intellectual property. A new paradigm for scholarly communications is coming into focus that is capable of providing open online access to the work of scholars without payment; online repositories of high-quality, certified materials; and a stable economic model to sustain these resources.

This will pose a particular challenge to libraries, shifting them from a focus on collecting and archiving knowledge resources, to assisting scholars in navigating these resources. Today, the campus library has become somewhat less central to researchers' lives. The library has evolved from a place into a utility. It too is becoming a part of the Internet.

Legal and policy issues are the second major issue area. It is clear that the emerging digital infrastructure imperils a great many of our existing practices, policies, and laws that have served intellectual activity in this country and globally so well over the past two centuries, forcing the rethinking of some fundamental premises and practices associated with intellectual property. Indeed, there is a concern that many of these will be challenged to the bedrock.

The third topic concerns the evolution of digital technology. In 2000 the National Academies

created a study group chosen from industry, higher education, and federal policy development to understand better what the implications of digital technology were for the research university, and even more broadly, for the research enterprise.³ The concern was that although the opportunities and challenges of this technology were important, many of the most significant issues were neither well recognized nor understood. Among the early conclusions of this effort was that the recognition that the extraordinary evolutionary pace of digital technology shows no sign of slowing, with some aspects such as storage and wireless bandwidth evolving at superexponential rates

The second conclusion was that the impact of the technology on the university will be profound, rapid, unpredictable, discontinuous, and disruptive. It will affect all of the activities of the university—teaching, research, outreach, its organization, financing, governance, even the definition of its faculty and students. Procrastination and inaction are the most dangerous courses of all during a time of rampant technological change.

The report's third major conclusion, and an interesting one, was that universities should begin the development of strategies for facing this kind of technology-driven change with a firm understanding of those key values, missions, and roles that need to be protected and preserved during a time of transformation. These include traditions such as openness, academic freedom, and the rigorous of academic inquiry.

A fourth area of concern is the commercialization of academic output, as the soaring commercial value of much of the intellectual property produced on the campuses raises very significant challenges to traditions such as openness and academic freedom.

Finally, there are the issues of national security, which again call into the question of balancing scientific openness and with the restrictions on public information necessary for homeland security.

As we address these complex issues, we might well keep in mind the well known observation of Thomas Jefferson:

If nature has made any one thing less susceptible than all others of exclusive property, it is the action of the thinking power called an idea, which an individual may exclusively possess, as long as he keeps it to himself. But the moment it is divulged, it

³ See National Research Council. 2003. *Issues for Science and Engineering Researchers in the Digital Age*,

forces itself into the possession of everyone, and the receiver cannot dispossess himself of it.

That ideas should freely spread from one to another over the globe for the moral and mutual instruction of man, and the improvement of his condition, seems to have been peculiarly and benevolently designed by nature when she made them like fire, expansible over all space without lessening their density at any point, and like the air in which we breathe, move and have our physical being, incapable of confinement or exclusive appropriation. Inventions then cannot, in nature, be a subject of property.