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BY JOHN M. UNSWORTH

If the nineties were the e-decade (e-commerce, e-business, e-publishing, eBay, E*Trade, etc.), the aughties are the o-decade (open source, open systems, open standards, open access, open archives, open everything). This trend, now unfolding with special force in higher education, reasserts an ideology, a meme, that has a continuous tradition traceable all the way back to the beginning of networked computing (in fact, as far back as Thomas Jefferson's famous defense of the principle that "ideas should freely spread from one to another over the globe"). Call this meme Liberation Technology. It has recently been adopted by some venerable institutions -- not only by some of the great public and private universities, but also by major private foundations -- and it means business.

Since the beginning of Internet time and before, Liberation Technology has been intertwined with and opposed to another ideology. Call it Command and Control. You see Command and Control at work in the military roots of the Internet, in the Recording Industry Association of America's prosecution of file-sharing college students, and in Microsoft's doubly possessive and oddly revealing slogan ("your potential, our passion"). Liberation Technology wants to keep information free; Command and Control wants to make the Internet safe for private property.

To be sure, not all proprietary operations oppose open inquiry, but the key to the business success of open-source products like Linux is that they allow people to make money by selling them, without allowing the seller exclusive control. Especially with information goods, the notion of nonexclusive commercial rights is key.

In the Early Days of the Web, Public Good vs. Property Rights

By the early 1990s, the Internet was expanding rapidly, going from one thousand hosts in 1984 to one million in 1992, and new, more sophisticated applications were appearing, like Gopher (1991) and the World Wide Web (the first Web server in the United States was set up in 1991, with Mosaic, the first graphical Web browser for personal computers, coming along in 1993). Throughout the 1990s, university faculty members and students outside of computer science were gradually becoming aware of the existence of the Internet, largely because of the Web; so was the rest of the world, for the same reason.

In retrospect, it's difficult to comprehend the rapidity with which the Web went from an obscure science experiment to a fact of daily life, but it took only about three years. By late 1994, the World Wide Web Consortium was founded to take over managing Web protocols and their development and to ensure that the Web would remain a nonproprietary public good. In 1996, the consortium presented the first draft of XML (Extensible Markup Language, the encoding format that is now used for exchanging text and many other kinds of data on the Web); the official

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draft of XML 1.0 was presented in 1998.

In distinct contrast to that ethos, with its focus on the public good, an aggressive campaign began in the late 1990s to expand the property rights of "content providers," in legislation like the Digital Millennium Copyright Act and the Sonny Bono Copyright Term Extension Act (both passed in 1998) and in case law arising out of the Recording Industry Association of America's suit against Napster in 2000. Mixed in there was the Microsoft antitrust case, initiated in 1998 under the Clinton administration, first decided against Microsoft, overturned on appeal, and eventually settled, quite favorably for Microsoft, by the Bush administration in 2001.

Against that backdrop, during the 1990s all over the United States universities became big IT consumers, not just in computer science or in the sciences, but increasingly in all disciplines, on every part of campus, for all kinds of services. As they came to rely more, and more broadly, on networked information in teaching, research, and administration, universities turned away from the strategy of meeting their own specialized needs with homegrown software and began to license more commercial products.

They also began to be seen, for the first time, as a profitable market for commercial IT products and services. WebCT and Blackboard, for example, both appeared on the scene in 1997 and over the next few years they signed up hundreds of university clients for "e learning" systems to put courses online, do grading online, accept homework assignments online, etc. On the administrative side, beginning in the mid-1990s, enterprise-resource-planning (ERP) systems from vendors like PeopleSoft and Oracle -- for managing payroll, student records, human resources, purchasing, etc. -- began to find a market in universities, partly built on the fear that Y2K would wreak havoc on older, usually homegrown, systems that had hitherto been performing those functions, often successfully, often for years.

Universities also got caught up in the Internet bubble -- that combination of greed, optimism, and willful ignorance of history that led us to believe that information technology would create a permanent bull market. In the heady days at the turn of the millennium, Columbia University, to take only one of many possible examples, plowed millions into launching Fathom, a for-profit online content provider for e-learning, confident that such a foray into the commercial sector would turn a handsome profit for the stakeholders, which included not just Columbia, but the London School of Economics and Political Science, the New York Public Library, the University of Chicago, the University of Michigan, and others.

Some time in 2000, though, the pendulum started swinging the other way, beginning, perhaps, in reaction to failures such as Fathom's. In his annual report for 2000-2001, the president of the Massachusetts Institute of Technology, Charles M. Vest, succinctly articulated a return to the original ideology of the Net when he announced [MIT's OpenCourseWare project](#) to make primary materials of its courses available online -- free. As he noted, "inherent to the Internet and the Web is a force for openness and opportunity that should be the bedrock of its use by universities."

Vest's report is not the source of the trend that is now unfolding, but it is certainly a document that crystallizes a historical moment. It is significant for another reason, too: It is emblematic of what's changed in this iteration of Liberation Technology.

Course Management, Portals, and Enterprise Systems

This time around, the ideas are being advanced not by ragtag communitarians, but by major institutions, with substantial backing not just from MIT, but from a number of other universities as well, and not

just from universities, but from corporations, foundations, and government agencies at home and abroad.

In MIT's case, support comes from the institution itself and also from two major private foundations, the William and Flora Hewlett Foundation and the Andrew W. Mellon Foundation. On a first visit, the [MIT site for OCW](#) looks a little longer on structure than substance. If you dip at random into courses, you may see mostly syllabi, perhaps some exercises, and a list of assigned readings, but not the readings themselves (leading you to wonder how the effort is going to provide new educational opportunities in the developing world, as claimed). But on further investigation, you'll find that some courses have the complete text of every lecture (in PDF), and others have full-length videos of every lecture (at three different resolutions for slow, medium, and fast connections). At that point, MIT's claim to be the first open-source university begins to seem more plausible.

MIT can't give away the readings in its courses -- in most cases, textbooks and articles that come from commercial publishers -- but it can give away the intellectual property created by its own faculty members, and that's what it's doing. As with the open-source-software movement from which it drew inspiration, it permits the reuse, modification, and redistribution of content. Unlike open-source software, however, it prohibits doing any of those things for commercial purposes.

That distinction is important, and it is key to understanding the doctrinal differences among open-source sects. Beginning in the early '80s, the innovation of the open-source-software movement was to argue that users should have the freedom to modify source code, but could sell the results, as long as the source code for the modified version was available for modification. Those terms are codified in the [GNU Public License](#).

Since then, other variants of open-source licensing have emerged. MIT's materials in OCW are covered by a different, newer copyright, developed by the [Creative Commons project](#), an effort led by Lawrence Lessig, who set up Stanford University's Center for Internet and Society, with support from Hewlett, Stanford and Harvard Universities' law schools, and others (including the philanthropic group Center for the Public Domain). The Creative Commons license allows copying and redistribution, but also allows the content creator a set of options with respect to attribution, commercial use, and modification of the work. The Creative Commons license is inspired by GNU, but also informed by a somewhat broader perspective, in that it is intended to cover creative work other than software.

Though legal variants of open-source licenses do exist, at a technical level, open systems require that everyone who designs or modifies the systems does so under the same set of rules. In the case of online courseware, content, and tools, the [IMS Global Learning Consortium](#) is providing some important common ground on which to coordinate a very broad range of specifications. One of the partners in that effort is another "open" entity, called the Open Knowledge Initiative, or OKI. That effort, financed by the Mellon foundation, is based at MIT with Stanford as a principal partner and supported by a number of major universities. It [describes itself](#) as "an open and extensible architecture that specifies how the components of an educational software environment communicate with each other and with other enterprise systems." The goal is to liberate universities from having to choose a single software solution for managing online instruction and/or online components of classroom instruction. The result would be greater portability of content, greater flexibility in choosing and assembling elements of a learning-management system, and a shift in the balance of power between the client (the university) and the software vendor, in favor of the client.

Universities -- or open-source developers at large -- could choose to produce and share their own modules for things like calendars, gradebooks, etc. Commercial vendors could also continue to build and

sell proprietary solutions that adhered to the architectural specification (and that, therefore, allowed users to unplug some of the vendor's modules and plug in some of their own, or some from another vendor). That speaks directly to the practice of monopolistic "bundling" that was at the heart of the antitrust case against Microsoft.

As with any standard, success will depend on whether both vendors and users buy into it. That is not yet a certainty with OKI, but in May 2002 Blackboard announced its intention to adopt the OKI architecture. In October 2002 OKI announced that it had joined in an informal consortium with other "leading organizations developing specifications for e-learning technology in higher education ... to coordinate strategy and conduct common activities."

While the OKI project aims at specifying an architecture for online learning systems, and MIT's OCW is focused on content for such systems, another open-source effort, the Sakai Project, focuses on educational software tools. According to the [Sakai Web site](#), the project hopes to "demonstrate the compelling economics of 'software code mobility' for higher education, and it will provide a clear road map for others to become part of an open-source community." Sakai is a collaboration among Indiana University, MIT, Michigan, and Stanford, which will begin using its tools in 2004.

Another partner in Sakai is the open-source project [uPortal](#). A number of other universities (in the United States and abroad) and for-profit companies (Sun Microsystems, SCT, Interactive Business Solutions) are involved in developing uPortal. Once again, the Mellon foundation is helping to support the project.

Portals can do more than integrate news and weather, or library and course information. They can also integrate the administrative-computing functions of the university, such as student records, payroll and human resources, and purchasing. Interestingly, but perhaps not surprisingly, one of the corporate sponsors of uPortal is SCT, a company whose interests could be threatened, or at least significantly reoriented, if uPortal achieves the success for which it seems destined. SCT provides a "solution" called Banner, one of those enterprise-resource-planning products mentioned above.

Over the past few years, universities have spent hundreds of millions of dollars to acquire, customize, and make the transition to such systems, often with very mixed results. The university that now employs me, and the one I worked at last, are both in the throes of such a transition, probably too far in to get out, but probably wishing they could.

Admittedly, it's a huge undertaking to retool an entire university's administrative-computing infrastructure and workflow, and it requires long-range planning and commitments. An institution makes those plans and commitments based on the best choices available at the time: Several years ago, when decisions were being made at the Universities of Illinois and Virginia, there were no plausible open-source/open-standards ERP alternatives, so the universities bought into monolithic proprietary systems. Now alternatives are beginning to come into view. It will be years before the current generation of university ERP adopters can switch to open-source alternatives, but their experience will certainly help to make the case for such alternatives as they emerge.

Toward a New Model of Scholarly Communication

There are a number of other pressing IT challenges facing higher education, and at or near the top of the list are digital libraries (or, more generally, data repositories). Those could include data held in an institution's library (licensed or locally produced scholarly information), data held outside the library (by an office of management information, for example), and/or data published by a university press.

The case for institutional repositories is laid out convincingly in [an article](#) by Clifford A. Lynch, executive director of the Coalition for Networked Information, published in the February 2003 newsletter of the Association of Research Libraries. Lynch argues that "an institutional repository is a recognition that the intellectual life and scholarship of our universities will increasingly be represented, documented, and shared in digital form, and that a primary responsibility of our universities is to exercise stewardship over these riches: both to make them available and to preserve them."

There are a number of noteworthy "open" initiatives in this area as well, and familiar institutions and financial supporters. Four very different, possibly complementary, open-source frameworks for institutional repositories and/or digital libraries are [MIT's DSpace](#) (supported by Hewlett-Packard), the [Cornell/Virginia Fedora Project](#) (supported by the Mellon foundation), [EPrints](#) (supported by the National Science Foundation and Britain's Joint Information Systems Committee), and [Greenstone](#) (produced by the University of Waikato, in New Zealand, and developed and distributed in cooperation with Unesco and Human Info NGO).

Beyond the individual repository, there is the problem of federated collections, and how to search across repositories, a dream long held in digital libraries. The Open Archives Initiative ([OAI](#)) is a project aimed at achieving that goal, by developing and maintaining standards to facilitate sharing information. Currently, there are 134 registered OAI repositories, and you can see a nice working example of sample searches across many of them on the Web site for the [Perseus Digital Library at Tufts University](#).

The EPrints software mentioned above is the self-archiving component of a larger project on open access, supported by the Soros Foundation and marching under the banner of the Budapest Open Access Initiative, whose purpose is "to make research articles in all academic fields freely available on the Internet" -- either by institutional self-archiving of articles that also appear in for-fee journals, or by authors publishing in [open-access \(free\) journals](#).

In the [American Scientist Open Access Forum](#) (moderated by Southampton University's Stevan Harnard), there is a lively, long-running, and unresolved debate on what open access means. That debate has been attracting considerable attention around the world, both within and beyond the academy.

The efforts to promote open access to scholarly research, to build interoperable digital libraries, and to create institutional repositories coincide with the broadening university revolt against the monopolistic bundling strategy of Elsevier, in which university libraries are required to subscribe to packages of titles and are locked into multiyear subscriptions. Faculty members and libraries at Cornell University, Harvard, North Carolina State University, the University of California system, and the University of North Carolina at Chapel Hill have all rejected those tactics in the last year.

University-press publishers have a golden opportunity here to distinguish themselves from commercial publishers and join with libraries and scholars to create a new model of scholarly communication. To seize the opportunity, though, university presses will require more capital, cooperation, and creativity than they seem to be able to muster.

The Battle for the Desktop

Journals, repositories, portals, and ERP systems are the macro end of IT in higher education; at the micro end is the individual user's desktop environment. The desktop has been Microsoft territory for years, but

open-source projects are cropping up here as well. In September 2003 25 universities joined with Mellon to provide funds for Chandler, an open-source alternative to Microsoft's Outlook. Chandler is (or will be) a desktop application for Linux, Mac OS X, and Windows, combining e-mail, calendars, address books, instant messaging, and file sharing. It's being produced by Mitch Kapor's [Open Source Applications Foundation](#), and it has two subtypes: a personal version called Canoga, due out in the fall of 2004, and a version called Westwood that is specifically aimed at higher education, due out in the fall of 2005.

What Chandler brings into focus is the battle for the desktop between Microsoft and the open-source community. Microsoft has already seen a serious challenge to its server market from Linux, but it still has a lock on the desktop, in spite of a much-improved Macintosh operating system and the persistence of efforts like OpenOffice, which provide an open-source alternative to Microsoft's word-processing, spreadsheet, and presentation software. Kapor estimates that it will be 2007 before Linux makes significant inroads here. Still, Microsoft is clearly already worried about its dominance, as one can see from a series of leaked Microsoft memos on how to combat Linux, available in annotated form on the open-source [Web site](#).

More immediately, there are some noteworthy open-source developments in the collaborative creation of content. One is a courseware project from Rice University called [Connexions](#), which converts "raw knowledge" into self-contained modules of information and places them in commons, to be used, reused, updated, and adapted. It is designed to highlight the nonlinear "connexions" among concepts both within the same course and, more important, across courses and disciplines. It is open source and based on open standards (XML), and has support from the Hewlett foundation.

Another, simpler and more general-purpose collaborative tool that's become quite popular in the last couple of years is Wiki, a Web-based platform for collaboration that comes in a variety of open-source incarnations. Perhaps the most robust and widely used is [TWiki](#). Using any Web browser, you can directly edit any Wiki page, add links automatically, group pages, search pages, attach files, track revisions, control access at the individual or group level, and so on. TWiki, which is just one type of Wiki, has hundreds, probably thousands, of installations, not only in higher education, but in corporate intranets at places like Disney, British Telecom, Motorola, SAP, and others.

Combined with something like [LionShare](#), Wikis could provide a powerful tool for collaboration in academe, one that could change teaching, project management, the work of professional societies, and many other activities. LionShare (another Mellon-financed project) is essentially peer-to-peer networking with authentication. Peer-to-peer networking is the technology underlying demonized post-Napster software like KaZaA, but it also has less well-known applications in things like videoconferencing. LionShare's addition of authentication makes it legitimate for a broad range of applications in institutional settings.

Choice and Compatibility With Commercial Software

The university-based open-source projects described here have in common two key characteristics: unbundling and interoperability. Those strategies are inherent to open-source software development, but have also proved compatible with commercial software development. They are hostile only to monopolistic practices.

Unbundling and interoperability are important because they provide choice and flexibility. Instead of being locked into a single application or suite of applications from a single vendor, you can choose to mix different applications to achieve the best performance for your particular purposes, at the best price. For the end user, that means that you can use

a word processor from one place, a collaboration tool from another, an e-mail client and an address book from somewhere else, and exchange data among all of them using open standards to which all adhere.

At the other end of the spectrum, in administrative computing or digital libraries, it means that you can use a database engine from one vendor, a portal kit from someone else, a Wiki for managing projects and discussions. When something better comes along for one of those functions, you can swap out that piece, rather than waiting until the whole system is intolerably outdated, and then undergoing vast, enterprisewide transition from one monolithic system to another.

On a broader level, what's noteworthy in the various threads of the trend assembled here is the concerted efforts of a handful of private foundations, working with public (and some private) universities, to promote self-determination in higher education's use and development of information technology. Most of the examples I've cited have been supported by two foundations, Hewlett and Mellon. Both foundations give to things other than higher education and, within higher education, both give to things other than IT projects. Yet they clearly are having substantial impact on the information infrastructure of the 21st-century university, and the projects they are helping get under way will liberate it from Information Property monopolies and IT monocultures. They've achieved those results by emphasizing long-term sustainability of projects and by adopting and promoting the open-source ethos of shared goals, shared work, and shared results.

Open-source methodology has already spread well beyond software development: In the world at large, the Human Genome Project is a famous example. Over the coming decade we're certain to see this new mode of production locked in mortal combat with older methods and the legal and ideological commitments that they entail. It will be interesting to see whether, at this critical juncture, the university comes down on the side of freely shared ideas.

With a little help from its friends, it just might.

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OPEN EVERYTHING: ONLINE RESOURCES

The following projects, articles, and other electronic sources are listed in the order in which they are discussed in the accompanying article.

MIT OpenCourseWare

Home page: <http://ocw.mit.edu/index.html>

GNU General Public License

Home page: <http://www.gnu.org/copyleft/gpl.html>

Creative Commons

Home page: <http://creativecommons.org>

IMS Global Learning Consortium

Home page: <http://imglobal.org>

Open Knowledge Initiative

Home page: <http://web.mit.edu/oki>

The Sakai Project

Home page: <http://www.sakaiproject.org/sakaiproject>

uPortal

Home page: <http://www.uportal.org>

DSpace Federation

Home page: <http://www.dspace.org>

The Fedora Project

Home page: <http://www.fedora.info>

EPrints.org

Home page: <http://www.eprints.org>

Greenstone Digital Library Software

Home page: <http://greenstone.org/cgi-bin/library>

Open Archives Initiative

Home page: <http://www.openarchives.org>

The Perseus Digital Library

Home page: <http://www.perseus.tufts.edu>

Sample search of Open Archive Initiative repositories:

<http://www.perseus.tufts.edu/PR/oai.ann.html>

Budapest Open Access Initiative

Home page: <http://soros.org/openaccess>

American Scientist Open Access Forum

Moderated discussion: <http://www.ecs.soton.ac.uk/~harnad/Hypermail/Amsci>

Open Source Applications Foundation

Home page: <http://www.osafoundation.org>

Open Source Initiative

Locked Microsoft documents available: <http://www.opensource.org/halloween>

Connexions

Home page: <http://cnx.rice.edu>

TWiki

Home page: <http://twiki.org>

LionShare

Home page: <http://lionshare.its.psu.edu/main>

<http://chronicle.com>
Section: The Chronicle Review
Volume 50, Issue 21, Page B16

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