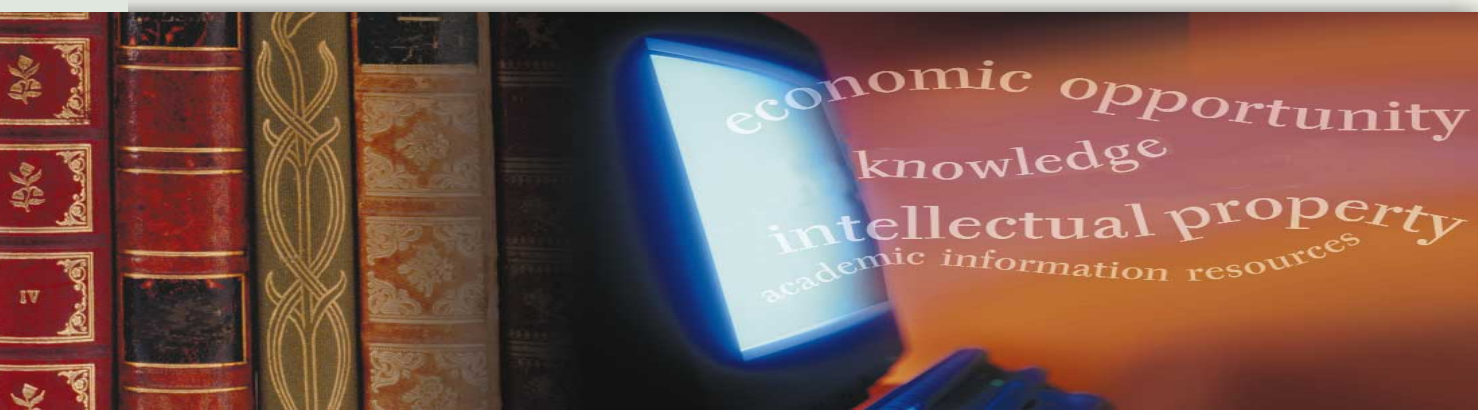


# Managing Academic Information Resources in the Future

By Richard N. Katz



Many scholars would agree that, in the knowledge-driven era, academic information resources remain the lifeblood of the academic institution while the library, or the academic information center, remains the scholarly, social, and cultural center of the campus. The

delivery of such information resources over networks is changing profoundly the culture, economics, and practices of colleges and universities. The evolving shift from a primarily print-based model of delivering academic information resources to one that is network-based demands the attention of senior

campus leaders. Changes in the ways academic information resources are stored, accessed, and distributed will alter the social and economic relationships among key campus constituents, could raise the costs of these resources tremendously, and could even threaten the relatively free flow of aca-

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FIGURE 1. INSTITUTION-PUBLISHER CENTRIC MODEL



ademic information. The transformation from predominantly print-based information resources, owned and financed by the campus, to a hybrid environment of print and networked multimedia resources will require a new conception of the flow of academic information within the campus, among institutions, and between higher education and the commercial sector. Campus leaders will need to develop appropriate strategies, management practices, and financial investments to support that new conception.

## Who Will Manage Academic Information Resources?

The emergence of the network as a significant, and eventually dominant, delivery vehicle for academic information resources will create significant economic opportunity for many. The diversity of institution priorities, historical investments, and levels of technological readiness suggests that there can be no monolithic solutions. The management roles and responsibilities (i.e., management models) associated with academic information resources will be supplemented by new management models.

Figure 1 describes the dominant practice in higher education. In this scenario, faculty members and other academic authors write up the results of their research and convey the publication rights to either commercial or

university publishers in exchange for recognition (e.g., tenure, promotion, job mobility) and, when suggested, money. Publishers add value to manuscripts by screening them and providing editorial services. Publishers are then responsible for the production of print and electronic publications, for their marketing, sale, order fulfillment, and distribution, and for the allocation of economic rents between themselves and the contributing authors.

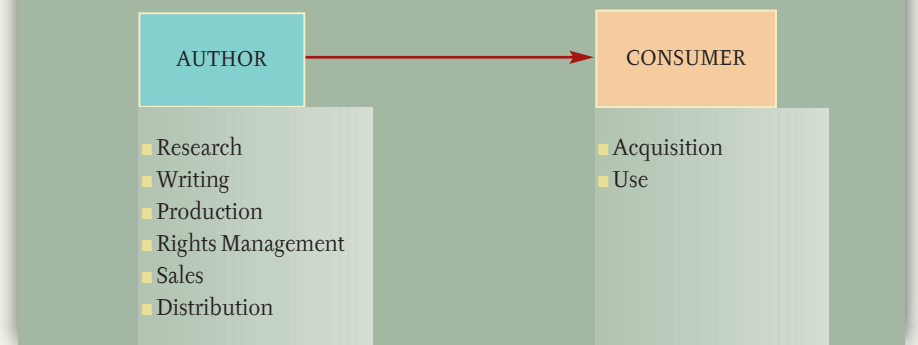
The consumers of the resulting publications—notably academic libraries—acquire, through current copyright law, the legal rights to disseminate the materials acquired by the institution. Limited copying rights for educational purposes are permitted under the fair-use conditions of the law.

Figure 2 describes a content creation and management model

wherein authors—in Marxian terms—take back the means of production. In this scenario, authors—enabled by technology—bypass both the commercial publishing sector and the academic information center and conduct commerce directly with end consumers over the network. These authors retain full rights to their intellectual property and employ a variety of push technologies (listservs, e-mail) and pull technologies (Web sites, search engines, metatags) to attract consumers.

There are many who believe that network technologies will enable such a fully distributed and decentralized marketplace. To a large extent, the devolution of many of the activities associated with the academic information “value chain” is occurring as a result of the eased “self-publishing” capabilities fostered by the World Wide Web. The author-centric model, like much of today’s Web environment, is a frontier, lacking in the business rules, quality controls, bibliographic values, and management practices that make it possible for those who acquire information to differentiate the quality of available information. In this frontier environment, there is an illusion that information is free of cost. Rather, authors who self-publish on the Web are rarely able to monitor the use of their intellectual property or to recover the costs of creating, producing, or distributing this property. Universities that serve thousands of Web pages are similarly unable to recover the costs of

FIGURE 2. AUTHOR-CENTRIC MODEL



their extra-institutional commerce. Finally, the consumers of undifferentiated information are unable to capture or recover the costs of the time they have invested in finding needles in haystacks. In sum, the author-centric model of academic information commerce, while appealing in a romantic, frontier-libertarian sense, is a model unsupported by a needed management infrastructure and is probably not scaleable. A world in which everyone can create a document, save it as an HTML file, post this file to a Web site, and broadcast the document's whereabouts via electronic mailing lists is likely to be one in which information content is substantially devalued. Such a world satisfies authors' need to say

something, without addressing students' or researchers' needs to know something. The collection-development librarian and the publisher as mediators of market demand and supply are missing from this model. The consequence of this model is likely to be an open Web frontier populated by second-class information and littered with abandoned, disused, and non-maintained sites.

Figure 3 describes the consortium model, which recognizes the unique scale economies deriving from electronic academic information resources. In general, those aspects of managing the storage and retrieval of physical artifacts (books, periodicals, etc.) benefit in limited ways from scale. With the ex-

ception of mass—and typically off-site—storage, the costs of accessioning artifacts, marking them for physical control, shelving them, storing them, and retrieving them are relatively constant across collection size. This is true because the dominant drivers of the costs of physical custodianship are labor and space. In fact, it is likely that diseconomies of scale exist in this area of academic information management if one assumes that the largest collections (Library of Congress, Harvard, Berkeley, UCLA) are maintained in geographies characterized by high costs of land, labor, and facilities.<sup>1</sup>

In electronic form, academic information resources enjoy the scale economies demonstrated by electronic mass storage generally, including scale economies of disk storage, systems management, and operations management. For this reason, the management of electronic academic information resources is likely to become highly centralized and, in all probability, commercialized. Firms like IBM and EDS currently manage huge data repositories under contract with a variety of public and private organizations and are likely to displace the roles of traditional distributors, government agencies, and academic libraries in storing and distributing information resources. Just as important, centralized and commercialized organizations may become the early developers and managers of the commercial infrastructure that will be necessary to monitor the global "trade" in information resources and to account for trade balances between suppliers and consumers. This activity will become of central importance as licensing agreements and pay-per-view pricing replace the current dominant pricing model of library acquisition and fair-use regulation.<sup>2</sup>

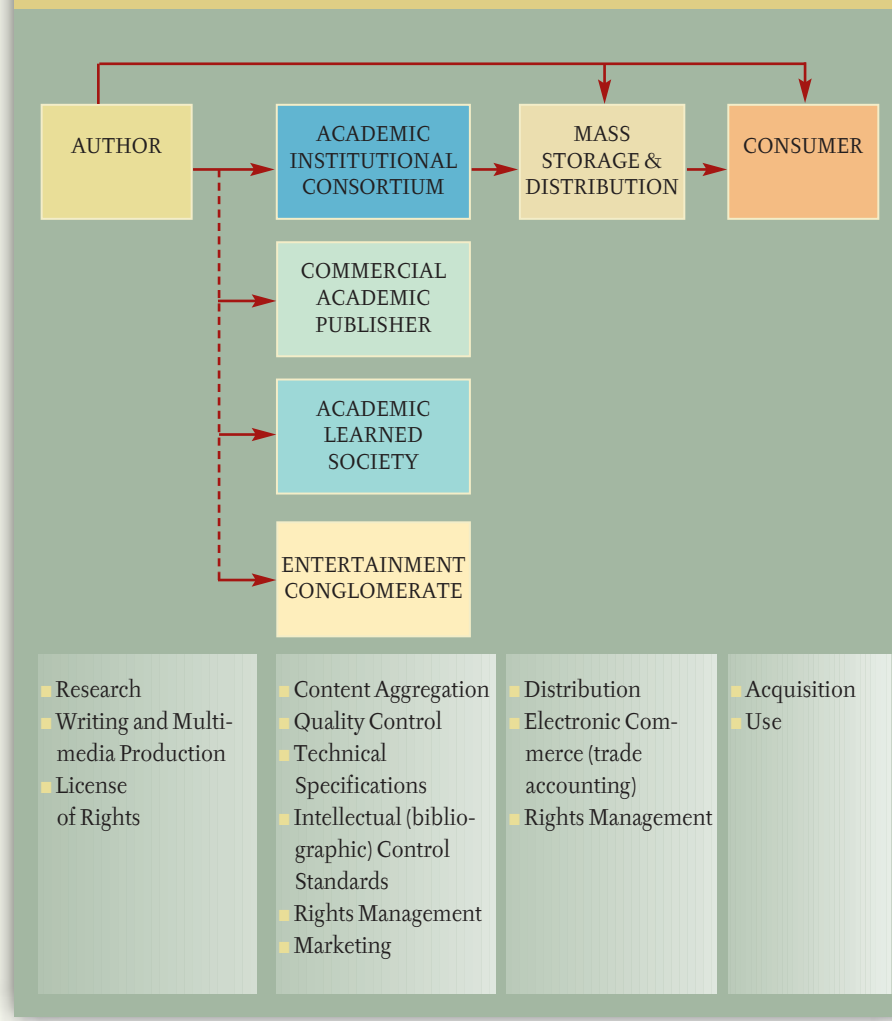
While it is probable that commercial organizations will come to dominate the distribution and rights accounting for academic information resources, it is unlikely that they will vertically integrate other activities, currently performed by university and commercial academic publishers, related to quality

assurance. The likely concentration of responsibility for electronic storage and distribution suggests strongly the need for concentration in activities related to production and selection (i.e., peer review). This environment is likely to be dominated by a mix of existing and evolving entities, notably commercial publishers, scientific and learned societies, and consortia of colleges and universities. It is also likely that as the boundaries currently distinguishing books from multimedia courses diminish, creative (talent) agencies and film studios will compete with traditional publishers to place star-quality faculty under contract. It is also possible that as concentration of key activities occurs, faculty writers/producers of academic information resources will form

It is important to note that while the consortium model is likely to be the emergent model of academic information resource management, the technology underlying this model will also support other models. The creators of academic information resources, in this technical environment, will be able to produce academic information resources independently and either distribute such materials independently (self-publish via the Web) or deposit them with distributors in a variation of the academic vanity press. Materials deposited in the latter fashion will enjoy the benefits of distributors' storage management practices and electronic accounting infrastructure but not the cachet or imprimatur (e.g., branding) of the academic or commercial publisher.

finance the costs of space, new print publications, and document preservation. These institutions must anticipate continued rising collection costs. Costs of acquisition are likely to rise at rates in excess of inflation as the publishers of academic information resources shift their attention to electronic media and reduce the quantities of print editions. Such institutions will also witness the erosion of their on-site patronage as traditional seekers of printed academic information resources acquire these materials instead over networks at their homes, offices, or other convenient locations. Importantly, institutions that choose to remain preeminent print repositories cannot eschew the new costs of electronic delivery. Indeed, the size and prestige of such institutions

**FIGURE 3.**  
**THE CONSORTIUM MODEL**



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production guilds (like United Artists) to protect and maximize their intellectual property rights.<sup>3</sup>

Importantly, in this scenario, the role of the individual academic institution is small and must, therefore, be leveraged. In the case of virtually all institutions, the ability of individual colleges and universities to influence the rights regarding either the sale or the use of academic information resources is likely to be limited. This likelihood underscores the importance of the role to be played by the academic consortium.<sup>4</sup> Consortia for the purposes of vetting and publishing academic information resources or for licensing the use of such materials are likely to be increasingly important mediators of supply and demand in this kind of concentrating market environment. Few colleges and universities will have either the marketplace strength (brand-name recognition) or the production scale to succeed in such a market. The roles of the institutional university press, as a supplier of academic information resources, and of the institutional university library, as a consumer of academic information resources, will likely undergo significant change in the next five to ten years.

**What Must Be Done?  
Recommended Actions**

If colleges and universities are to be able to maintain or enhance the current flow and economics of academic information resources, their leaders will need to guide campus strategies and investments in a number of key areas.

*Set the Course*

Campus leaders must craft a vision and finance sustainable strategies to support the increasing numbers of community members who will seek remote access to academic information resources.<sup>5</sup> The vision of a robust environment in which information resources and scholarly discourse are exchanged over networks will likely change forever the information management economics and practices of colleges and universities. Institutions that are technologically and organizationally adept will be able to provide members of their communities with access to rich collections available currently to large and elite research universities.

Ironically, those institutions that have delivered their academic missions by amassing such collections may find their flexibility impaired by the need to

will likely cause them to pursue a strategy of seeking preeminence in both domains. Institutions pursuing such a strategy will see total campus information resources management costs rise.

A second strategic choice for institutions is that of increasing specialization. In this vein, institutions may opt to continue to acquire and manage print-based academic information resources of specialized natures to support the academic programs based on such resources. Institutions choosing this strategy will manifest their academic objectives in part by collecting print materials, photographs, ephemera, or other artifacts in select areas. This choice may be a wise and economically accessible one for institutions that have already achieved recognition in specific collection areas. This strategy also suggests major investment in a technical infrastructure but has the advantage of focusing institutional investments in resources that are not electronic. Such a strategy also makes it possible to support changing scholarly needs as information technology influences the course of instruction and research in particular areas.

A third choice is to make the major institutional commitment, to network-

based academic information resources, that is necessary to become a global supplier of such resources. Institutions of this kind are associated with economically viable university press operations and have the financial resources and reputations to acquire ownership rights to important academic information resources. These colleges and universities will find themselves in an extraordinarily competitive global marketplace, with competitors from the publishing and entertainment industries and from a variety of consortia and cooperatives. This option is probably available only to institutions of sufficient intellectual appeal to attract the attention of would-be contributing authors. Academic institutions will have to compete

nity. Today's higher education Web sites, except for institutional logos and artwork, largely fail to promote a sense of place sufficient to foster loyalty. Web "surfing" is not a community-building activity, and campuses will have to investigate and implement technologies that encourage loyalty to their virtual environments. Such technologies must be organized to foster interaction, for interactivity is the primary source of learning, community building, and, ultimately, loyalty. Traditionally the campus library has been a major center of campus life, not merely a warehouse of books.

The mandate, under this last strategy, to construct robust distributed virtual environments is economic. The network will allow its users to acquire

academic work and access to information resources beyond the campus boundaries; and

- a service infrastructure to enable streamlining of institutional management and outreach activities.<sup>6</sup>

As academic information resources become increasingly digital, the economics of academic publishing will change. It is axiomatic that the unit costs of print publications rise as production volumes fall. Therefore, as publishers move increasingly toward a set of practices that assume the primary medium of distribution to be digital and network-based, the size of print runs will shrink and their unit costs will rise.<sup>7</sup> As the costs of print publications rise, campus leaders will

**Current technical and financial concerns about providing universal access will escalate with the growing complexity of information resources.**

financially to acquire global rights to sought-after material. The success of this strategy will depend on preferred access to scholars who publish, editorial talent, and a superior information-delivery infrastructure.

The fourth strategy for colleges and universities will be to prepare a technical and human environment that encourages members of the institution's community to use academic information resources through distributed virtual environments developed by those institutions. Such institutions will be, for the most part, consumers of academic information resources and will likely leverage their purchasing influence through membership in a variety of consortia or buyers' collectives. Institutional investments, under this strategy, should shift away from the collection of print publications and toward the acquisition of electronic information resources through consortia. In addition, significant effort and investment should go toward the development of institutionally unique virtual environments. These environments, unlike the Web of today, must recapture the community member's *sense of place* in the way that the campus and library foster a learning commu-

information from a variety of sources. Successful institutions will leverage their information-acquisition expenditures through site licensing, pooled purchasing, and other arrangements. If the virtual environments that provide the gateway to these materials are not compelling, members of the community will continue to demand access to traditional print collections at increasing costs for maintaining both print collections and an underused technology infrastructure. Conversely, those campuses that develop the best virtual environments to support access to electronic information resources are likely to attract the attention of donors, prospective students, alumni, grantors, and others.

*Invest in Campus Networking*

Dr. William Graves makes the point that a campus intranet, linked to the Internet and based on open Internet standards, can provide

- a method for enhancing the reach, timeliness, and effectiveness of human communication in every aspect of the institutional mission;
- a learning infrastructure to increase the quality of student and faculty

need to guide the strategic collection development and management investments of their campuses. In the specific case of static budgets, campuses will have to choose increasingly between investments in the campus network infrastructure and investments in additions to the library physical plant. In such a potentially divisive decision-making context, campus leaders must acculturate the campus to the notion of network investments *as investments in the library*. Regardless of the particular strategic mix of resources chosen, investment in high-speed and ubiquitous campus networks must be viewed not as a luxury but as a necessary cost of doing business in the future.

Current technical and financial concerns about providing universal access will escalate with the growing complexity of information resources. While the evolving potential of data communications networks to provide differential quality of service and to price for such differentiated service will address some of these concerns, they will also raise new, and possibly divisive, policy issues about allocating network resources among faculty members and academic disciplines. These new capabilities will also drive

the need for new funds to support core instructional and research activities.

#### *Foster a Culture of Collaboration*

The execution of any of the strategies described will involve unprecedented levels of collaboration within and between colleges and universities and with a variety of public and private organizations. Successful institutions will need to foster effective alliances for the acquisition, storage, and distribution of academic information resources. Campus leaders must create an environment and a set of reinforcing incentives that will encourage deep, unprecedented, and sustainable cooperation among faculty members, librarians, technologists, and media specialists to transform their traditionally

presentations of data, collaborative filters that gather recommendations from users, enterprise software with search capabilities, and advanced Web search engines.<sup>7</sup> In the longer term, technologies will be available that will answer questions not with lists of documents but with “multi-dimensional, immersive environments that provide a more intuitive view of large collections of data grouped or clustered by meaning.”<sup>10</sup> Colleges and universities must actively monitor the market for search, filtering, personalization, and “agent” technologies, experiment with these technologies, and deploy the best of them in campus servers and workstations. These technologies will allow campuses to begin building the compelling virtual environments that will

use will place new and different strains on the campus user-support infrastructure. For example, the use of collections of physical information resources—such as books, periodicals, and microforms—is self-limiting to the extent that academic resource centers maintain limited copies of any particular item. These limitations, plus the expense incurred by users of the collection by coming to campus, browsing catalogs and collections, waiting in lines, and so forth, limit further the use of collections. Network-based information resources are readily available from one’s home, office, or other location and are available simultaneously to any authorized user with a network connection. The removal of those barriers is likely to increase

**Key to the creation of distributed virtual environments is the deployment of technologies that enhance users’ ability to find academic information in cyberspace.**

compartmentalized responsibilities. If the challenge of the networked information vision is the challenge of integration,<sup>8</sup> then new levels of intra- and interinstitutional collaboration must be fostered. In addition, campuses must become increasingly adept at those skills related to the oversight of a variety of outsourcing and shared-service arrangements as they move from unified academic information resource management models to models in which major elements of the resource delivery system are owned and operated by others. The need to collaborate will be heightened by growing shortages of the skills essential to achieving institutional excellence in these areas of campus endeavor.

#### *Investigate and Invest in the “Search Engineering” Infrastructure*

Key to the creation of distributed virtual environments is the deployment of technologies that enhance users’ ability to find academic information in cyberspace. According to Netcraft, as of June 2000, there were 17,119,262 sites on the Web. That number is growing by more than 2 million per month.<sup>9</sup> In the immediate future, systems will be delivered that provide “visual repre-

foster user loyalty. To be effective, these technologies must be bundled with online help services that correspond to a mix of current (1) faculty office hours (for subject expertise), (2) reference library services (for search support), and (3) help-desk services (for technical support).

#### *Focus on Directory Services, Authentication, and Authorization*

Many campus librarians and information technologists are engaged in deep conversation about the authentication and authorization of the users of campus technical and information resources. These conversations are likely to seem arcane to most university presidents and provosts. While the technical aspects of managing authentication and authorization may indeed be arcane, the policy and economic issues that accompany these technical discussions deserve early attention at the highest campus levels. These issues ask important questions regarding who is a member of the campus community and what authorities and entitlements accrue to such individuals.

In the near future, the overall use of academic information resources in the electronic context will rise. This rising

institutional service loads and costs. Policy-makers will need to develop new strategies for allocating the costs of reference services and of printing network-based information resources.

In addition, the changing legal interpretation of “fair use” of an information resource, along with shifts toward information site licensing and pay-per-view pricing, will cause the unit (institutional) costs of information access to rise, even in cases where total institutional costs may fall.<sup>11</sup> These changing support requirements and economics of access suggest strongly the need for institutions to (1) develop and implement sound infrastructures for identifying, authenticating, and authorizing users, and (2) revisit existing assumptions about the nature and size of the “university community.” As Dr. Clifford Lynch put it, “It has become clear, rather suddenly, that our existing systems of authentication and authorization were not really designed to support the new [networked] environment, and that they can’t do so.”<sup>12</sup>

Many universities, for example, define the boundaries of their communities broadly to include the families of employees, retirees, and alumni. These inclusive boundaries are reasonable as

they relate to academic information resources in the context of self-limiting physical materials. In the context of access, via institutional networks and modem pools, to university-licensed electronic resources, the policy, economic, technical, and support issues become significantly more complex.<sup>13</sup> Such complexity rises as (1) members of the broader campus community come to expect access to campus printers, content and technical advisers, and other expensive resources, (2) the price of information resource site licenses must take into account the extended campus population, and (3) campuses must ponder the complexity and cost of managing the accounting and billing infrastructure that will be needed if costs are to be recovered.

faculty, alumni, staff, and others. The administration of this information about campus community members and their network and information predilections will raise significant privacy concerns on campus.

#### *Focus on Standards*

Another major area of campus technical concern must be the management of campus standards. Robust commerce in technologically complex academic information resources will require the creation of, and adherence to, a variety of emerging technical standards and specifications. Efforts such as the Global Learning Initiative bring together commercial and academic interests to develop the standards and specifications that will make it possible

compress, and decipher this information must also rise. In the near term, workstation capabilities and software environments will also need to rise in power and complexity. There is no likely relief in sight for those campuses caught in the seemingly never-ending funding race against short hardware depreciation cycles, except for the adoption and support of campus technology standards.

#### *Focus on Rights Management*

The last, and perhaps most complex, area demanding the attention of skilled campus administrators is the management of intellectual property rights. The current academic information resources property rights model calls for (1) the transfer of ownership from

**When opportunities arise, campuses should invest in their local infrastructures in ways that recognize and leverage national and consortium-based investments.**

In sum, campus policy-makers must begin now to determine who, for the purpose of accessing electronic information resources, will be deemed a member of the campus community. Campus leaders will need to develop policies that differentiate the rights and authorities among community members and to revisit policies regarding the appropriate use of institutional resources. Campus technologists will have to develop complex campus directory services, determine what levels of support can be offered to which members of the campus community, and implement authentication and authorization solutions that implement the campus policy. None of this will be easy. Finally, in addition to securing access to campus information resources, campus policy-makers and technologists will need to revisit institutional policies and practices regarding the protection of the privacy of members of the community. The administration of a robust infrastructure for authenticating and authorizing members of the community along with the powerful accounting environments to support electronic commerce in academic information resources will require the maintenance of significant information about students,

to develop and share course materials, instructional resources, and academic processes via networks. "Virtual" universities are creating standards for student portfolios, and course catalogs are redefining the standards that govern the interchange of academic course credits. These early efforts are creating the critical and necessary components of the multi-institutional and global infrastructure that will be needed to share academic information resources across networks. Campuses either should actively participate in these endeavors to build regional and national infrastructures or should follow them closely. When opportunities arise, campuses should invest in their local infrastructures in ways that recognize and leverage national and consortium-based investments.

In addition to participating in initiatives designed to create standards for interinstitutional commerce in academic information resources, campus technologists must continue to manage campus workstation and network standards. As the complexity of networked information rises, with the inclusion of graphical, audio, video, and other components, the complexity of campus network technical resources to decode,

author to publisher, (2) the sharing of economic rents between author and publisher, and (3) the administration of rights, under law, by college and university academic resource centers. In most cases, authors of academic works give copyrights to publishers in exchange for the recognition that accrues from the publishers' commitment to publish. Publishers, often with the support of faculty reviewers and editors, convert manuscripts into publishable resources, underwrite the expense of printing, marketing, and distribution, and sell finished publications back to college and universities. Colleges and universities, aided by the self-limiting nature of physical publications, make these materials available to members of the campus community under fair-use limitations specified in statute and case law.

This model benefits the author, who derives academic privilege, tenure, and promotion based, in part, on publishing activity, and it benefits the publisher, who receives a time-limited monopoly on the sale or license of material written by others. Colleges and universities realize no economic benefit except goodwill and prestige. These institutions ultimately bear the

total cost of this activity, in the faculty time spent on research and writing and in the direct expenditures for published materials held by libraries. Publishers, of course, have the opportunity for the greatest economic gain under this model.

As discussed, the economics of network-based delivery of academic information resources differ fundamentally from those economics related to print publishing, with the critical exception of copyright ownership. Print publication costs are highly influenced by scale because of the costs of printing, storage, and distribution. Network publication costs are relatively insensitive to scale because of the very low costs of mass storage and the marginal cost of network bandwidth. In the

capital, and infrastructure to become major suppliers in the network-based marketplace for academic information resources. Institutions that will predominantly *use* networked information must become aware of, and organized for, the changes in property rights that are being ushered in. In addition, the new technology infrastructure that will be developed to support the commerce in academic information resources will make it possible to account for activities such as browsing, lending, and printing. Such capabilities will allow publishers to charge users who browse, share, or make private noncommercial use of copyrighted works. Recognizing the revenue implications of these new capabilities, commercial publishers, distributors, and entertainment firms

substitute for libraries and publishers and to link authors of academic information resources directly with the end consumers of such resources. A longer-term view recognizes the important role of university consortia, learned societies, and commercial publishers in managing academic information resources. In particular, new economic realities will drive most campuses toward establishing consortia to make networked information resources economically accessible.

In a post-Web world, campuses must begin to create distributed virtual environments that mediate the quality of academic information resources and foster high levels of interaction among those who use them. Campuses must develop a variety of consortium

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relationships and create the organizational incentives and structures to foster collaboration among librarians, technologists, media specialists, faculty members, and others. Campuses must track, test, and implement new technologies for searching, browsing, and filtering network-based academic information resources. New technologies will make it possible to render information in new visual forms, creating meaningful groupings and clusters of information. Such technologies will go far toward making distributed virtual environments for teachers and learners a reality.

are seeking to expand current legal definitions of fair use to include use currently deemed under law to be private.<sup>14</sup> Such changes would raise higher education academic information resource costs tremendously and could even threaten the relatively free flow of academic information.

As perhaps the largest supplier and certainly the largest consumer of academic intellectual property, higher education has a huge stake in the outcome of new public copyright policy and law. College and university leaders must join this debate, align disparate views among potentially conflicting elements of the campus community (faculty, librarians, and university press officials), and organize an effective presence among policy-makers and lawmakers.

#### Summary

The World Wide Web is growing at an extraordinary rate and is still in its infancy. The Web currently satisfies authors' needs to publish more than readers' needs for high-quality information. The Web does not mediate quality or deliver service in ways that libraries do. In the short term, it will be tempting to consider the Web as a sub-

stitutions and create the organizational incentives and structures to foster collaboration among librarians, technologists, media specialists, faculty members, and others. Campuses must track, test, and implement new technologies for searching, browsing, and filtering network-based academic information resources. New technologies will make it possible to render information in new visual forms, creating meaningful groupings and clusters of information. Such technologies will go far toward making distributed virtual environments for teachers and learners a reality.

Networks will make it possible to deliver major elements of our missions independently of either time or place. The knowledge-driven era presents an opportunity for higher education to assume a position that is near the center of the societies we serve. Higher education's success in assuming this position of centrality will depend on effective leadership around a shared vision and on strategic investments in the key technologies and skills that will be needed to implement the vision. *e*

#### Notes

1. Even large regional library storage facilities that have been established for the purpose of lowering the unit cost of managing academic information resources may

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suffer diseconomies of scale, if the entire economic costs of this management strategy were accounted for. Such costs would necessarily include the cost of patrons' incremental time to retrieve resources from such facilities, as opposed to the institutions' cost of storage and retrieval.

2. See David Brodwin and David Kline, "Post Web World," *Upside.com*, February 1998. Brodwin and Kline argue that "while pundits pronounced the arrival of a new disintermediated information environment, where upstart publishers could market their wares directly to customers, ... what's happened is the recognition that content must be reintermediated with value-added services to cut through information overload and increase information's usefulness." The authors conclude that in a post-Web world, "the power of size, brand clout and reintermediated content is greater than ever."

3. It should be noted that colleges and universities need not be passive in the course of these forecasted changes. Agile institutions will, indeed, craft new partnerships with their faculty to accomplish shared purposes. However, in cases where campus policies and practices change slowly and in a context of competing objectives, commercial operations will have the resources and political will to outpace many of our institutions.

4. This forecast, while dire, does not depart in significant ways from the current environment. Currently, most faculty members are free to contract independently with publishers for the sale of their writings. Fur-

ther, academic libraries purchase (or not) the rights to make available materials written, in some cases, by their institutions' own faculty.

5. Richard N. Katz, "Technology-Enriched Teaching and Learning: A Business Planning Perspective," in Sandra L. Johnson and Jillinda J. Kidwell, eds., *Reinventing the University: Managing and Financing Institutions of Higher Education* (New York: John Wiley and Sons, 1996), 33-56.

6. William H. Graves, "A Strategy for IT Investments," in Diana G. Oblinger and Sean C. Rush, eds., *The Future Compatible Campus: Planning, Designing, and Implementing Information Technology in the Academy* (Bolton, Mass.: Anker Publishing Co., 1998), 27-28.

7. It is important to note that the demand for print-on-paper resources for instruction and research continues to rise despite the availability of electronic sources. Although paper will no longer be the primary archival and distribution medium, it has shown no signs of disappearing as a "use" technology. The capability of digital technology to produce paper products creates a potential strategy of "publication on demand" with no archival or dissemination functions.

8. Donald N. Langenberg, "Information Technology and the University: Integration Strategies for the 21st Century," *Journal of the American Society for Information Science* 45 (June 1994).

9. One host may have multiple sites by using different domains or port numbers. See the survey by Netcraft at <<http://www.netcraft.com/survey/>>.

10. Jeff Ubois, "Casting an Information Net," *Upside.com*, February 1998, 2, 5.

11. The comparative economics of print and network-based information management are poorly understood. It is possible that certain strategies, such as those involving a shift of collection activity away from print materials and toward consortially acquired networked materials, can lower total institutional costs in the long run. Such strategies replace rising labor and real estate costs with declining mass storage and network capacity costs.

12. Clifford Lynch, "The Changing Role in a Networked Information Environment," *Library Hi Tech* 15, nos. 1-2 (1997): 30. Lynch describes the authentication and authorization challenge very clearly and argues, "There is a need for large-scale service infrastructure, institutional and consortium initiatives, and broad agreement on the roles and responsibilities of the various players."

13. In several extreme cases, colleges and universities find themselves serving in the role of Internet Service Provider (ISP) to the spouses and children of campus employees, emeriti, alumni, and others. In many of these cases, internet access is provided at no cost or at rates that are below campus costs. This situation is not only problematic financially but may be legally unsustainable, vis-à-vis commercial providers' concerns regarding predatory pricing by nonprofits.

14. Pamela Samuelson, "Intellectual Property at Your Expense," *Wired*, January 1996, 135.