THE "WEARINESS OF THE FLESH" REFLECTIONS ON THE LIFE OF THE MIND IN AN ERA OF ABUNDANCE

By Paul B. Gandel, Richard N. Katz, and Susan E. Metros

Increasingly, the focus of attention in higher education is on the "three A's": accessibility, affordability, and accountability. One of the continuing problems in the so-called knowledge-driven era is the disequilibrium between the current supply of knowledge workers and the growing demand for their services. Yet the urgency of the supply-and-demand issues of accessibility, affordability, and accountability has blunted attention to a fourth "A": abundance.

A History of Scarcity

The history of human learning can perhaps best be described in terms of a *lack* of abundance, or scarcity. Before the invention of moveable type, literacy and learning were placed in the service of the secular or ecclesiastical ruling elites. Sacred and secular texts were copied by hand and stored in imperial palaces or monastic scriptoria for protection from both the elements and prying eyes. The diffusion of knowledge in an era of such scarcity was necessarily slow and highly controlled. Access to learning and knowledge was mediated by privilege and social standing; literacy was limited and rationed both because of the prevailing technologies (e.g., the hand copying and illuminating of manuscripts) and because of the desire to enforce social control.

The complexity of ruling (and taxing) nation-states necessitated the broadening of educational access in secular matters, creating an environment conducive to the construction of the great European universities at Bologna, Pisa, Oxford, Cambridge, and Paris. Still, social control was not to be sacrificed, and access continued to be confined to the (second and third) sons of the ruling elite.

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Johann Gutenberg's invention of the printing press in the fifteenth century fostered literacy (i.e., access), democratized learning, and thereby lessened the political authority of church and state in Europe. Among other things, the impact of this invention on the political economy of scarcity is credited with bringing about the Protestant Reformation. The spread of literacy, through the increase of experts and information resources, also indirectly contributed to the French Revolution, the American Revolution, and the spread of the idea of political democracy in Western Europe and the New World.

The history of Western higher education since the French Revolution has been dominated by at least seven epochal influences:

1. The Jeffersonian ideal that equated higher education with effective citizenship and the viability of the democratic system of government
2. The U.S. Morrill Act of 1862 granting federal land to U.S. states to create public universities that would freely admit students for the purpose of study in the agricultural and mechanical (engineering) arts (Canada and some European and Commonwealth countries enacted variations of this legislation)
3. The creation of the first research university in Berlin (Humboldt University) and the replication of this model in the United States (Johns Hopkins University)
4. The U.S. community college movement
5. The creation of the "mega-versity," exemplified by the Open University
6. The successful private-market capitalization, standardization, and globalization of higher education, exemplified by the University of Phoenix
7. The (partially) successful integration of online (synchronous and asynchronous) instructional techniques with the proliferation (controlled and uncontrolled) of online resources

All of these developments reflect inventions and institutions that were designed to foster equilibrium between the supply of expertise needed to promote social and economic prosperity and the demand for such expertise. Yet equilibrium, of course, has proved to be elusive as the world economy increasingly shifts from its reliance on traditional factors of production such as land, labor, and financial capital to a reliance on renewable factors such as intellectual capital.

An Era of Information Abundance

With the widespread proliferation of computers, networks, and networked information today, access to information is (or can be forecast to be) relatively easy, inexpensive, widespread, and democratic. Of course, even 3,000 years ago, King Solomon reminded us: "Of making many books there is no end; and much study is a weariness of the flesh" (Eccl. 12:12). The issues in the first decades of the knowledge-driven era concern a new abundance and a new and perhaps growing disequilibrium between the raw materials of learning production (information resources) and the other factors of learning production (tutors, professors, intelligent learning environments, asynchronous learning programs, online mediation techniques, and the like). Further, the current and prospective era of information abundance will challenge many basic assumptions and practices about safeguarding, protecting, filtering, preserving, evaluating, purging, describing, cataloguing, and vetting information for the purposes of teaching, learning, and scholarship. In particular, four factors explain why this issue of information abundance deserves more attention here and now.

First, the shift from an industrial to a knowledge economy—a shift recognized as early as 1973 by Daniel Bell[1]—has begun and is accelerating rapidly. The economies of many post-industrial nations are dominated by (1) information technology and telecommunications; (2) financial services; (3) entertainment, publishing, news, and other media; and (4) pharmaceuticals and biotechnology. For their success, these industries depend not on labor or land but instead on intellectual and financial capital. They are quintessentially knowledge industries—dependent on acquiring and using information technology, on having (or restricting) access to the right information at the right time, and on managing information flows.

Second, the economics of semiconductor (and related) manufacturing should force a reassessment of the issues of scarcity and abundance. Moore's Law, which posits the doubling of semiconductor performance at any constant price over any eighteen-month period, has been validated in the commercial market for more than twenty years. Further, numerous related "laws" have been coined to account for and anticipate the doubling of storage capacity, bandwidth, and other elements of the information technology infrastructure. In essence, a basic desktop computer with significant local storage now costs no more than the ubiquitous color TV. High-speed Internet access is widely available in most cities and in many college and university towns at prices comparable to that of premium cable television service. In short, the cost for access to the electronic tools of modern learning probably now compares favorably to the cost of textbooks and increasingly subsumes the costs of some licensed resources such as course materials, telephones, and televisions. These costs will likely continue to decline (in relation to performance) dramatically.

Third, information integration is becoming the norm. If the first fifty years of computing in higher education focused on developing standalone and institutionally based systems to support a myriad of administrative details—such as paying staff, accounting for money and budgets, issuing parking fines, tracking library books, registering and billing students for classes, and allocating classrooms—the next half-century is likely to be characterized by the standardization of these applications, the integration of these applications with one another, and the shift of attention, invention, and investment to systems designed to foster learning productivity and outcomes. Since 1997, U.S. colleges and universities

have spent more than $5 billion to modernize and standardize their core administrative information systems. New techniques and standards such as XML and Web Services are being investigated and deployed to further the moves toward standardization and interoperability. Already, two-thirds of U.S. colleges and universities have implemented one or more course management systems (CMS) to introduce automation and standardization into the delivery of instruction. New and improving technologies and techniques for storing, mining, analyzing, and presenting data and information are bringing together textual, aural, visual, and other modalities in new ways. Further, breakthroughs in animation, scientific visualization, virtual reality, and simulation are making it possible for people to interact with information in fundamentally new ways.

Fourth, one underlying principle of the knowledge-driven era is that education is a lifelong endeavor, one that will only occasionally be mediated by the "traditional" artifacts of historical learning experiences: places, professors, age-normed peer learners, degrees, and the like. The shift from the expectation of an age-specific learning experience to the expectation of a lifelong learning endeavor is already reshaping the marketplace for teaching and learning. New assessments of educational outcomes, new markers of educational attainment, new suppliers of educational materials, courses, and degrees, and new methods of institutional accreditation are appearing and evolving in the scramble to mediate supply and demand for knowledge and learning.

A Future of Nearly Unimaginable Abundance

In many ways, the markets for knowledge and learning are evolving like those for food. From a planetary perspective, we have the capacity to produce enough food to sustain human life in a reasonable fashion. The problems of nutrition and world hunger relate more to issues of distribution, global politics and economics, and education. With regard to information, knowledge, and learning, the future is one of nearly unimaginable abundance. As network access becomes broader and faster and as the costs of electronic storage continue to plummet, everyone who so chooses will be able to capture, make visible, disseminate, and preserve every moment of his or her life. The capacity to create a comprehensive digital record of work and life experiences will make earlier innovations, such as desktop publishing, look like rounding errors.

The new potential will immensely influence institutional and individual behaviors, expectations, and experiences. Before the invention of photography, for example, only the rich could afford to document their existence, by commissioning a painting or sculpture. The invention of photography allowed everyday people to document their lives. Today, reality TV, Webcams, and cell phones record, store, and broadcast the minutiae of people's lives. Weblogs, or "blogs," reflect early attempts to organize personal experiences for the purpose of sharing those experiences with others. In the next

decade, recording, storing, and broadcasting the minutiae of life will be technically and economically feasible for everyone. Seizing this possibility will simply be a matter of choice.

Although the educational benefits of such a possibility may be arguable, there is less argument that these capabilities will be available or that they will be used. Wild underestimates of people's capacity to find uses for telephones or PCs at home or in the office have been ascribed to the likes of Microsoft's Bill Gates and Digital's Ken Olsen and now make for humorous asides. The Internet long remained the domain of techies—until the Web opened up the medium to popular consumption.

The educational implications of staggering abundance—that is, the near-infinite individual recording, storage, and transmission capabilities—should in fact be argued in significant detail. For example, over 31 billion pieces of e-mail are now exchanged daily.[2] Even though it is unlikely that we will accurately forecast (let alone manage) the implications—both institutional and pedagogical—of massive information abundance, it is axiomatic that the impact will magnify King Solomon's complaint beyond comprehension.

The Management of Boundless Information

Economists will quickly remind you that "almost free" isn't free. Anyone who has been responsible for managing an institution's stock of technology, software licenses, licenses for library content, and so forth will quickly add that although costs per MIPS, per message transmitted, per gigabyte, and per lookup have indeed all plummeted, the total costs of maintaining this new environment have skyrocketed. Quietly, higher education technology providers are discussing which information technology services and service levels to maintain. Some are withdrawing from the decreasingly sustainable provision of telephone services for students in campus housing, while others are pondering the potential of offering e-mail services to alumni, parents, and other stakeholders in addition to current students, faculty, and staff. Clifford Lynch points out that higher education now has the capacity to make courses "visible" as more and more course materials are produced in digital form and stored on institutional computers.[3] MIT has taken the first step in this direction by freely offering all its course materials through its OpenCourseWare (OCW) initiative. The question then becomes: how much "almost free" disk space should be allocated to members of the community, for how long, and for what purposes?

Institutions are becoming more and more sophisticated in the use of the information they possess and will need to get progressively better at data modeling, warehousing, mining, and reporting. The potential nuclear meltdown at Three Mile Island illustrates this point. Meltdown nearly occurred not because information was lacking but because technicians did not attend to the "right" information. As Christopher Burns points out, "The crisis at Three Mile Island dramatically illustrates how

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disaster can result if information quantity is used as a substitute for information quality."[4] Similarly, the tragic events of 9/11 also illustrate, in part, the problem of too much information. Almost everyone associated with the investigation into the terrorist attacks agrees that the failure to prevent the attacks stemmed not from a lack of intelligence information but rather from a failure to recognize this information, to isolate it from the fray and redundancy of all other information, and to act on it in a coordinated fashion.

The clash of cultures within the data-management professions further exacerbates the development of effective institutional information-management strategies. Technologists view the problem from the perspective of creating greater capacities for digital storage or creating better search engines. Librarians often focus on the acquisition of published information external to the institution. Moreover, the systems that librarians have created are built on preservation and scarcity, not abundance. Archivists and records managers, on the other hand, are geared to making policy decisions about "what's important." However, the scope of their responsibility is limited to official and, typically, paper documents. Furthermore, they too often focus on the evidentiary qualities of records rather than on the informational content of records—content that can be used for decisions and actions.[5]

The personal counterpart to the institutional data-management dilemma was richly described by Russell L. Ackoff, more than thirty-five years ago, in his article "Management Misinformation Systems." Ackoff found that students who were given only abstracts of journal articles performed better on exams than students who were asked to read the entire articles. Ackoff concluded: "I do not deny that most managers (people) lack a good deal of information that they should have, but I do deny that this is the most important information deficiency from which they suffer. It seems to me that they suffer from an *over abundance of irrelevant information*."[6]

Creating Boundaries: The Ecology of Managing Information

Information, knowledge, and wisdom involve more than just the collection of bits within large data stores. The social character of information—that is, how information is used—needs to become key in setting information-management agendas. Whereas the raw information of scholarship and learning is being collected at an astounding rate, it is also being lost or made unusable at an even more astounding rate. Therefore, we need to take a much more holistic approach, one that recognizes the interconnection of information resources and of the individuals who create and use these resources. A metaphor that has been used to describe this holistic approach is to view information systems as a form of ecosystem—an information ecology.

Bonnie Nardi and Vicki L. O'Day define an *information ecology* as a system of "people, practices, values, and technology in a particular local environment."[7] For Thomas Davenport, an *information ecology* puts "how people create, distribute, understand, and use information at its center."[8] Both definitions focus on human activities—not technology—as the core of an information system. The key is capturing not simply the data and information but the contextual relationships and meanings that people give to the data and information. These ideas can be traced to Vannevar Bush and his famous conceptualization of the "memex." In 1945, Bush argued:

> Our ineptitude in getting at the record is largely caused by the artificiality of systems of indexing. When data of any sort are placed in storage, they are filed alphabetically or numerically, and information is found (when it is) by tracing it down from subclass to subclass. It can be in only one place, unless duplicates are used; one has to have rules as to which path will locate it, and the rules are cumbersome. Having found one item, moreover, one has to emerge from the system and re-enter on a new path.
>
> The human mind does not work that way. It operates by association. With one item in its grasp, it snaps instantly to the next that is suggested by the association of thoughts, in accordance with some intricate web of trails carried by the cells of the brain.[9]

The idea behind an information ecology is that the basic elements are flows and nodes (think of flows as conduits, and nodes as information stores) that are intertwined, with one building on the other. The dynamics of flows and nodes are not random but are determined by the interaction of four dimensions: interdependency, change, time-boundness, and differentiation. More simply, an information ecology is a system of people, practices, values, and technologies in a particular environment. The word *ecology* is important here because it conveys the sense of urgency about the need to take control of information systems—as Nardi and O'Day explain, "to inject our own values and needs into them so that we are not overwhelmed by some of our technological tools."[10]

As Bush argues, too often we expect information to fit into some preordained system, such as the way books fit into the Dewey Decimal System. Taking a more ecological approach to information systems calls for focusing instead on the way information is created and used. In many respects, this approach is not unlike the one used by traditional archivists. Traditional archival approaches follow the principles of provenance and original order in building stores of information and data. Provenance is more about keeping intact the original intent, organizational order, and associational thinking of the creator and reflecting the context in which the information was used—in other words, focusing on the individual creator and user of the information.

Focusing on the Individual

Just as the study of ecological systems focuses on the individual organisms, perhaps too the design of information systems should focus on the individuals who create and use information. How would such a design work? First, it would have to address individual information needs.

Personal digital repositories offer intriguing possibilities to bring together an individual's knowledge and wisdom collected over time and to share it with others.

For example, institutions that are beginning to create institutional digital libraries or repositories are finding it difficult to get professors to contribute documents and other materials to these repositories. Part of the problem may be the rigid organizational schemes designed to meet broadly based needs or the fact that centralized repositories are too far removed from the comfort of the professors' home disciplines. The problem may also be that these systems were not designed with the management of individual information needs in mind. It may be unreasonable to expect a professor or university administrator to create a plethora of specialized meta-tags to meet the requirements of an institutional digital repository, especially if that activity is separate from and above and beyond his or her scholarly, creative, or work activity. On the other hand, what if individuals were provided with the tools to easily automate, create, and share personal digital libraries or repositories designed to meet the productivity needs of the scholar, administrator, or student—systems designed to organize and facilitate their own research, work, or learning agendas?

These questions almost inevitably lead to an exploration of e-portfolios. If an e-portfolio is not simply a collection of materials, but a collection of materials *with a purpose*, it performs the functions associated with personal archives. That is, such a collection, mindfully built according to conscious choices about what to retain and what to discard, forms a knowledge base about an individual—a repository that serves as a container to collect and synthesize data and information in the way that the individual needs and uses that data and information. Whereas the term *e-portfolio* or *content management system* could be used to describe such a personal information system, *personal digital repository* is a much more appropriate term because it reflects the specific purpose of such a system. A personal digital repository begins to fulfill Bush's prophesy of the memex: "a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory."[11]

Personal digital repositories offer intriguing possibilities to bring together an individual's knowledge and wisdom collected over time and to share it with others. Imagine if researchers could sift not only through Albert Einstein's own writings, published and unpublished, but also through the other writings that he collected over the years and used as a basis for forming his own ideas. Furthermore, imagine if researchers could also trace the contextual relationships and references that Einstein created among all these materials. It would be like looking over the shoulder of a great thinker, following the evolution of his thought process over time by exploring his personal knowledge store.

On the other hand, for years CIOs have worked diligently to eliminate "shadow" systems so that all information might be kept in centralized and standardized repositories. Encouraging the development of personal digital repositories would require a change in our strategic focus. It also raises several questions. What role, if any, should the community play in the articulation and enforcement of standards regarding such repositories or archives? What costs should the institution incur to support them? What rights of access or ownership should institutions receive or grant vis-à-vis these repositories? These broad policy questions do not even skim the surface of myriad other, more practical issues, such as standards of authenticity for information in digital repositories.

Creating Institutional Repositories from the Bottom Up

Although the fear that personal digital repositories could become isolated silos of information is certainly real, a very different scenario can be envisioned. Recent developments such as Weblogs and P2P technology demonstrate that it is possible to build shared knowledge stores from the bottom up. Using networked models based on jointly shared and controlled resources, personal digital repositories could be viewed as the building blocks for creating collective knowledge stores for affinity groups and organizations—communities of practice. These self-governing groups could develop a set of standardized practices and approaches to building collective repositories from individual repositories over time. The tactics for collecting these aggregated resources could focus on how organizations and groups actually use these information resources. And as in the scholarly community and work environment, peer review and peer pressure could serve as the mechanisms for separating the wheat from the chaff in these collective repositories.

This organic approach to building organizational digital repositories from the bottom up is very much in keeping with the ecological approach advocated by Davenport for institutional information repositories. Davenport notes: "A centralized highly engineered approach to this vast amount of information is clearly untenable. Even the most carefully maintained records are of no value unless they are used. Information management strategies that make every employee a records manager seem to be the only viable alternative."[12]

To facilitate navigation through the network of personal and collective digital repositories, meta-tools could be developed akin to Web services. That is, meta-tools could allow information repositories to "advertise" their availability, in much the same way that archivists develop tools to describe their collections. These tools could include the following: a repository guide, which summarizes the holdings; finding aids, which detail the contents; and an index, which complements the provenance or arrangement as an aid to identifying relevant parts of the collections. Together, these tools would work to provide both a broad, overall view of the material and pointers to specific parts of the collection. Examples of how such discovery and navigation tools may work can be found in the world of Weblogs. Bloggers are using RSS (Rich Site Summary or, sometimes, Really Simple Syndication)—a lightweight XML format originally designed for syndicating news and the content of news-like sites—

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in imaginative ways to share news and information and to notify other blog sites of new activities.

Implementing an Information Collective

If digital repositories can be built from the bottom up as part of a collective process of individual records management and knowledge creation, more questions arise. Where will all this information reside? How will repositories be linked? A special form of data storage would be needed, one that could provide a permanent electronic address for the collection of digital bits making up the repositories regardless of their physical location. In other words, it would serve as an "electronic archival bucket." Permanent electronic locations would also facilitate creating links between repositories. Within the buckets, multiple formats and multiple internal organization schemes would have to be supported.

Work on such systems for the permanent storage of digital archival records is already under way. The DSpace digital library system from MIT and HP and the Flexible Extensible Digital Object and Repository Architecture (Fedora) Project, funded by the Andrew W. Mellon Foundation and jointly developed by the University of Virginia and Cornell University, are two examples. The VUE project at Tufts demonstrates that it is possible to build tools and standards that allow for the sharing of information, as well as the associated contextual mapping of that information, within the framework of a digital repository. The Digital Library Initiatives, funded by the National Science Foundation (NSF), are working toward building ubiquitous knowledge environments for creating, disseminating, and preserving scientific and engineering knowledge.

In addition, new technologies have emerged to address the problem of how to store and access these vast collections of digital assets. One such technology is Webdisk, based on a technology called WebDAV. Webdisk provides users with a flexible, easy, and inexpensive way to upload and download files from a remote server. It allows a "disk" to mount on any Internet-connected computer running the required client software and to be configured as a local disk drive, a network place, or a mounted file system. These same technical approaches may be useful for creating a full network of both individual and group repositories, creating the nodes and flows necessary for a vibrant and effective ecological system of shared information and individual knowledge and wisdom.

Understanding the New Roles of the Information Professional

Clearly, in a world of networked information systems consisting of individual as well as collective digital repositories, the roles of information and technology specialists will need to change. Technologists will need to devise a more transparent systems plan for convergence of systems and for convergence of information types. Instructional designers will need to support and educate the academic community about the benefits of gathering and sharing digital assets and learning objects. Librarians will have a smaller role in organizing materials according to rigid standards and a larger role in developing more flexible organizing principles for a wide variety of materials built on an underlying set of standard guidelines. Librarians' focus will be less on organizing the material after the fact and more on teaching others how to organize their materials as they produce these materials.

Records managers' roles will be defined in terms of the types of materials addressed, the overall information policy of the organization, and the needs of individuals within the organization. Archivists will likely continue to serve as the resident information ethicists and to shepherd those nodes and flows that serve the construction of a meaningful historical record. Publishers will succeed only if they exploit new dissemination models rather than continuing with the current content-ownership approach. Publishers will need to seek new ways of adding value, for example by "googlizing" collections of digital assets or abstracting and summarizing key libraries within a community of practice. Finally, CIOs will need to become the chief coordinators of information across an organization—setting standards and guidelines based on input and providing the tools that will allow individuals to build and share personal repositories of information.

New roles will emerge as obsolete roles wither away in the environment of networked digital repositories. Information architects and interface designers will gain prominence as demand for their skills and talents increases. Added to this genre of workers will be entry-level course builders and meta-taggers (not too far removed from the keypunch operators of the past). And professional knowledge brokers and strategists will help their clients to secure the right kinds of information and to sift and navigate through dense collections of information and knowledge.

Conclusion: Memex Redux

The idea of creating a shared system of interconnected individual information systems capable of forming a network of shared knowledge and wisdom is the culmination of the vision created over a half-century ago by Vannevar Bush. From the scholar's workstation to hypertext and the worldwide Web, Bush's vision has been a guiding metaphor for technology developments in education. Personal digital repositories, linked together and easily shared, would be the final step in realizing Bush's vision. For Bush, the answer to the information explosion was the memex, a scholar's "mechanized private file and library"—in other words, a personal digital repository. According to Bush, a scholar's memex would in turn be linked to a network of scholars so that one scholar could pass information to a "friend for insertion in his own memex, there to be linked into the more general trail."[13] Today this trail points the way to the effective management of information, starting with the individual and ending with collective knowledge and wisdom.

Until recently, the scarcity of information and of the means to manage it has been a defining character of human history. Political and social orders have rested on a foundation of scarcity, and our

management systems have been configured largely to ration, conserve, and optimize the use of scarce resources. As global networks increase the interconnections between people, institutions, and knowledge and as declining costs make it less expensive to retain information resources than to manage them in our current fashion, the current fashion is likely to bend and then yield.

Time and again we have learned that centralized intelligence, in the long run, fails in the face of rising complexity. The emerging abundance of information technology and resources suggests the very real (and present) need to explore a fundamental new information architecture that rests on the premise that individuals, and not institutions, will become the managerial locus of responsibility regarding information about themselves. Where abundance works to our advantage is by allowing for the creation of a worldwide, collectively managed information commons. In the truest sense, our institutions may then become portals or, perhaps more fittingly, docking stations into which increasingly mobile student, faculty, staff, and other personal information is parked. Perhaps then, much study will not have to be a "weariness of the flesh."

Notes

An earlier version of this article appeared in *Journal of Asynchronous Learning Networks*, vol. 8, no. 1 (February 2004), <http://www.sloan-c.org/publications/jaln/>.

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RELATED RESOURCE

The idea of "New Learning Ecosystems" has been identified as an EDUCAUSE NLII Emerging Key Theme for exploration during 2004. For more about this topic as a useful way of thinking about higher education and learning environments, see the discussion, questions, activities, and resources on the NLII Web site (http://www.educause.edu/nlii/keythemes/learningecosystems.asp).