

# Introduction

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**T**HE FUNDAMENTAL ACTIVITIES of the university—creating, preserving, integrating, transmitting, and applying knowledge—are being deeply affected by ever-advancing technologies. Because new information technologies change the relationship between people and knowledge, they are likely to have a profound impact on both the mission and function of the university. Technological change can be both a creative force enabling renewal and a disruptive force requiring dramatic adaptation. In either case, it is particularly difficult to predict and assess.

The Forum on the Internet and the University (the Internet Forum) convenes during the annual Aspen Symposium of the Forum for the Future of Higher Education (the Forum), held each fall at the Aspen Institute. The Forum is a community of academic leaders and scholars from across the country who explore new thinking in higher education, particularly about issues related to institutional change, strategy, economics, and technology.

The Internet Forum's research culminates at the Aspen Symposium, where scholars present their work for discussion

and debate. Its goals are to create a scholarly platform from which participants can explore how new learning media and related technologies can improve learning, and manage the opportunities and risks created by rapid technological change.

Scholarship presented during the 2002 Internet Forum is offered here so as to share more broadly the insights, discussions, and inquiry it sparked.

### Embracing Change: Creating the Future

If you are reading this book, no doubt you are well aware of the extraordinary rate of improvement in information technology over the past 40 years. Still, these astounding examples of just how much progress has been made are worth repeating: ENIAC, the first fully electronic digital computer, contained about 18,000 vacuum tubes and stood 10 feet tall and 80 feet wide. Today, a holiday card that plays a tune when opened is *100 times faster* than the 30-ton ENIAC. The computer in the card costs about 25 cents; the card is meant to be opened once or twice and then discarded. More recent progress is evidenced by today's \$1,000 notebook computers, which have more computing power than a \$20 million supercomputer of the early 1990s.

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### *University Alert*

Wm. A. Wulf, president of the National Academy of Engineering, points out that although the exponential pace of technological change cannot go on forever, the slowdown is not on the horizon and, more importantly, is not going to spare us from rethinking the university. Ironically, although we can predict the improvement of technology with precision, predicting the societal impact of that improvement has proven difficult. Wulf suggests that perhaps the wisest course of action might be imagining a range of scenarios that could result. While none of them might come to be exactly as anticipated, the exercise of devising responses to these scenarios will improve our ability to respond to what actually happens.

Wulf explores the implications of technology for higher education by looking at several aspects of universities—scholarship, textbooks, libraries and books, and teaching—and noting how they have been or might be changed. He believes that in the final analysis, information technology largely obviates the need for the university to be a physical place, particularly for its research function: remote scholarship and authoring are the direct analogs of telecommuting in the business world. As for teaching, we can't say yet whether it can be successfully distributed electronically, but we must consider the possibility.

Wulf poses several provocative questions about the new shape of the university of the future, such as whether it makes sense for every university to offer the full complement of disci-

plines. He offers these questions not to threaten, but rather to stimulate open conversation. Our challenge is to anticipate and exploit the inevitable changes on the horizon. In this time of continued technological evolution, procrastination and inaction are the most dangerous courses for higher education. The university is simply too important to our society to evade such discussion. Instead, Wulf encourages dispassionate contemplation of the possibilities and careful examination of our often unstated assumptions as the best course for preserving the critical functions universities provide for our society.

*Mastering the Challenges of Change*

Rosabeth Moss Kanter, Ernest L. Arbuckle Professor of Business Administration at the Harvard Business School, focuses on the challenges facing institutions as they strive to adapt and undergo systemic change, with a deep emphasis on the human skills that build meaningful community out of mere connections. She observes that the World Wide Web is both the stimulus for a new organizational culture—making it necessary—and a facilitator of that same culture—making it possible. No matter where they are on the continuum of Internet use, people and organizations everywhere would do well to evolve and embrace the e-culture of tomorrow.

Kanter analyzes how established companies do or don't evolve with respect to Internet use. She sorts them into two main groups—laggards and pacesetters—which, interestingly, differ very little in how *hard* they work, but differ dramatically in

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how they respond to change. Laggards' first reaction is to deny the importance and potential of a new technology. Indeed, Kanter's analysis shows that in the business world, companies that had been profitable in the previous two years were less likely to be innovative. These companies had what they considered to be a success formula and were determined to stick with it. Pacesetters, on the other hand, nurture organizational cultures that foster open, honest discussion, wherein people are free to imagine what might happen under various scenarios—an approach strongly encouraged by Kanter to help prepare people and institutions for change, and which echoes that put forth by Wulf.

An appropriate organizational model for success in the current environment is the connected community, in which collaboration is the norm. A community makes people feel like members—not just employees, but members who care about contributing to something not on their immediate list of responsibilities. One of the key differences Kanter's research found between laggards and pacesetters was in how they treat people, which directly affects the strength and connectedness of the larger community. Kanter reminds us that although we can't predict the future, by building a connected community we can put our institutions in a better position to not just be ready for the future, but to create it.

### *The Dynamics of Innovation*

James Utterback, David J. McGrath jr. Professor of Management and Innovation at the Massachusetts Institute of Tech-

nology, examines the role of technological evolution and innovation in shaping the destinies of industries and firms and applies his analysis to higher education. Technological change, he writes, is a key factor as both a creative force in the growth of enterprises and as a disruptive force making those same enterprises vulnerable to competition.

Utterback's analysis of America's ice industry serves as a fascinating vehicle to describe the invasion process of a radical technological innovation, which tends to follow a predictable pattern. The new technology may at first be viewed as crude. One problem with early machine-made ice, for example, was its cloudiness, making it seem less clean or pure than ice harvested from frozen lakes and ponds. A more recent example is early word processors: Apple's first personal computer was difficult to master and produced only uppercase letters. Few were willing to give up their IBM Selectrics for it. The performance superiority of the established technology may prevail for quite some time, but if the new technology has real merit, it typically enters a period of rapid improvement—just as the established technology enters a stage of slow incremental improvements. Eventually, the newcomer improves its performance, matches the established technology, and then rockets past it. But it's easy to understand how established firms can ignore radical innovation when it first appears. For one thing, in its early stages it is far from clear that the radical innovation will have much impact.

Utterback suggests strategies for mastering innovation as a force for renewal. First, leaders need to develop an awareness

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of their own vulnerability—a slow and difficult process for any firm or organization that has experienced substantial success. Recognition of an external threat is the first requirement for effective action. Second is to make the necessary organizational adjustments. The organizational problem for most established firms is that they and their technology are often stuck in a relatively static stage of development, while the challenger and its innovations are still in a dynamic and fluid stage.

Utterback urges higher education leaders to tap the tremendous promise that innovations in technology and new learning media hold for making education more widely available, more reasonably priced, and more tailored to learners.

### *Institutional Transformation*

When Shirley Ann Jackson, president of Rensselaer Polytechnic Institute, took office, she was charged with leading the institute into the twenty-first century by piloting it through a transformation that would affect its organizational structure, its perception by others, its wealth and financial health, and, most importantly, the quality and nature of the activities it pursues to fulfill its mission.

Jackson describes the planning effort as a multidimensional exercise wherein planning occurred in three directions simultaneously: horizontally, across the institute; vertically, from the top down; and orthogonally, from an outside, independent perspective. The elaborate process, known as *The Rensselaer Plan*, articulates a strategic vision and delineates the means to

achieve it. It is an “evergreen” plan, designed to be refreshed on a regular basis. The plan contains 147 “we will” statements, or promissory notes on a blueprint for the future. Fulfillment of the “we will” promissory notes makes progress clearly measurable.

Jackson warns that, over time, even the best-laid plans can be slowly derailed by day-to-day decisions and territorial conflicts. Thus, execution is key: annual detailed performance planning clearly spells out action plans and metrics for measuring progress. Such planning and associated accountability of key administrators to achieve their plans also demonstrate how a businesslike approach can work in higher education. Jackson notes further that maintaining momentum is essential. The true secret, she says, is creating belief by getting things done and building upon one’s successes.

### Collaboration

Ira Fuchs, vice president for research in information technology at The Andrew W. Mellon Foundation, believes the benefits to colleges and universities of collaborating on information technology are enormous and far exceed the drawbacks and compromises institutions may need to make to work together. Unlike other “industries,” higher education has a culture and an ethos of sharing the fruits of much of its labors, whether published research, textbooks, course syllabi, or locally developed software. This willingness to pool resources for the com-

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mon good is higher education's unique advantage and offers the key to cost-effective use of information technology.

Fuchs discusses the impediments to collaboration as well as remarkable current efforts that might point the way to the future of information technology in higher education. The key to successful collaboration—the basis for hope—is *middleware*, which Fuchs describes as the layer of software that stands between the campus infrastructure (campus networks and data repositories, for example) and the applications that run on and take advantage of that infrastructure. The middleware layer acts like the middleman in a transaction to eliminate problematic, direct communication between the applications and the infrastructure and to provide safe translations between the layers. Middleware enables institutions to assemble and run a common architecture that lowers the threshold of effort and therefore substantially decreases the cost of development and ownership.

The Open Knowledge Initiative (OKI) and the OpenCourseWare (OCW) initiatives, supported by The Andrew W. Mellon Foundation and led by the Massachusetts Institute of Technology, are large-scale, ambitious efforts incorporating middleware. These projects hold tremendous potential to, on the part of OKI, improve and facilitate courseware development, and, through OCW, to create free access to the full breadth and depth of university curricula via the Internet. First, though, we must generate a critical mass of developers and decision makers within higher education to collaborate and cooperate in building a common technological foundation that will be more

stable and less costly, and that ultimately will enrich teaching and learning around the world.

### Digital Scholarship and Preservation

As collaborative efforts expand the possibilities for improving teaching and learning on a global scale, so too new media open up exciting possibilities for enhancing the spread of knowledge. Some of our most creative and dedicated faculty are aggressively exploring the frontiers of digital media. These scholars are beginning to develop the various genres that represent the intellectual descendants of the monograph for the digital age. Preservation of this new scholarly record, however, is proving to be problematic on a number of fronts.

#### *Expanding the Concept of Literacy*

Elizabeth Daley, dean of the University of Southern California (USC) School of Cinema-Television and executive director of the Annenberg Center for Communication, urges that the definition of literacy be expanded to acknowledge the prevalence of the multimedia language of the screen in our everyday lives. Today, most people receive information, communicate with one another, and entertain themselves through methods that most often involve audio recordings, radio, film, television, and computers rather than print language. Technology is enabling these alternative means of communicating to penetrate our

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lives more directly and in more powerful ways. Thus, Daley maintains, to be able to interpret and express oneself in the language of the screen, of sound and image, is arguably as important as being able to read and write an essay.

The language of multimedia enables modes of thought, communication, teaching, research, and publication that are essentially different from text. Perhaps the key characteristic of multimedia production is that it most often involves a collaborative effort. Collaboration is an implicit part of the creative process; indeed, faculty have commented on the surprisingly consistent ability among students to collaborate, each contributing his or her unique abilities and ideas to bear on the project at hand. USC faculty from disciplines as diverse as quantum physics, art history, and philosophy working on multimedia projects also have found common ground, insights, and points of access into the pedagogical and research issues in one another's disciplines. Multimedia may well have the potential to provide a much needed new space in which cross-disciplinary conversation can occur between the humanities and the sciences.

Daley acknowledges that acceptance of the language of multimedia as equal to text will require a major shift in thinking to challenge the domination of science and rationality, abstraction and theory. Yet this shift may be long overdue. In recent years she has become more convinced than ever that the rapidly developing language of multimedia—the language of the screen—can bring important new approaches to teaching, research, and publication.

*Preservation of Scholarship*

Deanna Marcum, president of the Council on Library and Information Resources, and Clifford A. Lynch, director of the Coalition for Networked Information, discuss pressing issues and concerns about the preservation of digital scholarship such as Daley describes. Digital documents are far from eternal. Anyone who has ever stared at a computer screen full of gibberish when trying to open a document created in an early word-processing program, or looked in vain for the slot on a computer that accepts floppy disks from a previous era, knows firsthand about the limited lifetimes of digital storage media. For the most part, higher education faculty and administrators have high expectations for long-term access to digital materials, based on their experience with the paper model. Yet technology has moved us well beyond that model today.

In short, in too many cases the pathbreaking work being done by early adopters of new learning media resides on their computers, which are being rather informally managed; they are not part of any institutional infrastructure or program to preserve and maintain access to content. If we were to lose the scholar—to a new interest, retirement, or the proverbial bus—we would lose the scholarship.

Marcum notes that content creators today play a new role in the chain of scholarly communication—as do publishers, libraries and archives, and users. From the custodian's point of view, it is important to capture the attention of scholars while

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they are in the process of creating digital content so as to affect the decisions they make, consciously or unconsciously, and help them become the stewards of their own intellectual property. Ultimately, Marcum believes, libraries and archives may find themselves in the business of negotiating with repositories that store digital bits to make the necessary arrangements for providing access to digital materials to those who need them. It is likely that a few regional repositories with massive digital collections may be established around the country, and local libraries will serve as intermediaries on behalf of local “customers.”

Lynch examines obstacles to successful development of digital preservation strategies and describes some promising efforts in various arenas of interest. The technical details are complex and controversial, particularly with regard to the curation of bits, and he notes that we are far from a widely accepted general theory or practice of digital preservation. Experimentation is hard; we do not know how to accelerate time in the context of software evolution to test approaches synthetically. Lynch observes that we can never prove that we have succeeded in preserving digital information—only that we have not yet failed. Beyond technical problems, Lynch explores the legal, social, and political challenges involved in preserving digital materials. So as not to leave us feeling overwhelmed by the problems he and Marcum so compellingly outline, Lynch also describes local, national, and international efforts on the part of institutions, foundations, governments, and organizations to address the multifaceted and complicated issues brought on by technological progress.

## Conclusion

The challenges inherent in new technologies call for inspired and informed leadership of our nation's colleges and universities. We must create a compelling vision for the future of our institutions, one that anticipates and exploits the transforming innovations on the horizon. At the same time, we must acknowledge that we cannot predict the future and that the unexpected is bound to occur. In the best of cases, those unexpected changes will open the way to greater opportunities than we can possibly imagine today.

It is our hope that the following chapters serve to inspire your vision and imagination as you consider the future of both your institution and higher education as a whole.

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