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THE ANSWER IS
STILL TECHNOLOGY—

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The technological changes and advancements in higher education during the last two decades have been monumental at both the personal and the institutional levels. However, questions remain about how effective higher education institutions are in using technology, particularly information technology, and about whether their investments in technology are meeting their strategic goals. In short, is technology still the "answer" to higher education's strategic questions?

A comparison might be made with U.S. industry. The economist Robert Solow coined the term "productivity paradox"[1] to describe the fact that even though U.S. corporations made very large investments in information technology during the period 1960–90, there was very little positive effect on productivity during these years—except in the

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communication and computing industries. Yet in the 1990s, there were substantial productivity increases across U.S. industries. I suggest that this productivity jump resulted not from computing per se but rather from the great strides in broadband telecommunications (a product of computing and communication technologies) and from the introduction of the World Wide Web and platform-independent Web browsers. Alternatively, it may be that in the early years of a technology, its applications largely automate old processes, and as a technology matures, one creates new and more effective processes, thus increasing productivity. The point is that large investments and technical capability do not a priori lead to positive change. Higher education, like corporate America, has made significant investments—but it is unclear how much we have profited from them.

In reflecting on where higher education policy- and decision-makers have been, where we are now, and where we should go, I believe that we must make technology more strategic if we are to fulfill our responsibilities, realize return on our investments, and advance our institutional missions and goals.

Technology Report Card

To see whether my emphasis on the need for the strategic use of technology is individual or is shared by a broader sector of the higher education community, I recently surveyed fellow provosts on how they would grade the use of technology with respect to key strategic indicators for higher education. The most striking finding from this survey is the fact that there was almost no variation across the fifteen provosts who responded.

Table 1 presents the grade I assigned and also the average grade these provosts gave to the use of technology in twelve key areas. In general, the grades were disappointingly low. Institutions seem to do best using technology to provide information access, enhance research, increase student convenience, and improve the overall student experience. They are more deficient in the areas of cost reduction, return on investment, and the paperless office. My own assessment generally mirrored those of my colleagues, with one major exception. I assign an "in-

complete" grade to the effective, strategic use of technology to improve teaching and learning, whereas the average grade for this subject was a C+. It is essential for the health of the nation that the compact between higher education and the public be renewed. As part of this, no qualified person should be denied access to a college or university education regardless of location. This can be achieved cost-effectively only through the use of technology-delivered education.

Obviously, many faculty are using multiple technologies aimed at enhancing the learning experience: a few million students are enrolled in technology-assisted courses, and a smaller but growing number are taking technology-delivered courses. But has the teaching and learning experience improved? If the answer is yes, has it improved for all students or just for some? At what cost? I believe that it is too early to tell.

But even in teaching and learning there has been change. Indeed, it is no longer heretical within the academy to use terms such as *market niche, return on investment, cost benefit, partnering,* and *students as customers* when discussing teaching. Whether or not those of us in higher education welcome the presence of such concepts, they are in our lexicon now, and our success will depend on how we deal with them.

Setting Strategic Priorities

The world of business may be useful in helping us think about what is happening in institutions of higher education today. In separate works, Charles Handy (*The Age of Paradox*) and Andrew Grove (*Only the Paranoid Survive*)[2] have both articulated a helpful concept, which they call, respectively, the Sigmoid Curve and the Inflection Point (see figure 1). Both authors posit that successful businesses continue to increase their successes and their profits until they hit a maximum, at which point the successes and profits start to decline. Handy and Grove argue that the leadership in an effective corporation must recognize the approaching maximum and must take strategic actions to begin a new (successful) curve. This drives the questions as to whether higher education is similarly approaching an inflection point, and if so, whether the strategic use of technology can be used as a primary tool for beginning a new curve.

It's certainly debatable whether the business concepts described above contain lessons for higher education. Colleges and universities have neither the motive of profit nor a tangible, easily defined product. Rather, the driving goals are the discovery and dissemination of knowledge. Moreover, it is certainly more difficult to anticipate disruptive changes in an enterprise (higher education) that is one of the nation's greatest successes and one with a cycle time measured in decades, if not centuries, than in a business with a cycle time of eighteen months. Nonetheless, those of us in higher education would be poor stewards if we did not examine and respond to the
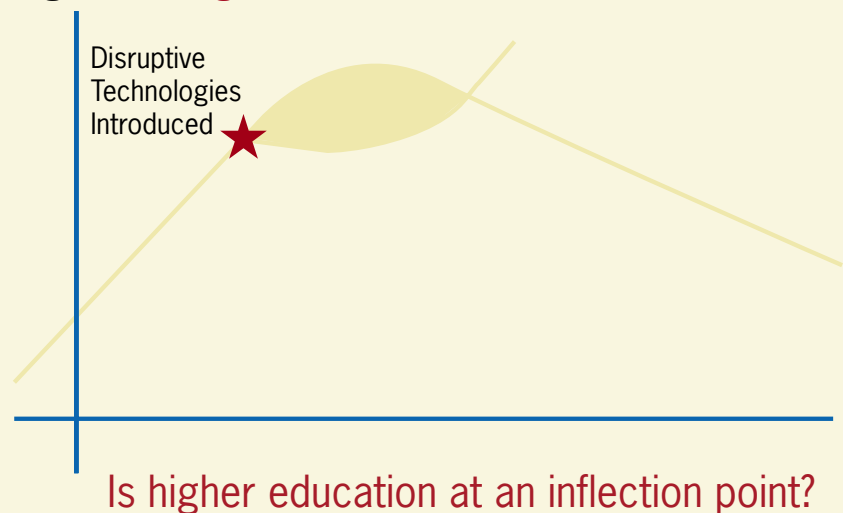

Figure 1. Sigmoid Curve/Inflection Point

Disruptive Technologies Introduced

Is higher education at an inflection point?

Table 1. Report Card on Strategic Technology

Research Enhancement: A *(average grade: B)*
This area represents one of the great success stories in the use of technology in higher education. Faculty and students are engaged in research activities that could not even have been imagined just a few years ago. These include mapping the human genome, exploring the atmospheres of Mars, and innovative, daring breakthroughs in the arts, to mention only a few.

Information Access: A- *(average grade: B+)*
This area is also a notable success story. Even as knowledge increases exponentially, we are able to access knowledge in a truly democratic way. The transition from automating the backroom (moving card catalogs to computers) to accessing databases and searching out information from a broad community is nothing short of spectacular. As tools improve, the technologies will become invisible, and the challenge will be the sifting and winnowing of the information.

Student Convenience: B+ *(average grade: B)*
Today's students have online access to admission, registration, financial aid, and numerous other activities without having to wait in lines, as in the past. (Unfortunately, since today's students have no memories of standing in line for hours in an un-air-conditioned gym to get whatever classes remain, they do not appreciate the improvement but instead see only the limitations.)

Overall Student Experience: B- *(average grade: B)*
Today's students are able to efficiently and effectively carry out administrative and logistical tasks far more easily than in the past. Even more important, they can communicate with faculty and other students independent of time or place. They are able to acquire supplementary materials and carry out cooperative learning as never before. Technology has allowed a variety of learning activities that together might be classified as learner-centered education—for example, joint projects, collaboration, tailoring of learning to individual learning styles, inquiry-based learning, simulation exercises, and learning by objectives.

Cost Containment: B *(average grade: C-)*
Colleges and universities have been faced with greater governmental mandates and reporting regulations, with increased accountability expectations, and with larger and more diverse student bodies, among other new demands. They have met these expectations largely without additional staff, thanks to technological solutions.

People Intensity: D *(average grade: D+)*
The fact that institutional budgets consist largely of salaries leads to a lack of flexibility and an inability to change directions and innovate as an institution. The introduction of technology has not improved this situation and, in fact, has probably exacerbated it.

Decision-Making: D *(average grade: C+)*
Although greater information about institutional operations and issues is now accessible, the actual decision-making is hampered by tools that are not user-friendly, by data definitions that differ from institution to institution and even within institutions, and by the lack of sophistication and knowledge of the decision-makers. The development of new tools and the increase in technology/information-savvy leaders should improve this situation over the next decade.

Faculty Time Leveraged: D *(average grade: D+)*
Thus far, the overwhelming evidence is that the introduction of technology has increased faculty workload and has not allowed scaling of class size in a way that protects and enhances quality. Yet as the technology and our use of it matures, there is the potential for this scaling to occur. If higher education institutions cannot adapt the technology and their use of that technology to scale their most precious resource, faculty time, it will be difficult to continue to justify the large and growing investment in new technology.

Cost Reduction: D *(average grade: D)*
To a large extent, technology has been an add-on cost. The large investment in technology has not enabled concomitant cost reductions elsewhere. Although the cost of computing has dropped dramatically, the needs have increased even faster. And the hoped-for personnel savings has been dashed as institutions have been forced to add technology-support staff, who require higher compensation than other support staff.

Return on Investment (ROI): D *(average grade: D)*
The term "ROI" does not resonate well in higher education. In addition to our disinclination to see a dollar value placed on education, quantifying the educational experience is very difficult. Since technology does not generally increase the number of students served or decrease the cost, it is difficult to give high marks on a strictly dollars-and-cents axis. It will be intriguing to learn, in the next few years, whether the massive investment that many colleges and universities are making in enterprise resource planning (ERP) systems will be justified by higher productivity and/or greater effectiveness.

The Paperless Office: D *(average grade: D)*
It is hardly worth commenting on this area. People that formerly bought paper by the ream now buy it by the case. The nation is using three times the amount of paper that it used a decade ago, and studies show that most people print out anything over a half-page in length.

Teaching and Learning: I *(average grade: C+)*
I assign the grade "Incomplete" to this area, the primary responsibility of all colleges and universities. An overwhelming majority of faculty members are using technology to improve and supplement the education of their students. But the public, rightly or wrongly, expects much greater use of technology—to actually substitute for face-to-face interaction between teachers and students and thus take advantage of scale. Most anecdotal reports reveal that technology-delivered education consumes more time of the instructor, not less. At present, there is no well-documented evidence of cost-effectiveness or quality achievement on a significant scale. However, interesting experiments are under way and should shed light on these questions in the near future.

Access. Although access is encompassed within teaching and learning, it is so important that it should be a category of its own. As we become an even more information-intensive society, access to higher education for all qualified citizens becomes even more important. To have segments of society excluded from the opportunity to attend and complete college because of limitations of time or place will serve neither those segments nor the nation. Television presented an opportunity that achieved access in only a limited and less-than-satisfactory fashion. The potential of Web-based learning and the explosive growth of the Internet offer new potential to make access for all parts of the nation's social compact with higher education. Although the growth of such efforts is rapid, we are still in the early stages of sophistication, and much is yet to be done.

Institutions have often been directed more by the capability of the technology than by their strategic goals.

new environment in which we function.

We can continue to be reactive and use whatever technology seems to fit a given or perceived need, or we can be proactive and purposefully consider the larger arena in which we operate, and adapt our strategies accordingly. The more we understand the drivers of change, the better equipped we will be to act strategically. As the report card indicates, higher education has embraced technology across a range of issues. But I fear that institutions have often been directed more by the capability of the technology than by their strategic goals. Colleges and universities have often failed to assess the larger picture, to weigh the costs and benefits, and to consider long-term versus short-term implications. This is understandable, but probably unwise, given the disruptive forces within higher education today: the needs of the knowledge economy, increased student demand and diversity, the belief that costs are out of control, the debate about whether higher education is a public good or a private benefit, the role of higher education in basic and problem-oriented research, and the entry of new competitors into the marketplace.

The Knowledge Economy

To compete in the knowledge economy, society must invest in and promote leading-edge research and must invest in a quality business and living environment. The methodologies of basic inquiry are not predicated on the just-in-time model. Yet the just-in-time learning demands of members of the "new economy" workforce require an almost overnight response to very specific employment-sector needs. Likewise, the current fifteen-week semester delivery system for degree-seeking students does not fit the needs of employees who want to stay ahead of the curve in a specific area.

Increased Student Demand and Diversity

Over the next decade, enrollment by college freshmen is predicted to grow by 300,000 per year. The projected growth in the U.S. college-age population (those eighteen to twenty-four years old) between 2001 and 2015 is over four million. Most of this growth—95.6 percent—will be in nonwhite population groups.[3] The "traditional" eighteen-to-twenty-two-year-old college freshman will co-enroll with students from sixteen to eighty years old. Students will also come from more diverse backgrounds, with more diverse needs and expectations and with a greater array of contributions to make. Finally, with the growing disparity in earning power for high school graduates and college graduates and the need for lifelong learning in the knowledge economy, a higher proportion of the population will be entering colleges and universities.

These students will have higher expectations for technology than the students who came before. Today, 75 percent of eight-to-twelve-year-olds use computers.[4] The current year's incoming freshmen—the high school class of 2001—are "wired": whereas two-thirds of the U.S. population can claim to be online, nearly 100 percent of the class of 2001 can make this claim. Internet usage among this group has nearly doubled in the four years since they started high school. Four out of five students turn on their computers instead of the radio (57 percent) or the television (55 percent) to get their news and information. The Internet is their preferred method of communicating with the world. Nine out of ten students send and receive e-mails on a daily or frequent basis, compared with only 13 percent who write letters by hand. More than half (54 percent) have visited monster.com, the career-planning Web site, and significant numbers have frequented other career sites.[5]

Cost Concerns

Unfortunately, the relatively low consumer price (in contrast to the total cost) of education at U.S. public institutions is one of the nation's best-kept secrets. In a survey of the general public, 70 percent of respondents estimated tuition at public universities at over $10,000—an estimate that is three times the actual price.[6] Although perceptions about the high costs of higher education have been widely noted, primarily driven by the reports on the tuition at elite private institutions, the fact remains that the average resident tuition at a public university is about $3,500 per year. In the same survey, 90 percent of all respondents stated their belief that a four-year education was usually or sometimes worth the price, a much higher rating than that given to any other sector of the U.S. economy.[7] Yet "cost" remains a dominant theme in legislative and trustee debates.

Public Good versus Private Benefit

Changes in societal values have paralleled changes in technology, and one of the most relevant here is the fact that many now perceive a college or university education as a private good rather than a public benefit. When taxpayers believe that the individual degree recipient (not society) is the primary beneficiary, it should not be surprising that support for higher education has decreased in many sectors.

At the same time, colleges and universities are caught in something of a catch-22. State institutions have an established mission that flows from the belief that they have an obligation to help provide an enlightened citizenry and a highly skilled workforce. Added to this is

research universities' mission to provide the cutting-edge knowledge with which to fuel the U.S. economic base and to enhance society's collective understanding of the universe and ourselves. Higher education institutions are expected to fulfill these demanding goals while making education available to the broadest-possible range of students, especially undergraduates, "as nearly free as possible."

Basic and Problem-Oriented Research
Today's basic research is the foundation for the inventions and breakthroughs of tomorrow, and the college/university is the primary source of basic research in the nation. Both the general public and the country's leaders must be educated about the need for a continued commitment to basic research. The paucity of public advocacy for basic research is a result of both a low regard for scholarship that does not translate easily into practical uses and a lack of understanding of the intense immersion necessary to discover new knowledge. And yet our national economy is now being driven in no small part by discoveries made in universities over the past four decades. Many corporate leaders recognize that they are prospering today from college/university discoveries of two decades ago and that such new knowledge is not being replenished at a sufficient rate. If one examines today's economic growth sectors and future growth sectors, it becomes clear that the future economies will be driven even more by research and that this nation will be engaged in a global competition to maintain our quality of life, even as all economies become global economies.

New Competitors
New educational providers are competing directly with traditional colleges and universities and are doing so in ways that differ from those of the past. Four factors are contributing to the complexity of this new competition. First, the private, for-profit sector has recognized that education is an untapped market. Using Scott Soffen's 1999 estimates as a base, education is the nation's second-largest sector of the economy ($700 billion, compared with $1 trillion for health care and $300 billion for defense). Of this $700 billion, about $200 billion is spent in the higher education sector.[8] A purely bottom-line Wall Street view that an enrolled student is a source of exceptional revenue and earnings potential—a "predictable, recurring revenue stream for a number of years"—is antithetical to the traditional role of higher education in democratic society. Education is thus a potential growth market for entrepreneurs.

Second, technology offers the potential to carry out education with new models. Each month brings reports of new for-profit and not-for-profit initiatives in technology-delivered education. It is estimated that by 2005, nearly 90 percent of all U.S. higher education institutions will offer some type of distance or distributed education.[9] Growth in distributed learn-

ing will likely come from a latent market of learners, who may be place-bound and time-bound. Today, 45 percent of college students are adult learners. The unique needs of this group—a highly interactive learning environment, convenience, access, shorter time to completion, and rolling admissions—create a new and very attractive market.

Third, for many colleges and universities, the greatest threat may come from the competition for their bread-and-butter courses. Half of the lower-division credit hours in the United States are produced by twenty-five to thirty courses. These courses subsidize much of the remaining enterprise. A fairly simple business plan shows that if very high quality technology-delivered courseware could capture even a small fraction of the market share for these courses, there would be rapid payback of the initial investment. Courseware that allows students to set their own pace and that includes 24×7 support would permit students to learn

through a pathway appropriate to their preferred learning styles, thus resulting in "mass customization" of the learning effort.

Finally, we must ask whether higher education institutions can use technology to import courseware and thereby leverage faculty time. There are numerous models to watch and to learn from. Whether the ultimate "winners" resemble the University of Phoenix, the Fathom Knowledge Network, the United States Open University, MIT's OpenCourseWare initiative, the Pew Learning and Technology Program, or one of the several statewide initiatives such as Arizona Regents University, the presence of courseware exporters is a given. However, the interest and willingness of colleges and universities to export courseware is not mirrored by a faculty interest in importing courseware. To make the exporting of courseware valuable, someone has to be willing to import it.

As an example of this difficulty, I cite here an e-mail exchange between a faculty member and his dean. The dean had inquired as to the possibility of taking courseware from another institution, supplementing it with local talent, and thus creating a course. The faculty member responded: "Whether a course could be delivered...from [these] materials might depend very much on the nature of the materials and the professors who would use them. In recent years, Web-based course materials for [classes] have been developed...and then 'turned over' to other faculty members so that they can have a turnkey course-delivery system. The results have been decidedly mixed. Many faculty dislike the perceived scripting of the courses and are annoyed that there is little room for 'adding value' to the material. Others feel the materials are suitable, but do not have any ownership of the material, and deliver the material in an automaton-like manner. Still others (primarily ones who dislike teaching in

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the first place) like having materials already prepared."

Noticeably missing from this discussion are words like *quality, learning*—even *student.* The entire response was focused on the faculty member and not on the student. This is not to say that faculty are unconcerned with learning and the student and that faculty are not using new and creative approaches to increase learning but rather to say that there is a long and successful tradition that places high value on the "great teacher" as the most effective approach to learning. This emphasis puts traditional higher education institutions at a serious competitive disadvantage to the nonprofit or for-profit vendor that decides to focus on the learner and not on the teacher.

In sum, these are the competitive drivers of higher education today. Traditional colleges and universities are part of a growing market, new models of delivery are being created and perfected, core bread-and-butter courses are vulnerable for takeover, and faculty skepticism about importing courseware could limit institutional strategic options.

Making Technology Strategic

To be maximally effective in the long term, the use of technology must be tied to the primary mission and goals of the college or university. To make technology a strategic tool in an institution's toolkit, institutional leaders must recognize that using technology solely to do better what they've always done will not allow campuses to prosper in the next century—nor will it serve society and the many stakeholders in higher education. Instead, major new technology initiatives should have transformational potential as colleges and universities seek to establish a new Sigmoid Curve, to use Handy's term.

The strategic use of technology re-quires four key actions. First, institutional leaders must identify absolutely essential goals that will enable the college or university to play its role in creating a better society. Among these goals might be the following: improving access for students who are place-bound and/or time-bound; increasing the effectiveness of student learning; supporting student recruitment; tailoring the learning experience to individual students' learning styles; enhancing the research capacity of faculty and students; and creating sustainable partnerships between the institution and its many stakeholders. Second, these goals must have clear objectives that are agreed upon and championed by the leadership of the campus community. These goals and objectives must also be prioritized and continually reviewed as circumstances change. Third, information technology must be at the table when key decisions—from mission identification to strategic planning to budgeting—take place. For many institutions, this means defining a new role for information technology officers, who will move from "implementers" to proactive advisers and policy consultants; for other institutions, it may mean insisting that senior officers be technology-savvy. And finally, there must be agreed-upon costs and benefits with specific success criteria that are known to all involved. Since most academic funding is already spent on personnel, for technology to be affordable and cost-effective, it should not lead to an increase in personnel. Thus technology will have to be implemented in ways that leverage faculty time and that simplify, rather than complicate, the faculty member's job. Doing so will allow higher education institutions to enhance their research capacity and to tailor instruction to fit the needs of students; it will also likely require trade-offs between faculty and staff. If new technology does not let institutions innovate to fundamentally change their learning and research activities, higher education cannot fulfill its role in the knowledge economy.

Immediate Challenges

Let's talk a little about the end goal. For many traditional colleges and universities, the primary competitive advantage over the new providers is the campus experience. But to compete effectively, the campus environment must be truly value added and not simply a place where students take a course. The campus environment must contribute to a liberating experience that opens new doors, provides collegial interaction, and builds a capacity to be effective employees and socially responsible citizens. The campus environment should be a place where a student learns not only to make a living but also to make, even transform, a life. So one key challenge is using technology to enhance and enrich the campus experience.

Likewise, most colleges and universities will be experimenting in some sort of distributed learning. These experiments are necessary, and institutions should create "risk-free zones" in which to conduct such experiments—but institutions also need to be prepared to eliminate the failed experiments. To this end, each campus must carefully define what will characterize "success." For example, I would argue that should online learning become as successful as many predict, the idea that a student will take all of his or her online courses from a single institution quickly loses credibility. In the long term, campus boundaries and state boundaries will be irrelevant for online course offerings. More likely, networks will emerge in which a consortium will include access to leading economists from one college or university

and leading physicists from another institution to build a best-in-class complement of courses. This raises new policy issues: institutions should anticipate such issues and be proactive in linking them to the environment made possible by new technology. How will campuses reward faculty and build incentives? What credits will they honor? Who awards the degree? How will quality be ensured? What changes are required in intellectual property policies?

And more important, what issues of governance, in the best sense of the word, will arise? An education is more than a collection of courses; rather, it is a closely linked set of experiences. Institutions must reconcile the capacity of technology with their values and expertise.

Finally, traditional colleges and universities face new issues related to protecting their franchise. Those of us at traditional institutions of higher education need to focus on our core business: discovery (research) and the transmission of knowledge (teaching/learning). The

campus experience provides students of all backgrounds, skill levels, and expectations with opportunities that cannot be readily duplicated, certainly not by any of the new providers. The opportunity to meet face-to-face with peers and teachers to discuss ideas, the socialization that occurs through classroom and nonclassroom experiences, the integrating power of studying the liberal arts, and the chance to explore new ways of doing familiar things and old ways of looking at new things on a college or university campus are all unparalleled experiences. This is our trump card.

A specific example of the strategic use of technology is building community. The issue of community is of critical concern on campuses as well as in society at large, leading to much discussion about whether technology is more likely to create community or to cause isolation. Nicholas Negroponte has argued that the tailored online media ("The Daily Me") can expand horizons and make one a part of

the greater world;[10] on the other hand, Cass Sunstein has argued that by customizing our news, we lose the serendipitous, expanded learning experience of a newspaper browsed.[11] Similarly, many students communicate by e-mail with a much broader collection of people than is possible without e-mail; however, by communicating largely by e-mail, they may also risk becoming reclusive. The proper mix of high-tech and high-touch will be important in these new communities.

Conclusion
Traditional higher education may be at an inflection point. As information technology expenses mount, as public support wavers, and as competitors loom, institutions *must* make strategic use of technology, tying its use to the institutional mission. We can no longer do what "we can"—we must instead do what "we should." Strategic technology should have clear objectives with agreed-upon costs and benefits, should display

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transformational potential, should derive from institutional strategic priorities, and should allow faster and better decision-making.

At Arizona State University, this means that strategic technology should improve the student experience by providing greater access for students (time and place), enhancing learning, and building community. It should assist the institution by serving as the easily accessible front door to the university, supporting student recruitment, positioning the university, exploring alternative means of scholarly communication, and reducing staff demand. It should advance teaching and learning by scaling/leveraging the faculty, by simplifying rather than complicating the faculty member's job, and by increasing research capacity. The goal is not to replace faculty with technology but to free up valuable faculty time for those areas in which they make the greatest contribution. I suspect the use of strategic technology means the same thing at many other institutions.

And the competition? Although for-profit schools are likely to become more competitive, especially as publicly financed institutions suffer financially, the for-profits still face high barriers to entry, including issues of reputation, economies of scale, and accreditation. Traditional providers of higher education must focus on their competitive advantages even as they innovate with new technologies and new learning strategies. At the same time, they must ensure that social and intellectual values are the primary drivers of decisions. There is no question that the challenges are great. It is equally clear that the talent and energies in our colleges and universities are fully capable of meeting these challenges head-on and of preparing our institutions for the transition to the next decade of successful service to society. The major tool available to us is not technology per se but the strategic use of the technology. *e*

Notes

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10. Negroponte in Cass R. Sunstein, *Republic.com* (Princeton, N.J.: Princeton University Press, 2001).
11. Ibid.