The Future of the University:
A Perspective from the Oort Cloud

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Introduction

Whenever any group of university presidents get together, the discussions always begin with the usual topics: money, students, politics, and for the unfortunate few, intercollegiate athletics. However, after a bit of nudging, it is sometimes possible to push the conversation up to the 100,000 foot level to gain a better perspective of the key challenges and opportunities facing higher education today.

This is where I intend to begin, at the level of issues such as the current budget crunch facing universities both in the U.S. and abroad, the changing educational needs of society, social diversity, technology, and market pressures. But I am going to take the discussion a bit further out, first to the L_1 or Lagrange point, one million miles out where Earth appears as "a big blue marble", and where these issues all converge into three themes of the 21st century: demographic change, globalization, and the knowledge explosion. Finally I will move all the way out to the lunatic fringe, far beyond Pluto to my personal Oort Cloud (from whence I occasionally launch provocative comets inward toward the higher education solar system), and consider several issues that I believe compel us to at least admit into our speculations about the future possibility of the disappearance of the university itself, at least as we understand it today.

The 100,000 Foot Level

The Budget Crunch

Of course, foremost on the minds of most university leaders these days are the devastating cuts in appropriations as the states struggle to cope with crushing budget deficits or the erosion of private support from gifts and endowment income associated with a weak economy. Of course, the optimist might suggest that this is just part of the

ebb and flow of economic cycles. In bad times, state governments and donors cut support, hoping to restore it once again in good times. But this time it may be different.

Why the doom and gloom? In Europe and Asia, the erosion of public support is seen as a consequence of demassification of higher education, in which tax revenues once supporting only university education for the elite are now being stretched beyond capacity to fund higher education for an appreciable fraction of the population. In the United States, I would characterize our current dilemma somewhat differently as a transition from "guns" to "pills", as a nation which once viewed education as critical to economic prosperity and national security, seems today more concerned with sustaining the social benefits and tax relief demanded by an aging baby boomer population (and to hell with the kids). (Kane, 2003; Kristof, 2005; OECD, 2005).

The Changing Higher Education Needs of Our Society

Today, a college degree has become a necessity for most careers, and graduate education desirable for an increasing number. In the knowledge economy, the key asset driving corporate value is no longer physical capital or unskilled labor. Instead it is intellectual and human capital. This increasingly utilitarian view of higher education is reflected in public policy. The National Governors Association notes that "The driving force behind the 21st Century economy is knowledge, and developing human capital is the best way to ensure prosperity." Education is becoming a powerful political force. Just as the *space race* of the 1960s stimulated major investments in research and education, there are early signs that the *skills race* of the 21st Century may soon be recognized as the dominant domestic policy issue facing our nation. But there is an important difference here. The space race galvanized public concern and concentrated national attention on educating "the best and brightest," the academically elite of our society. The skills race of the 21st Century will value instead the skills and knowledge of our entire workforce as a key to economic prosperity, national security, and social well-being.

Diversity

The increasing diversity of the American population with respect to race, ethnicity, gender and nationality is both one of our greatest strengths and most serious challenges as a nation. A diverse population gives us great vitality. However, the challenge of increasing diversity is complicated by social and economic factors. Far from

evolving toward one America, our society continues to be hindered by the segregation and non-assimilation of minority cultures. Our society is challenging in both the courts and through referendum long-accepted programs such as affirmative action and equal opportunity aimed at expanding access to higher education to underrepresented communities and diversifying our campuses.

As a leader of society at large and a reflection of that society, the university has a unique responsibility to develop effective models of multicultural, pluralistic communities for our nation and our world. We must strive to achieve new levels of understanding, tolerance, and mutual fulfillment for peoples of diverse racial and cultural backgrounds both on our campuses and beyond. We need to shift our attention from simply access to educational opportunity to success in achieving educational objectives. The recent Supreme Court decisions in the Michigan cases have now not only reaffirmed the importance of this fundamental commitment but also clarified the path we may take to achieve diversity in higher education. But we will still have many battles yet to fight before this war is won.

Technology

The medium of the university is knowledge itself, and rapidly evolving technologies such as computers and telecommunications are changing in profound ways the manner in which such knowledge institutions function. Such technologies are characterized by an exponential pace of evolution in which characteristics such as computing speed, memory, and network transmission speeds for a given price increase by a factor of 100 to 1000 every decade. Over the next decade, we will evolve from "giga" technology (in terms of computer operations per second, storage, or data transmission rates) to "tera" and then to "peta" technology (one million-billion or 10^{15}). The number of people linked together by digital technology will grow from millions to billions. We will evolve from "e-commerce" and "e-government" and "e-learning" to "e-everything," since digital devices will increasingly become predominant interfaces not only with our environment but also with other people, groups, and social institutions. Clearly information and communications technology will affect the activities of the university (teaching, research, outreach), its organization (academic structure, faculty culture, financing and management), and the broader higher education enterprise. (Duderstadt, 2005).

Markets

These economic, social, and technological factors are stimulating powerful market forces that are likely to drive a massive restructuring of the higher education enterprise, similar to that experienced by other economic sectors such as health care, transportation, communications, and energy. We are moving toward a revenue-driven, market-responsive higher education system because there is no way that our current tax systems can support the degree of universal access to postsecondary education required by knowledge-driven economies in the face of other compelling social priorities (particularly the needs of the aging). This is amplified by an accelerating influence of the market on higher education and a growing willingness on the part of political leaders to use market forces as a means of restructuring higher education in order to increase the impact of the competition. Put another way, market forces are rapidly overwhelming public policy and public investment in determining the future course of higher education.

Whether a deliberate or involuntary response to the tightening fiscal constraints and changing priorities for public funds, the long standing recognition that higher education is a public good, benefiting all of our society, is eroding. Both the American public and its elected leaders increasingly view higher education as a private benefit that should be paid for by those who benefit most directly, namely the students. Without the constraints of public policy, earned and empowered by public investments, market forces could so dominate and reshape the higher education enterprise that many of the most important values and traditions of the university could fall by the wayside, including its public purpose. (Newman, 2004; Zemsky, 2005)

The L_1 Point

Demographics

Over the next decade the percentage of the population over the age of 60 will grow to over 30% to 40% in the United States, Europe, and parts of Asia. Already we are feeling the consequences, as our national priorities increasingly focus on the concerns the elderly (e.g., health care, Social Security, tax relief) rather than the needs of the young (e.g., education). Yet, ironically most of the world is characterized by youth. In developing nations in Asia, Africa, and Latin America, the average age is less than 20, with over 2 billion teenagers. Their demand for education will be staggering since in a knowledge economy, it is clear to all that this is the key to one's future security. Yet it is

estimated that today there are over 30 million people in the world who are fully qualified to enter a university but for whom no university place is available. Within a decade there will be 100 million university-ready people. Unless developed nations such as the United States step forward and address this crisis, billions of people in coming generations will be denied the education so necessary to compete in, and survive in, an age of knowledge. And the resulting despair and hopelessness among the young will feed the terrorism that so threatens our world today. (Daniel, 1996).

There is another demographic fact of life that need concern us: The United Nations now projects the Earth's population in the year 2050 as 9.1 billion, 50% larger than today. Which of course raises the logical question: Can we sustain a population of that magnitude on Spaceship Earth? This is an issue to which I will return momentarily.

Globalization

Whether through travel and communication, through the arts and culture, or through the internationalization of commerce, capital, and labor, our nation and our people are becoming increasingly linked with the global community. The world and our place in it have changed, with globalization determining not only regional prosperity but also national and homeland security. As the recent report of the National Intelligence Council's 2020 Project has concluded, "The very magnitude and speed of change resulting from a globalizing world–apart from its precise character–will be a defining feature of the world out to 2020. During this period, China's GNP will exceed that of all other Western economic powers except for the United States, with a projected population of 1.4 billion. India and Brazil will also likely surpass most of the European nations. Globalization–growing interconnectedness reflected in the expanded flows of information, technology, capital, goods, services, and people throughout the world–will become an overarching mega-trend, a force so ubiquitous that it will substantially shape all other major trends in the world of 2020." (National Intelligence Council, 2004).

The Knowledge Economy

Today we are evolving rapidly into a post-industrial, knowledge-based society, a shift in culture and technology as profound as the shift that took place a century ago when our agrarian societies evolved into industrial nations. Industrial production is steadily shifting from material- and labor-intensive products and processes to knowledge-intensive products and services. A radically new system for creating wealth

has evolved that depends upon the creation and application of new knowledge. In a very real sense, we are entering a new age, an *age of knowledge*, in which the key strategic resource necessary for prosperity has become knowledge itself—educated people and their ideas. Unlike natural resources, such as iron and oil, that have driven earlier economic transformations, knowledge is inexhaustible. The more it is used, the more it multiplies and expands. (Drucker, 1999).

But knowledge can be created, absorbed, and applied only by the educated mind. Hence schools in general, and universities in particular, will play increasingly important roles as our societies enter this new age. And it is this reality of the hyper-competitive, global, knowledge-driven economy of the 21st Century that is stimulating the powerful forces that will reshape the nature of our society and our educational institutions.

Today rapidly evolving technologies and sophisticated supply chain management are allowing "global sourcing", the ability to outsource not only traditional activities such as low-skill manufacturing, but to off shore essentially any form of knowledge work, no matter how sophisticated, to whatever part of the globe has populations most capable and cost-effective to perform it. As Tom Friedman stresses in his provocative book, *The World is Flat*, "The playing field is being leveled. Some three billion people who were out of the game have walked and often ran onto a level playing field, from China, India, Russia, and Central Europe, nations with rich educational heritages. The flattening of the world is moving ahead apace, and nothing is going to stop it. What can happen is a decline in our standard of living if more Americans are not empowered and educated to participate in a world where all the knowledge centers are being connected. We have within our society all the ingredients for American individuals to thrive in such a world, but if we squander these ingredients, we will stagnate." (Friedman, 2005).

Whence the University?

It is hard for those of us who have spent much of our lives as academics to look objectively at the university, with its tradition and obvious social value, and accept the possibility that it might change in dramatic ways. But although its roots are millennia old, the university has changed before. In the 17th and 18th centuries, scholasticism slowly gave way to the scientific method as the way of knowing truth. In the early 19th century, universities embraced the notion of secular, liberal education and began to

include scholarship and advanced degrees as integral parts of their mission. After World War II, they accepted an implied responsibility for national security, economic prosperity, and public health in return for federally funded research. Although the effect of these changes have been assimilated and now seem natural, at the time they involved profound reassessment of the mission and structure of the university as an institution.

Of course, this ever-changing nature of the university itself is part of the challenge, since it not only gives rise to an extraordinary diversity of institutions, but also a great diversity in perspectives. What is a university? Is it a "college", in the sense of the heritage of the colonial colleges (and, before that, the English boarding schools)? Is it the 20th century image of university life–football, fraternities, Joe-college, campus protests? Is it Clark Kerr's multiversity, accumulating ever more missions in response to expanding social needs–health care, economic development, technology transfer? Or is the true university something more intellectual: a community of masters and scholars (*universitas magistorium et scholarium*), a school of universal learning (Newman) embracing every branch of knowledge and all possible means for making new investigations and thus advancing knowledge (Tappan)?

What is the core of its university activities? Student development (or, in the words of Lord Rugby, "transforming savages into gentlemen")? Or creating, curating, archiving, transmitting, and applying knowledge? Or serving society, responding to its contemporary needs– health care, economic development, national defense, homeland security, entertainment (e.g., athletics)?

What are its core values? Critical, rigorous thinking (e.g., "the life of the mind")? Academic freedom? Individual achievement (noting that the contemporary organization of the university is really designed to enable individuals to strive to achieve their full potential as students, faculty, athletes)?

With much the character of the proverbial elephant being felt by the blind men, it is not surprising that discussions involving the future of the university can be difficult. It is particularly difficult to ignite such discussions among university presidents, who generally fall back upon the famous Clark Kerr quote: "About 85 institutions in the Western World established by 1520 still exist in recognizable forms, with similar functions and with unbroken histories, including the Catholic Church, the Parliaments of the Isle of Man, of Iceland, and of Great Britain, several Swiss cantons, and…70 universities."…*Hakuna Matata.*

In contrast, during one of the workshops the National Academies conducted recently for university provosts, it was noted that in a single generation following the Civil War, higher education in America changed quite radically: From the colonial

colleges to the Humboldtian research university; with the Land Grant Acts creating the great public universities with strong service missions; from enrollments of hundreds to thousands of students; the empowerment of the faculty. Indeed, everything that could change about the university did change during this brief period. The consensus in several of our workshops has been that we are well along in a similar period of dramatic change in higher education. In fact, some of the provosts were even willing to put on the table the most disturbing question of all: "Will the university, at least as we know it today, even exist a generation from now?" To illustrate some of the possibilities, let me now move out to my Oort Cloud.

The Perspective from the Oort Cloud

Global Sustainability

There is compelling evidence that the growing population and invasive activities of humankind are now altering the fragile balance of our planet. The concerns are both multiplying in number and intensifying in severity: the destruction of forests, wetlands, and other natural habitats by human activities leading to the extinction of millions of biological species and the loss of biodiversity; the buildup of greenhouse gases such as carbon dioxide and their possible impact on global climates; the pollution of our air, water, and land. It could well be that coming to grips with the impact of our species on our planet, learning to live in a sustainable fashion on Spaceship Earth, will become the greatest challenge of all to our generation. We must find new ways to provide for a human society that presently has outstripped the limits of global sustainability.

This will be particularly difficult for the United States, a nation that has difficulty in looking more than a generation ahead, encumbered by a political process that generally functions on an election-by-election basis, as the current debate over global change makes all too apparent. As the noted biologist Peter Raven observes: "The United States is a small part of a very large, poor, and rapidly changing world, and we, along with everyone else, must do a better job. Globalization appears to have become an irresistible force, but we must make it participatory and humane to alleviate the suffering of the world's poorest people and the effective disenfranchisement of many of its nations." Our challenge as educators to prepare a new generation for this role of stewardship to Mother Earth–graduates who will embrace investment as a higher value than consumption, much as did our forefathers who sacrificed so much to build and protect this great nation. (Raven, 2002).

Exponentiation of Technologies

The technologies driving such profound changes in our world, technologies such as information technology, biotechnology, and soon nanotechnology, are all characterized by exponential growth. When applied to microprocessor chips, this remarkable property, known as Moore's Law, suggests that every 18 months computing power for a given price doubles. Other aspects such as memory, bandwidth, and miniaturization are evolving even more rapid, 100 or a 1,000 fold every decade, applies in similar ways to many other aspects of the info-bio-nano technologies. In fact, scientists and engineers today believe that the exponential evolution of these microscopic technologies is not only likely to continue for the foreseeable future, but the pace may be accelerating.

Beyond this fact, there is another important characteristic of such technologies: they are disruptive! Their impact on social institutions such as corporations, governments, and learning institutions is profound, rapid, and quite unpredictable. As Clayton Christensen explains in *The Innovators Dilemma*, while many of these new technologies are at first inadequate to displace today's technology in existing applications, they later explosively displace the application as they enable a new way of satisfying the underlying need. If change is gradual, there will be time to adapt gracefully, but that is not the history of disruptive technologies. (Christensen, 1997).

Consider, for example, the implications for the residential campus. When we think of digitally mediated human interactions, we generally think of the awkwardness of e-mail or televideo conferences. But as Wm. Wulf suggests, "Don't think about today's teleconference technology, but one whose fidelity is photographic and 3-D. Don't think about the awkward way we access information on the network, but about a system in which the entire world's library is as accessible as a cell-phone." It is only a matter of a decade or so before exponentially evolving information and communications technology will allow human interaction with essentially any degree of fidelity we wish, perhaps even totally immersive in all of our senses as in the "sim-stim" (simulated stimulus) technologies envisioned by science fiction writers. (Duderstadt, 2005; Gibson, 1984).

The Singularity

John von Neumann once speculated that "the ever accelerating progress of technology and changes in the mode of human life gives the appearance of approaching some essential singularity in the history of the race beyond which human affairs, as we know them, could not continue." The acceleration of technological progress has been the central feature of the past century and is likely to be even more so in the century ahead. Some futurists have even argued that we are on the edge of change comparable to the rise of human life on Earth. The precise cause of this change is the imminent creation by technology of entities with greater than human intelligence. For example, as digital technology continues to increase in power a thousand-fold each decade, at some point computers (or, more likely, large computer networks) might "awaken" with superhuman intelligence. Or biological science may provide the means to improve natural human intellect. (Kurzweil, 2005).

When greater-than-human intelligence drives technological evolution, that progress will be much more rapid, including possibly the creation of still more intelligent entities, on a still shorter timescale. To use Von Neumann's terminology, at such a technological "singularity", our old models must be discarded and a new reality appears, perhaps beyond our comprehension. We probably cannot prevent the singularity, driven as it is by humankind's natural competitiveness and the possibilities inherent in technology, we are likely to be the initiators. We have the freedom to establish initial conditions, make things happen in ways that are less inimical than others.

Peering over the Horizon: What Might Happen?

To illustrate just how profoundly these forces might reshape higher education as we know it, let me give you several examples of what the "University of the 21st Century" might become:

The Globalization of Higher Education

The emergence of a global knowledge economy is driven by a radically new system for creating wealth that depends upon the creation and application of new knowledge and hence upon advanced education, research, innovation, and entrepreneurial activities. Both mature and developing nations are making major investments in building the knowledge infrastructure–schools, universities, research

institutes, high-tech industry, cyberinfrastructure, public policies and programs–necessary to achieve prosperity and security in the knowledge economy.

In parallel with these trends, there is a strong sense that higher education is also in the early stages of globalization, both through the rapid growth in international partnerships among universities, and through the emergence of truly global universities that not only intend to compete in the global marketplace for students, faculty, and resources, but are also increasingly willing to define their public purpose in terms of global needs such as public health, environmental sustainability, and international development. Note here we are talking about the emergence of "universities of the world and in the world", universities that not only compete in the global marketplace but define their public purpose in terms of global needs, e.g., global health, global sustainability, wealth disparity and poverty.

In June I will be co-chairing with the former rector of the University of Geneva the 6th Glion Colloquium, concerned with the globalization of higher education. Glion VI will bring together university leaders from around the world–both from mature economies such as EU, Switzerland and U.S. and from rapidly growing nations, to explore both the challenges and opportunities inherent in the globalization of higher education. Using the highly interactive framework of the Glion meetings, the aim will be to identify the key issues and build the relationships necessary for higher education to play a key role in the global economy. As for the five previous colloquia, a book will be published afterwards.

Lifelong Learning

Today, as our nation is undergoing a profound transition from an industrial to a knowledge-based economy. Just as in earlier critical moments in our nation's history when federal initiatives expanded the role of education, e.g. the Land Grant Acts in the 19th century to provide higher education to the working class, universal access to secondary education in the early 20th century, and the G. I. Bill enabling the college education of the returning veterans of World War II, today a major expansion of educational opportunity could have extraordinary impact on the future of the nation. It is time for the United States to take bold action, completing in a sense the series of these earlier federal education initiatives, by providing all American citizens with *universal access to lifelong learning opportunities*, thereby enabling participation in the world's most advanced knowledge society.

The needs for lifelong learning opportunities in a knowledge society are manifold. The shelf life of education early in one's life, whether K-12 or higher education, is shrinking rapidly in face of the explosion of knowledge in many fields. Today's students and tomorrow's graduates are likely to value access to lifelong learning opportunities more highly than job security, which will be elusive in any event. They understand that in the turbulent world of a knowledge economy, characterized by outsourcing and off-shoring to a global workforce, employees are only one paycheck away from the unemployment line unless they commit to continuous learning and re-skilling to adapt to ever changing work requirements. Furthermore, longer life expectancies and lengthening working careers create additional needs to refresh one's knowledge and skills through. And, just as students increasingly understand that in a knowledge economy there is no wiser personal investment than education, many nations now accept that the development of their human capital through education must become a higher priority than other social priorities, since this is the only sure path toward prosperity, security, and social well-being in a global knowledge economy.

Of course, establishing as a national goal the universal access to lifelong learning would require not only a very considerable transformation and expansion of the existing postsecondary education enterprise, but it would also require entirely new paradigms for the conduct, organization, financing, leadership, and governance of higher education in America. For example, most of today's colleges and universities are primarily designed to serve the young–either as recent high school graduates or young adults early in their careers. Yet achieving the objective of universal access to lifelong learning would expand enormously the population of adult learners of all ages. Traditional university characteristics such as residential campuses designed primarily to socialize the young with resources such as residence halls, student unions, recreational facilities, and varsity athletics would have marginal value to adult learners with career and family priorities. Such universal lifelong learning could change dramatically the higher education marketplace, providing for-profit institutions already experienced in adult education with significant advantages. Furthermore it seems likely that the only way that such ubiquitous access can be provided to lifelong learning to adults with career and family responsibilities will be through technology-mediated distance learning.

It is time for the nation to step up to its responsibility as a democratic society to enable all of its citizens to take advantage of the educational, learning, and training opportunities they need and deserve, throughout their lives, thereby enabling both individuals and the nation itself to prosper in an ever more competitive global economy. While the ability to take advantage of educational opportunity always depends on the

need, aptitude, aspirations, and motivation of the student, it should not depend on one's socioeconomic status. *Access to lifelong learning opportunities should be a right for all* rather than a privilege for the few if the nation is to achieve prosperity, security, and social well-being in the global, knowledge- and value-based economy of the 21st century.

The Meta University

Perhaps the most interesting activities in higher education today involve an extension of the philosophy of open source software developed to open up opportunities for learning and scholarship to the world by putting previously restricted knowledge into the public domain and inviting others to join both in its use and development.

Several years ago the MIT faculty made the bold decision to put the digital assets supporting all 1,800 of their courses into the public domain, enabling their use by students, faculty, and universities throughout the world in a well-organized, searchable manner. Today what MIT calls the OpenCourseWare initiative is utilized by over 3 million people around the world–and, of course, essentially all MIT students. Over 100 universities are now embracing the OCW paradigm to distribute their own instructional materials, including the British Open University.

Closely related is another project based at Michigan and consisting of a consortium of several universities (Michigan, MIT, Indiana, Stanford, Oxford) and corporations (IBM, Apple, Cisco, and Unisys) to develop open-source middleware to support the instructional and scholarly activities of higher education. Several hundred colleges and universities are now moving to the Sakai platform, including all of our instructional activities at Michigan. But, interestingly enough, beyond the support of classroom instruction and scholarly activities, the Sakai team and their collaborators are exploring taking elements of their open source middleware up to the enterprise level (for administrative purposes) and down to the desktop level (within the Linux framework). And most recently they are involved in a large development effort to develop technology to support the OpenCourseWare effort pioneered by MIT.

Perhaps the most controversial effort, again involving my university, is the Google print library project, where Michigan, together with five other institutions (Stanford, Harvard, Oxford, NY Public Library, and most recently the University of California), agreed in 2004 to allow Google to digitize a substantial part of our library collections (at Michigan, 7.8 million volumes) and make it available through sophisticated search engines to the world. Here the fact that Larry Page was an

undergraduate engineering major at Michigan, involved in our digital library project, stimulated Google's interest and led to a couple of years of discussion before the announcement. Our earlier involvement in the JSTOR digitization project, sponsored by the Mellon Foundation, gave us a good head start.

While there are still many copyright issues that need to be worked through, within a few years we hope to have our entire library holdings available to scholars and students throughout the world. When combined with the holdings of the other members–now roughly a dozen of the world's leading libraries, this will amount to almost half of the estimated books in the world–in over 400 languages.

The Google, Sakai, and OpenCourseWare projects are examples of a rapidly growing effort, the Open Education Resources initiative, to open up opportunities for learning and scholarship to the world by adopting the spirit of open source software development, putting previously restricted knowledge into the public domain and inviting others to join both in its use and development. Other examples include the open learning initiative of Carnegie Mellon, the open knowledge initiative, and even the open university philosophy pioneered by the British Open University, removing the traditional constraints on admission and enrollment to broaden participation in higher education on the world level.

Open source, open content, open learning, and other "open" technologies, along with cyberinfrastructure, the term used to describe the software, hardware, people, organizations, and policies characterizing digital technology, become the scaffolding on which to build truly global universities–what Chuck Vest terms the "meta" university. It is becoming increasingly clear that the current approaches to higher education are simply inadequate to meet the exploding needs for education and knowledge throughout the world. As Vest observes, "the incredibly large scale of education world wide; the huge diversity of cultural, political, and economic contexts; and the distribution of public and private financial resources to devote to education are too great." Instead Vest suggests that "through the array of open paradigms, we are seeing the early emergence of a *Meta University* – a transcendent, accessible, empowering, dynamic, communally-constructed framework of open materials and platforms on which much of higher education world wide can be constructed or enhanced." Cyberinfrastructure provides the technology and the open paradigms use it to distribute knowledge and learning opportunities to the world

Universal Access to Knowledge and Learning

Some of you may have read Kevin Kelly's article in last summer's New York Times in which he recalled the age old dream of having in one place all knowledge, past and present. All books, all documents, all conceptual works, in all languages. He noted that the closest we ever came was the great library at Alexandria, constructed around 300 B.C., which once held between 30 and 70 percent of all books in existence then. Yet this dream was quickly overwhelmed by the explosion of civilization and knowledge throughout the world and became an impossibility. Kelly went on to observe:

"Until now. When Google announced in December 2004 that it would digitally scan the books of five major research libraries to make their contents searchable, the promise of a universal library was resurrected. Indeed, the explosive rise of the Web, going from nothing to everything in one decade, has encouraged us to believe in the impossible again. Might the long-heralded great library of all knowledge really be within our grasp? We can provide all the works of humankind to all the people of the world. It will be an achievement remembered for all time, like putting a man on the moon. And unlike the libraries of old, which were restricted to the elite, this library would be truly democratic, offering every book to every person."

Think a bit what might happen if we can put all of these pieces together.

- Internet-based access to all recorded (and then digitized) human knowledge augmented by powerful search engines.
- A knowledge scaffolding based on open source paradigms (the "meta university").
    - Open source software (SAKAI)
    - OpenCourseWare learning resources (OCW)
    - New, collaboratively developed learning tools (Wikipedia II)
    - Open learning (UK Open University, Carnegie Mellon)
- Ubiquitous cyberinfrastructure (Negroponte's $100 laptop)

We can imagine a time in the near future where anyone with even a modest Internet connection has access to all of the recorded knowledge of our civilization along with ubiquitous learning opportunities. (Note here that Negroponte's $100 PC could well erase the digital divide, extending this opportunity to a substantial fraction of the world's population. Imagine further the linking together of a substantial part of the world's population with limitless access to knowledge and learning opportunities enabled by rapidly evolving cyberinfrastructure increasing a thousand-fold in power every decade.

While science fiction continues to entertain us with the possible emergence of superhuman artificial intelligence, of far more likelihood and interest in my view is the emergence of a new form of collective human intelligence, as billions of world citizens interact together, unconstrained by today's monopolies on knowledge or learning opportunities. Perhaps this, then, is the most exciting vision for the future of the university–no longer constrained by space, time, monopoly, or archaic laws of copyright–but rather unleashed by cyberinfrastructure to empower the emergence of a new global civilization of humankind.

Preparing for Unknowable Futures

So what might we anticipate as possible future forms of the university? The monastic character of the ivory tower is certainly lost forever. Although there are many important features of the campus environment that suggest that most universities will continue to exist as a place, at least for the near term, as digital technology makes it increasingly possible to emulate human interaction in all the sense with arbitrarily high fidelity, perhaps we should not bind teaching and scholarship too tightly to campuses or even institutions. Certainly, both learning and scholarship will continue to depend heavily upon the existence of communities, since they are, after all, highly social enterprises. Yet as these communities are increasingly global in extent, detached from the constraints of space and time, we should not assume that the scholarly communities of our times would necessarily dictate the future of our universities. For the longer term who can predict the impact of exponentiation of technologies on social institutions such as universities, corporations, or governments, as they continue to multiply in power a thousand-, a million-, and a billion-fold during a single generation?

So what are university leaders and stakeholders to do, as their institutions are buffeted by such powerful forces of change, and in the face of unpredictable futures? Here I certainly can claim no particular wisdom. But two decades of leading institutions facing such change suggest some possibilities: First, it is important to always begin with the basics, by considering carefully those key roles and values that should be protected and preserved during a period of transformation. For example, how would an institution prioritize among roles such as educating the young (e.g., undergraduate education), preserving and transmitting our culture (e.g., libraries, visual and performing arts), basic research and scholarship, and serving as a responsible critic of society? Similarly, what are the most important values to protect? Clearly academic freedom, an openness to new ideas, a commitment to rigorous study, and an aspiration

for the achievement of excellence would be on the list for most institutions. But what about values and practices such as lay governing boards, shared governance, and tenure? Should these be preserved? At what expense?

Of course, we all aspire to excellence, but just how do we set our goals? There is an increasing sense that the paradigm characterizing many elite institutions, which simply focuses more and more resources on fewer and fewer, does not serve the broader needs of our society. Rather the premium will be on the development of unique missions for each of our institutions, missions that reflect not only their tradition and their unique roles in serving society, but as well their core competency. If such differentiation occurs, then far greater emphasis should be placed on building alliances with other institutions that will allow them to focus on core competencies while relying on alliances to address the broader and diverse needs of society.

In a rapidly changing world characterized by unpredictable futures, experimentation may become more important. Perhaps more emphasis should be placed on exploring possible futures of the university through experimentation and discovery. That is, rather than continue to contemplate or debate possibilities for the future, a more productive course might be to build several prototypes of future learning institutions as working experiments. In this way we could actively explore possible paths to the future.

Finally, it is important for university leaders to approach issues and decisions concerning institutional transformation not as threats but rather as opportunities. True, the status quo is no longer an option. However, once we accept that change is inevitable, we can use it as a strategic opportunity to control our destiny, while preserving the most important of our values and our traditions. Creative, visionary leaders can tap the energy created by threats such as the emerging for-profit marketplace and technology to engage their campuses and to lead their institutions in new directions that will reinforce and enhance their most important roles and values.

To be sure, we should bear in mind the well-known quote of Machiavelli:

> "There is no more delicate matter to take in hand, nor more dangerous to conduct, nor more doubtful of success, than to step up as a leader in the introduction of change. For he who innovates will have for his enemies all those who are well off under the existing order of things, and only lukewarm support in those who might be better off under the new."

It is sometimes difficult to act for the future when the demands of the present can be so powerful and the traditions of the past so difficult to change. Yet, perhaps this is the

greatest challenge for our institutions, and the most important role of our leadership, in the years ahead as we navigate our institutions through the stormy seas of a changing world.

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