The Future of the University:

A Perspective from the Oort Cloud

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Introduction

Whenever any group of university presidents gets together, the discussions always begin with the usual topics: money (never enough), politics (always too much), students (what are they up to now?), and for all too many university presidents these days, intercollegiate athletics (what is the next scandal?). 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: the impact of the current global economic crisis on their institutions, the rising costs of education and research, the rapidly changing demographics of students as minorities become majorities, the reshaping of learning and research by rapidly evolving technologies, the emergence of powerful market forces, and the inadequate public understanding of the importance of the American university (Cole, 2009; Duderstadt, 2000).

Of course, while important today, these may not be the dominant issues facing higher education over the longer term, a subject that I will address later in this paper. But these near term challenges must be addressed soon if our institutions are to meet the growing and changing needs of the nation. So let me begin with a few comments on the issues of today, being so bold as to actually suggest some actions we might take to address them drawn from a very recent

study conducted by the National Academies.

The National Academies Study on
the Future of the American Research University

As a follow-on to the National Academies 2005 study of American competitiveness, *Rising Above the Gathering Storm* (Augustine, 2007), which led to the America COMPETES Act, in 2010 the National Academies received the following request from US Senators Lamar Alexander and Barbara Mikulski and US Representatives Bart Gordon and Ralph Hall:

"America's research universities are admired throughout the world, and they have contributed immeasurably to our social and economic well-being. Our universities, to an extent unparalleled in other countries, are our nation's primary source of long-term scientific, engineering, and medical research. We are concerned that they are at risk.

"We ask the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine to assembly a distinguished group of individuals to assess the competitive position of American research universities, both public and private, and to respond to the following question:

"What are the top ten actions that Congress, state governments, research universities, and others can take to maintain the excellence in research and doctoral education needed to help the United States compete, prosper, and achieve national goals for health, energy, the environment, and security in the global community of the 21st Century?"

This National Academy effort was chaired by Chad Holliday, former CEO of DuPont and non-executive chair of the board of directors of Bank of America. The committee consisted half of academics, including presidents, deans, and governing board chairs from Stanford, Harvard, MIT, Michigan, Texas, Virginia, Cornell, McGill, UC Berkeley, and Kentucky, and CEOs and other senior

executives from Accenture, Bank of America, CitiBank, Eli Lilly, Cisco, and the venture capital community. While the final report of the study is just emerging from the review stage and hence, is still embargoed, it is useful to summarize here some of the key points made during several days of testimony and discussion.

Leaders of higher education and its various stakeholders (e.g., business and industry, federal and state government, students and faculty) raised many concerns (Berdahl, 2010; McPherson, 2009; COGR, 2011). Federal policies no longer place a priority on university research and graduate education. In the face of economic challenges and the priorities of aging populations, states no longer are either capable or willing to support their public research universities at world-class levels. Business and industry have largely abandoned the basic and applied research that drove American industrial leadership in the 20th century (e.g., Bell Labs), largely ceding this responsibility to research universities but with only minimal corporate support. Research universities themselves have failed to achieve the cost efficiency and productivity enhancement in teaching and research required of an increasingly competitive world.

More broadly, while America's research universities remain the strongest in the world, they are threatened today by many forces: the economic challenges faced by the nation and the states, the emergence of global competitors, changing demographics, rapidly evolving technologies, inadequate investment, and the absence of a bold national strategy. Even as other nations around the world have emulated the United States in building research universities to drive economic growth, America's commitment to sustaining the research partnership among the federal government, the states, industry, and higher education that built a great industrial nation seems to have waned.

Yet, a time of crisis can also stimulate a call to action. During past eras of challenge and change, our national leaders have acted decisively to create innovative partnerships to enable its universities to enhance American security and prosperity (Cole, 2009). While engaged in the Civil War, Congress passed the Morrill Land-Grant Act of 1862 to forge a partnership between the federal government, the states, higher education, and industry aimed at creating universities capable of extending educational opportunities to the working class

while conducting the applied research to enable American agriculture and industry to become world leaders. The results were the green revolution in agriculture that fed the world, an American manufacturing industry that became the economic engine of the 20th century and the arsenal of democracy in two World Wars, and an educated middle class that would transform the United States into the strongest nation on earth.

Eighty years later, emerging from the Great Depression and World War II, Congress answered the call once again (Bush, 1945) to strengthen this partnership by investing heavily in basic research and graduate education to build the world's finest research universities, capable of providing the steady stream of well-educated graduates and scientific and technological innovations central to our robust economy, our vibrant culture, our vital health enterprise, and our national security in a complex, competitive and challenging world. This expanded research partnership enabled America to win the Cold War, put a man on the moon, and develop new technologies such as computers, the Internet, GPS, and new medical procedures and drugs that have contributed immensely to national prosperity, security and public health.

Today, our nation faces new challenges, a time of rapid and profound economic, social, and political transformation driven by the growth in knowledge and innovation. A decade into the 21st century, a resurgent America must stimulate its economy, address new threats, and position itself in a competitive world transformed by technology, global competitiveness, and geopolitical change. In this milieu, educated people, the knowledge they produce, and the innovation and entrepreneurial skills they possess, particularly in the fields of science and engineering, have become the keys to America's future.

The National Academies study benefited from substantial testimony, both written and oral from many constituencies including federal agencies, business leaders, state governments, and, of course, leaders of American higher education. Key was the effort to develop recommendations and actions aimed at both reaffirming and revitalizing the unique partnership that has long existed among the nation's research universities, the federal government, the states, and

business and industry. This testimony suggested that this would require a balanced set of commitments by each member of the research partnership (federal government, state government, research universities, and business and industry) to develop and implement enlightened policies, efficient operating practices, and necessary investments. This agenda should have sufficient flexibility to accommodate the differences among research universities and their various stakeholders. Even though our study was conducted by the National Academies for science, medicine, and engineering, there was a strong recognition of the importance of supporting the comprehensive nature of research universities, spanning the full spectrum of academic and professional disciplines including the arts and humanities, that enable it to provide the broad research and education programs required by a knowledge- and innovation-driven global economy.

More pragmatically, it was recognized that this study would only have impact if it launched a decade-long effort when both challenges and opportunities were likely to change, evolving from an emphasis during the early phase developing policies and practices that facilitate research university productivity and cost containment during the current economic crisis to phasing in recommended investments in research and graduate education in later years as the economy improves.

The testimony received by the National Academies committee can be framed in terms of several recommendations suggested for each of the partners:

Federal Government

The federal government should implement public policies and investments for university research and education sufficient to produce the new knowledge and educated citizens necessary to achieve national goals of prosperity, public health and security in an increasingly knowledge- and innovation-driven world, e.g. complete the authorized funding proposed by the America COMPETES Act (Augustine, 2007). Both the federal government and other research sponsors should strive to cover the full costs of research projects and other activities they procure from research universities in a consistent and transparent manner so that

these activities do not have to be subsidized from other university revenues such as student tuition or patient clinical fees (Berdahl, 2010; McPherson, 2009). Federal efforts should be taken to ensure a better-balanced regulatory environment that increases the cost-effectiveness of research universities (COGR, 2011). The federal government should develop and implement new programs that invest in emerging campus needs in areas such as research facilities and cyberinfrastructure, as well as in opportunities for the next generation of university faculty (similar to the Canadian research chairs) (Canada, 2011) program. Finally, the federal government should ensure that the nation would continue to benefit strongly from the participation of international students and scholars in our research enterprise through efforts to facilitate the citizenship of those receiving advanced degrees in key strategic areas.

States

For states to compete for the prosperity and welfare of their citizens in a knowledge- and innovation-driven global economy, the advanced education, research, and innovation programs provided by their research universities are absolutely essential. Hence, as the budgets of the states recover from the current recession, they should strive to restore and maintain funding for public research universities sufficient to maintain world-class quality, corresponding to a per-student funding level comparable to that characterizing the 1990s before the precipitous decline in state appropriations began, a funding gap for public research universities now estimated to exceed \$15 billion/year (Desrochers, 2011; McPherson, 2009; Birgeneau, 2009; Courant, 2010). However, since such restoration of funding may be challenging in the near term in view of the economic challenges facing the needs and priorities of aging populations and federal mandates, states should move rapidly to provide their research universities with sufficient autonomy and agility to navigate an extended period with limited state support. To provide further incentives for state actions to protect the quality of public research universities as both a state and a national asset, federal programs designed to stimulate innovation and workforce development at the state level should be accompanied by strong incentives to

stimulate and sustain adequate state support for their public universities.

Business and Industry

Business and industry should strengthen its role in the research partnership, structuring the relationship with research universities into a peer-to-peer nature, stressing collaboration in areas of joint interest, rather than the traditional customer-supplier relationship in which business procures graduates and intellectual property from universities (Weber, 2010). Universities should improve management of intellectual property to bolster the speed and effectiveness of technology transfer while developing the graduate degree programs that address strategic workforce gaps for employers. The federal government should continue to encourage, fund, and expand research support mechanisms that promote such collaboration and innovation.

Research Universities

In response to these commitments from federal and state governments and business and industry, the nation's research universities should commit to the achievement of substantial increases in productivity and cost effectiveness. In particular, they should set and achieve bold goals in cost-containment, efficiency, and productivity in business operations, academic programs, and auxiliary enterprises such as clinical affairs, student housing, and intercollegiate athletics.

Universities should develop clear metrics, assess outcomes relative to productivity and cost-containment goals, and publicly release progress reports on these efforts on an annual basis. University organizations such as the Association of American Universities and Association of Public and Land-Grant Universities should develop and implement more powerful and strategic tools for financial management and cost accounting that better enable universities to determine the most effective methods for containing costs and increasing

productivity and efficiency (McPherson, 2009). Universities, working together with key stakeholders, should intensify efforts to educate key audiences about the unique character of U.S. research universities and their importance to state, regional, and national goals, including economic prosperity, public health, and national security. Universities should address the currently unacceptable attrition rates and time to degrees characterizing graduate education, particularly at the doctoral level (Wendler, 2010). Moreover, research universities should work to improve education for all students at all levels by engaging in outreach to K-12 school districts and undertaking efforts to improve access and completion in their own institutions and improving the quality of undergraduate education in key strategic areas such as STEM. All stakeholders (federal and state governments, local school districts, industry, philanthropy, universities) should take action—urgent, sustained, comprehensive, intensive, and informed—to successfully increase the participation and success of women and underrepresented minorities in graduate degree programs across all academic and professional disciplines (Holliday, 2011).

Although many of these suggested actions were bold and ambitious, all were felt to be necessary to preserve one of the nation's most important assets, its world-class research universities. The nation was urged to embark on a decade-long campaign to achieve them.

The View from the Oort Cloud

The issues dealt with by the National Academies study are very much today's challenges. However, to look over the longer term of a decade or more requires a broader perspective. From a more distant vantage point, perhaps the L-1 or Lagrange point, one million miles out where Earth appears as "a big blue marble", all issues tend to converge into four themes of the 21st century: a world driven by knowledge and innovation, the globalization, demographic change, and the sustainability of humankind on Planet Earth.

But why stop here? It is interesting to move out to even a more distant perspective, perhaps to that academic Oort Cloud (in astronomical terms, a

gigantic cloud a light year from the sun comprised of ice, methane, ammonia and other debri from the origin of the solar system where comets are thought to originate) where has-been university presidents are exiled, doomed to contemplate issues out of sight, out of mind–although they occasionally are able to launch provocative comets inward to perturb the higher education solar system.

So, in this spirit then, from my personal Oort Cloud, if you will, let me suggest several possible game changers for the future of the university:

The Globalization of Higher Education

While universities must be responsive to the imperatives of a global economy and attendant to their local responsibilities, they must also become responsible members of the global community. Yet, the challenges facing our world, such as poverty, health, conflict, and sustainability not only remain unmitigated but in many respects become even more serious through the impact of the human species. The global knowledge economy requires thoughtful, interdependent and globally identified citizens. Institutional and pedagogical innovations are needed to confront these challenges and ensure that the canonical activities of universities—research, teaching, and engagement—remain rich, relevant, and accessible.

There is a strong sense that higher education, long international in participation, may now be in the early stages of such globalization (Weber, 2008). An increasing number of established universities are attempting to compete in the global marketplace for students, faculty, and resources, although many are still in the phase of establishing beachheads through campuses overseas much in the "colonial" spirit of earlier international development activities. Perhaps more successful are the numerous international partnerships being developed at a peer-to-peer level with universities abroad. Here, one must also add the efforts of for-profit organizations (e.g., higher education companies like the Apollo Group, Inc. (University of Phoenix) and Laureate Education, Inc. are rapidly expanding into global players through the acquisition of foreign universities).

There is also a sense that new types of universities may appear that

embrace a more transformational approach to globalization, what might be termed "universities in the world and of the world", which increasingly define their purpose beyond regional or national priorities to address global needs, such as health, environmental sustainability, and international development. Early efforts such as NYU, Carnegie Mellon, and MIT are particularly notable here. As a new world culture forms, we are likely to see many universities evolve into learning institutions serving the world, albeit from a particular geographical base.

Lifelong Learning

The needs for lifelong learning opportunities in a society driven by new knowledge and innovation are manifold. The shelf life of education received 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 reskilling 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 from time to time. 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.

Just as in earlier critical moments in our nation's history when federal initiatives expanded the role of education, such as the Land Grant Acts in the nineteenth century to provide higher education to the working class, universal access to secondary education in the early twentieth 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 such earlier federal education initiatives, by providing all American citizens with universal access to lifelong learning opportunities as a "civil right" in a 21st century world rather than a privilege (Miller, 2006).

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 (Duderstadt, 2000).

Cyberinfrastructure

The information and communications technologies enabling the global knowledge economy—so-called *cyberinfrastructure*, the current term used in the United States to describe hardware, software, people, organizations, and policies—are not only evolving exponentially, doubling in power every year or so, but changing dramatically in character. For example, information and communications services are increasingly delivered as a utility, much like

electricity, from remote data centers and networks. Both data and applications are now moving into massive network "clouds" managed by providers, such as Microsoft, Google, Amazon, and Apple. They provide not only global connectivity to organizations (e.g., corporations, governments, and universities), but also to individuals in rapidly changing forms, such as instant messaging, televideo, crowd sourcing, and affinity communities. It is becoming increasingly clear that we are approaching an inflection point in the potential of these technologies to radically transform knowledge work (Atkins, 2003; Bement, 2007). Many leaders, both inside and beyond the academy, believe that these rapidly changing technologies will so transform our educational institutions—schools, colleges, universities, learning networks—over the next generation as to make them unrecognizable within our current understandings and perspectives.

Consider, for example, the changing nature of communication. When we think of digitally mediated human interactions, we generally think of the awkwardness of e-mail or televideo conferences. Yet 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.

For planning purposes, we can assume that by the end of the decade we will have available infinite bandwidth and infinite processing power (at least compared to current capabilities). We will denominate the number of computer servers in the billions, digital sensors in the tens of billions, and software agents in the trillions. 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 with other people, groups, and social institutions.

Universal Access to Knowledge and Learning

Ironically, while we generally think in terms of terabit/sec networks and petaflop supercomputers, the most profound changes in our institutions may be driven not by the technology itself but rather the philosophy of openness and

access it enables— indeed, imposes—on its users. Of particular importance are efforts to adopt the philosophy of open source software development to create new opportunities for learning and scholarship for the world by putting previously restricted knowledge into the public domain and inviting others to join in both its use and development (Atkins, 2007). MIT led the way with its Open CourseWare initiative, placing the digital assets supporting almost 2,000 courses into the public domain on the Internet for the world to use (Vest, 2004). Today, over 1,000 universities have adopted the MIT paradigm to distribute their own learning assets to the world, with over 15,000 courses now available online. New resources, such as Apple's iTunes U, are providing access to such open educational resources.

Furthermore, a number of universities and corporations have joined together to develop open-source middleware to support the instructional and scholarly activities of higher education, already used by hundreds of universities around the world (e.g. Moodle and Sakai). Others have explored new paradigms for open learning and engagement, extending the more traditional, yet highly successful, models provided by open universities, such as Rice University's Connexion Project and Carnegie Mellon University's Open Learning Initiative. There are increasing efforts to open up both data collection and scholarly publication by both individual institutions and university organizations. More recently, major federal research agencies, such as the National Institutes of Health and the National Science Foundation, have implemented new requirements that both the data and publications resulting from their research grants be placed in the public domain on a timely basis.

To this array of open educational resources should be added efforts to digitize massive quantities of printed material. For example, the Google Book project (Google, 2011) is currently working with a number of leading libraries (30 at last count in 35 languages) around the world to digitize a substantial portion of their holdings (16 million volumes in 2011, with a goal of 30 million by 2020), making these available for full-text searches using Google's powerful internet search engines. It has launched negotiations with publishers to provide full-text access (beyond full-text searches) to the vast volume of "orphan" works no longer in print.

A number of United States universities (26 thus far) have pooled their digital collections to create the Hathi Trust ("Hathi" means "elephant" in Hindi), adding over 400,000 books a month to form the nucleus (already at 10 million books, including 2.5 million with full-text access) (HathiTrust, 2011) of what could become a twenty-first century analog to the ancient Library of Alexandria (Kelly, 2006). While many copyright issues still need to be addressed, it is likely that these massive digitization efforts will be able to provide full text access to a significant fraction of the world's written materials to scholars and students throughout the world within a decade.

Finally, it is important to note how dramatically communication activities are changing, with mobile technologies, social networking, and immersive environment.. We all know well the rapid propagation of mobile communications technology, with over 5 billion people today having cell-phone connectivity and 1.5 billion with broadband access. It is likely that within a decade almost all of the world's population will have some level of cell-phone connectivity. Rapidly evolving forms of social networking such as Facebook, Twitter, and Google+ are facilitating the formation of large social communities with ubiquitous, always-on connectivity and interaction.

The University as an Emergent Civilization

So what might we anticipate over the longer term 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 senses with arbitrarily high fidelity, perhaps we should not bind teaching and scholarship too tightly to buildings and grounds. 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

(Borgman, 2008; Thomas, 2011).

But there is a possibility even beyond these. Imagine what might be possible if all of these elements are merged, such as Internet-based access to all recorded (and then digitized) human knowledge augmented by powerful search engines and AI-based software agents; open source software, open learning resources, and open learning institutions (e.g., open universities); new collaboratively developed tools (e.g., Wikipedia, Google Docs); and ubiquitous information and communications technology (e.g., inexpensive network appliances, such as iPhones or iPads). Mobile and social networking enables the formation of new types of social interaction (e.g., crowd sourcing, flash mobs). In the near future it could be possible that anyone with even a modest Internet or cellular phone connection will have access to the recorded knowledge of our civilization along with ubiquitous learning opportunities and access to network-based communities throughout the world (perhaps even through immersive environments such as Second Life).

Imagine still further the linking together of billions of people with limitless access to knowledge and learning tools enabled by a rapidly evolving scaffolding of cyberinfrastructure, which increases in power one-hundred to one thousand-fold every decade. This hive-like culture will not only challenge existing social institutions—corporations, universities, nation states—that have depended upon the constraints of space, time, laws, and monopoly. It will also enable the spontaneous emergence of new social structures as yet unimagined—just think of the early denizens of the Internet such as Google, Facebook, Wikipedia, …and, unfortunately, Al Qaeda. In fact, we may be on the threshold of the emergence of a new form of civilization, 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 knowledge and learning organizations, such as the university, no longer constrained by space, time, monopoly, or archaic laws, but rather responsive to the needs of a global, knowledge society and unleashed by technology to empower and serve all of humankind. And all of this is likely to happen during the lives of today's students. These possibilities must inform and shape the manner in which we

view, support, and lead higher education. Now is not the time to back into the future.

Preparing for Unknowable Futures

Of course, today's university looks very much like it has for decades–indeed, centuries, in the case of distinguished European universities. They are still organized into academic and professional disciplines; they still base their educational programs on the traditional undergraduate, graduate, and professional discipline curricula; they are still governed, managed, and led as they have been for ages.

But if one looks more closely at the core activities of students and faculty, the changes over the past decade have been profound indeed. The scholarly activities of the faculty have become heavily dependent upon digital technology–rather cyberinfrastructure–whether in the sciences, humanities, arts, or professions (Duderstadt, 2003). Although faculties still seek face-to-face discussions with colleagues, these have become the booster shot for far more frequent interactions over Internet. Most faculty members rarely visit the library anymore, preferring to access far more powerful, accessible, and efficient digital resources to work with colleagues scattered about the globe. Many have ceased publishing in favor of the increasingly ubiquitous preprint route. And, as we have suggested earlier, student life and learning are also changing rapidly, as students bring onto campus with them the skills of the net generation for applying this rapidly evolving technology to their own interests, forming social groups, role playing (gaming), accessing services, and learning, despite the insistence of their professors that they jump through the hoops of the traditional classroom paradigm (Brown, 2000; Borgman, 2008; Thomas, 2011).

In one sense, it is amazing that the university has been able to adapt to these extraordinary transformations of its most fundamental activities, learning and scholarship, with its organization and structure largely intact. Here, one might be inclined to observe that technological change tends to evolve much more rapidly than social change, suggesting that a social institution such as the university that has lasted a millennium is unlikely to change on the timescales of

tech turns, although social institutions such as corporations have learned the hard way that failure to keep pace can lead to extinction. Yet, while social institutions may respond more slowly to technological change, when they do so, it is frequently with quite abrupt and unpredictable consequences.

It could also be that the revolution in higher education is well underway, at least with the early adopters, and simply not sensed or recognized yet by the body of the institutions within which the changes are occurring. Universities are extraordinarily adaptable organizations, tolerating enormous redundancy and diversity. It could be that information technology revolution is more a tsunami that universities can float through, rather a rogue wave that will swamp them.

An alternative viewpoint of the transformation of the university might view it as an evolutionary rather than a revolutionary process. Evolutionary change usually occurs first at the edge of an organization (an ecology) rather than in the center where it is likely to be extinguished. In this sense, the cyberinfrastructure that is now transforming scholarship and the communications technology enabling new forms of learning communities have not yet propagated into the core of the university. Of course, from this perspective, recent efforts, such as the Google Book project, take on far more significance, since the morphing of the university library from stacks to Starbucks strikes at the intellectual soul of the university (Duderstadt, 2005).

Admittedly, it is frequently the case that futurists have a habit of overestimating the impact of new technologies in the near term and underestimating them over the longer term. There is a natural tendency to implicitly assume that the present will continue, just at an accelerated pace, and fail to anticipate the disruptive technologies and killer apps that turn predictions topsy-turvy. Yet, we also know that far enough into the future, the exponential character of the evolution of Moore's Law technologies such as info-, bio-, and nano- technology makes almost any scenario possible. For the longer term, who can predict the impact of exponentiating 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 (Kurzweil, 2005)?

Even in the near term, we should again recall Christensen's innovator's dilemma as these disruptive technologies, which initially appear rather

primitive, stimulate the appearance of entirely new paradigms for learning and research that could not only sweep aside the traditional campus-based, classroom-focused approaches to higher education but seriously challenge the conventional academic disciplines and curricula (Christensen, 1997). We have entered a period of significant change in higher education as our universities attempt to respond to the challenges, opportunities, and responsibilities before them. This time of great change, of shifting paradigms, provides the context in which we must consider the changing nature of the university.

The successful adaptation of universities to the revolutionary challenges they face will depend a great deal on an institution's collective ability to learn and to continuously improve its core activities. It is critical that higher education give thoughtful attention to the design of institutional processes for planning, management, and governance. Only a concerted effort to understand the important traditions of the past, the challenges of the present, and the possibilities for the future can enable institutions to thrive during a time of such change (Zemsky, 2009).

Certainly, the need for higher education will be of increasing importance in our knowledge-driven future. Certainly, too, it has become increasingly clear that our current paradigms for the university, its teaching and research, service to society, and financing, all must change rapidly and perhaps radically. Hence, the real question is not whether higher education will be transformed, but rather how and by whom. If the university is capable of transforming itself to respond to the needs of a global culture of learning, then what is currently perceived as the challenge of change may, in fact, become the opportunity for a renaissance, an age of enlightenment, in higher education in the years ahead.

In this spirit then, perhaps it is appropriate to conclude with a note of reassurance drawn from a declaration developed by an international group of university presidents, the Glion Colloquium, at the turn of the millennium and drafted by Frank Rhodes, former president of Cornell:

For a thousand years, the university has benefited our civilization as a learning community where both the young and the experienced could acquire not only knowledge and skills, but also the values and discipline of the educated

mind. It has defended and propagated our cultural and intellectual heritage, while challenging our norms and beliefs. It has produced the leaders of our governments, commerce, and professions. It has both created and applied new knowledge to serve our society. And it has done so while preserving those values and principles so essential to academic learning: the freedom of inquiry, an openness to new ideas, a commitment to rigorous study, and a love of learning. There seems little doubt that these roles will continue to be needed by our civilization. There is little doubt, as well, that the university, in some form, will be needed to provide them. The university of the twenty-first century may be as different from today's institutions as the research university is from the colonial college. But its form and its continued evolution will be a consequence of transformations necessary to provide its ancient values and contributions to a changing world (Rhodes, 1999).

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