

Current Global Trends in Higher Education and Research:  
Their Impact on Europe

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## Introduction

Rector Winkler, Distinguished Guests, Members of the Faculties, and Colleagues: It is indeed a great honor to be invited to deliver an address on the *Dies Academicus 2009* commemoration of the founding of the University of Vienna on this date some 644 years ago. It is also somewhat intimidating, since my own university is a mere adolescent compared to your institution and the other great universities of Europe. In fact, we are preparing to celebrate in 2017 only the second century from our founding.

Like most American universities, the University of Michigan looked to Europe for its models. Although my university is regarded by many as the first truly public university in America, it borrowed its early structure from Napoleon's *Universite Imperiale de France*, adopting the imposing name of "Cathleopistimead of Michigania" when it was founded in 1817! When the Michigan territory entered the Union twenty years later, the University was restructured as a state university after the Prussian system. Finally in 1850 it became the first American university to embrace the Humboldt model of a research university. Unfortunately this early focus on scholarship was misaligned with the frontier culture of the times, and the Michigan president who imported the German model was eventually fired, but only after he prepared the way for the appearance of true universities in America (e.g., Cornell, Wisconsin, Johns Hopkins).

Actually, beyond our common intellectual heritage, today there are many other similarities between our two universities. Both institutions are roughly of the same size in student enrollment (70,000), faculty size, and academic characteristics such as disciplinary breadth, library collections, and research facilities. Both are leading universities both within our nations and around the world. In fact, this afternoon while walking around your courtyard to view statues of your distinguished faculty members, I noticed the bust of Ludwig Boltzmann, whose famous equation provided the subject of my own PhD dissertation! There were many other historical figures I recognized (and had studied) among your distinguished faculty, but I somehow missed the scholar

that seems most appropriate to my present efforts to understand the American economy: Joseph Schumpeter (with his theory of creative destruction)!

My assignment this evening is to discuss the topic: “Current Global Trends in Higher Education and Research—Their Impact on Europe”. Here there is also a great challenge. Events of today are changing so rapidly that much of what I describe is likely to have changed yet again before I fly back to the United States this weekend! Hence perhaps the best approach is to break my discussion into three different timeframes:

1. Now! Or at least within a few months!!!
2. Soon! Within a few years!
3. Eventually! Within our lifetimes—and certain those of our students!!!

So...What Is Happening Today? Now!!!

Let me begin with a few datapoints:

- Six months ago Harvard announced that its endowment had risen to \$37 billion, while Stanford set a new record for annual gifts at \$832 million. Three months later Harvard’s endowment had lost roughly \$10 billion in value; Stanford had lost \$5 billion; and both institutions are planning to reduce expenditures by 15% or greater, as were several other of America’s wealthiest private universities, whose operations had become heavily dependent on the income from long-term endowment investments of limited liquidity. Harvard has recently had to borrow \$2.5 billion in high interest, taxable bonds just to maintain its operations this year.
- As the global recession has deepened, state after state began to project tax revenue declines and warn their public universities of deep budget cuts in the range up to 20% to 30%. This retrenchment is on top of two decades of eroding tax support of public universities as the states have struggled with the shifting priorities of aging populations.

- (Actually, this decline in public support was nothing new for my university, located in the Rust Belt close to Detroit and the collapsing American automobile industry. Over the past 30 years we had seen our public support decline from 70% of our operating budget to less than 6% (more specifically, state support of \$322 million/year compares to the total University of Michigan budget of \$5.5 billion/year). As university president I used to explain that during this period we had evolved from a state-supported to a state-assisted to a state-related to a state-located university. In fact, with Michigan campuses now located in Europe and Asia, we remain only a state-molested institution.)
- In an effort to head off public and political concerns about possible tuition increases to compensate for declining public support, many university presidents have offered to forego their salary increases or even take salary cuts.
- On a more personal note, most faculty members of American universities do not have pensions for retirement; rather we participate in “defined contribution” retirement programs that contribute every year to personal accounts invested in the stock market. Hence most of us have lost 50% or more of our retirement savings over the last several months. Fortunately, since we do not have mandatory retirement ages in the United States, we can continue to work, although we may never recover enough assets to afford retirement.
- Even more serious is the possibility that impact of the collapse of faculty retirement accounts and consequent decisions by senior faculty members to remain long after normal retirement age could eliminate the availability of positions opening up for the recruitment of new, younger faculty and the intellectual renewal of our universities.

There have also been several recent events on the research front:

- During the past several years our National Academies led a major effort both to double federal support of basic research and achieve a better balance among disciplines—particularly between biomedical research, which had risen to over 62% on the campuses, and research in the physical and social sciences. Although this resulted in major new legislation, the America COMPETES Act of 2007, it failed to be funded, threatening U.S. participation in important European projects such as ITER and LHC.
- On a more positive note, President Obama’s economic stimulus package included a one-time investment of \$21.5 billion in research. However over \$11 billion of this was for biomedical research rather than distributed across the broader spectrum of R&D activities. Hence there remains a serious imbalance in federal funding of scientific research across the disciplines.

Of course there are broader themes at play here. The American approach to higher education over the past several decades—at least during the eras of conservative American presidents such as Nixon, Reagan, and Bush I and Bush II—has been to place almost total reliance on market forces rather than public policy and public investment. This has resulted in a shift in the perspective of higher education as less a public good to society than an individual benefit for students; a shift from public support to private support (primarily tuition and fees); and a shift of government-provided student financial aid from grants to needy students to subsidized loans and then to tax benefits (which tend to favor the affluent). Just as the tax policies favored by a series of conservative governments drove increasing economic inequality in our nation, so too did both tax and financial aid policies enabled the emergence of a class of super-rich private institutions.

Yet, today this blind dependence on “the invisible hand” of the marketplace has collapsed. The American electorate has finally rebelled and chosen a new president with priorities that stress greater economic equity,

integrity, and stability; who as set out bold visions in areas such as health care, education, and global sustainability; and who is determined to rejoin the global community in new spirit of cooperation. This sea change in public and political attitudes is likely to have dramatic impact on American higher education. And the early signs are very good.

In his first address to Congress, President Obama announced a national goal of achieving the world's highest proportion of college graduates by 2020. This will be a challenge for a nation that currently ranks 10<sup>th</sup> among OECD nations with only 39% of 25-to-34 year olds having an associate degree or higher and ranks almost last in college completion rates, particularly when the fastest growing component of our population comes from minority groups (particularly Latinos) with the lowest participation in higher education. (OECD,2008) To this end, President Obama has proposed that the federal government's programs for student financial aid become entitlement programs similar to Social Security and Medicare and no longer dependent each year upon the whims of Congress. He has also called for doubling federal funds for basic research, similar to the unfunded America COMPETES Act that sought to increase research in the physical sciences and engineering by \$20 billion/year over the next five years, but is now augmented with an additional increase of \$6 billion/year for cancer research at NIH. There are also plans for a very substantial increase in energy R&D, perhaps to a level of \$25 billion/year (compared to the current level of less than \$3 billion/year).

But despite grounds for strong optimism with the priorities of the new administration, there remain serious challenges facing American higher education. The deep cuts in state appropriations now facing our public universities come on the heels of two decades of eroding public support as aging populations stress social priorities such as retirement security, health care, safety from crime, and tax relief rather than higher education. It is also clear that in the current deep economic recession, there will be strong public and political pressure to resist efforts to increase tuition levels to mitigate the impact of such funding cuts.

For private universities, endowments heavily dependent upon long-term, ill-liquid assets have suffered great losses (30% or greater) causing temporary

declines in operating revenues. While this could threaten survival of the less well-endowed private universities, for the wealthiest institutions it amounts to a less threatening near-term challenge, since many were already spending at extremely high levels (over \$120,000 per student per year in some cases). It is likely that with their strong investment management capability, private universities with large endowments will likely come out of the recession taking advantage of low prices for attractive equity investments and hence widen the resource gap between themselves and poorly state supported public universities even further.

While the more optimistic among us may prefer to focus on opportunities that sometime arise in a crisis—the yang in the yin—it is also the case that such traumatic stresses can reveal flaws in the system, as I will suggest later. But let me first broaden both the discussion and the timescale a bit and review some of the near-term challenges facing higher education from a global perspective.

### Challenges for the Near Term

First, let me offer a few observations on the global context for higher education. First the good news: Today our world has entered a period of rapid and profound economic, social, and political transformation based upon a emerging new system for creating wealth that depends upon the creation and application of new knowledge and hence upon educated people and their ideas. It has become increasingly apparent that the strength, prosperity, and welfare of a nation in a global knowledge economy will demand a highly educated citizenry enabled by development of a strong system of tertiary education. It will also require institutions with the ability to discover new knowledge, develop innovative applications of these discoveries, and transfer them into the marketplace through entrepreneurial activities. (Friedman, 2005)

Yet the traditional institutions responsible for advanced education and research—colleges, universities, research institutes—are being challenged by the powerful forces characterizing the global economy: hypercompetitive markets, demographic change, increasing ethnic and cultural diversity, and disruptive technologies such as information, biological, and nanotechnologies. More

specifically, markets characterized by the instantaneous flows of knowledge, capital, and work and unleashed by lowering trade barriers are creating global enterprises based upon business paradigms such as out-sourcing economic activity and off-shoring jobs, a shift from public to private equity investment, and declining identification with or loyalty to national or regional interests.

The populations of most developed nations in North America, Europe, and Asia are aging rapidly while developing nations in Asia, Africa, and Latin America are characterized by young and growing populations. Today we see a serious imbalance between educational need and educational capacity. In a sense, many of our universities are in the wrong place, where populations are aging and perhaps even declining rather than young and growing, driving major population migration and all too frequently the clash of cultures and ethnicity.

New technologies are evolving at an exponential pace, obliterating both historical constraints such as distance and political boundaries and enabling new paradigms for learning such as open educational resources, virtual organizations, and peer-to-peer learning networks that threaten traditional approaches to learning, innovation, and economic growth.

On a broader scale, the education investments demanded by the global knowledge economy are straining the economies of both developed and developing regions. Developing nations are overwhelmed by the higher education needs of expanding young populations at a time when even secondary education is only available to a small fraction of their populations. In the developed economies of Europe, America, and Asia, the tax revenues that once supported university education only for a small elite are now being stretched thin as they are extended to fund higher education for a significant fraction of the population (i.e., massification). Yet their aging populations demand highest priority for public funding be given to health care, security, and tax relief, forcing higher education systems to become more highly dependent on the private sector (e.g., student fees, philanthropy, or intellectual property).

With this global context in mind, let us consider several of the important challenges facing higher education:

Challenge 1: Caught Between Massification, League Tables, and Tax Relief



In many respects the challenges facing higher education in the United States and Europe are similar:

- The need to dramatically broaden participation in higher education to build a competitive workforce (massification);
- The desire to enhance the quality of both education and scholarship to compete in a knowledge-driven economy (as measured by league tables); and
- The pressures to reduce the relative burden on tax payers who face other public spending priorities such as health, retirement, and national security.

The incompatibility of these objectives create strong and conflicting demands on universities for greater accountability in areas such as cost containment, productivity, and learning outcomes. Many national and regional governments continue to view public support of higher education and research not as an investment but rather as an expenditure competing with other current needs (e.g., health care, retirement pensions). Furthermore, many of today's universities are being encouraged to reduce the burden on limited tax revenues by diversifying their funding sources through mechanisms such as raising student fees, building relationships with industry, encouraging philanthropy, and expanding the market for educational services through adult education or international students (or including the possibility of establishing international campuses).

#### Challenge 2: Mission Differentiation and Profiling

It is increasingly apparent that the great diversity of higher education needs, both on the part of diverse constituencies (young students, professionals, adult learners) and society more broadly (teaching, research, economic

development, cultural richness) demands a diverse higher education ecosystem of institutional types. Key is the importance of mission differentiation, since the availability of limited resources will allow a small fraction of institutions to become globally competitive as comprehensive research institutions. (David Ward, former president of the American Council of Education and the University of Wisconsin, estimates that supporting a public world-class research university with annual budgets typically in the range of \$1 billion or more requires the tax base of a population of five million or greater.)

A differentiated system of higher education helps to accomplish both the goals of massification of educational opportunity and the conduct of research of world-class quality, but it assigns different roles in such efforts for various institutions. Enabled both by continental scale and its decentralized nature, the United States has achieved such a highly diverse system, enabling it to focus significant public and private resources to create a small set (less than 100) of world-class research universities, while distributing the broader roles of mass education and public service among a highly diverse collection of public and private institutions (roughly 3,600 in number), albeit with an inevitable tendency toward “mission creep”.

But such diversity in institutional profiles is a major challenge for most nations where differentiation among the missions and character of universities faces formidable challenges of both tradition and political pressures. Stratification is a particular challenge in Europe, where broad distribution of resources leads to the illusion that the continent has one thousand quality research universities, with the result being that only a handful are truly world-class. Yet shifting from an egalitarian to a more elitist system that focuses resources to build and sustain only a small number of world-class research universities, likely excluding some EU nations entirely, will encounter political resistance.

### Challenge 3: A Myopic Preoccupation with the Flat World

Many governments are now realigning higher education policies to address the challenges presented by the knowledge and innovation economy (as

Tom Friedman would call it, the “flat world”) by focusing priorities almost entirely on degree production (massification) and building research reputation (league tables) to the exclusion of the broader roles of the university. For example, there is a growing utilitarianism associated with the role of higher education in addressing the need for human capital that could overwhelm the university’s traditional social and cultural impact on society and civilization and its transformative potential through the creation, retention, and dissemination of knowledge. It is ironic that this shifts the value proposition from that of government responsibility for supporting the educational needs of a society to university responsibility for addressing the economic needs of government—an interesting reversal of traditional responsibilities and roles.

As a consequence, a serious gap can appear between national and regional higher education policies. For example, in America there is a mismatch between the priorities of the federal government for world-class excellence in graduate education and research and those of the states that are primarily focused on baccalaureate degree production. Fortunately in the United States such focused efforts by federal or state governments to demand that higher education address particular near term priorities (e.g., economic competitiveness, national defense, public health, the needs of underserved minority communities, etc.) are less influential. While the cacophony of demands from the highly diverse stakeholders attempting to influence American higher education (students, politicians, media, business, patients, sports fans...) can be a headache for university leaders and governing boards, it does have a moderating effect on dominance by any particular constituency or agenda because of the diversity of funding sources. Part of the challenge is balancing the needs of various stakeholders in higher education, predominantly the state, students, and business—and keeping all three satisfied without distorting the fundamental purpose of the university. Fortunately, the intensely competitive American higher education marketplace in which faculty, students, and resources move easily from one institution to another, has a self-correcting effect. If some institutions lose their way and become too focused on an agenda far removed from their core academic competence, they will quickly lose faculty, students, and eventually reputation.

This phenomenon may be a more serious issue in Europe because of the strong influence of government (support and regulation) on higher education. The cultural constraints on a freely operating market for faculty and student talent in Europe, coupled with the much stronger role that governments play in both financing and governing higher education, put European universities at somewhat greater risk in the face of such present day imperatives as the innovation economy.

#### Challenge 4: Collapsing Financial Paradigms

There are growing concerns that the current model for financing higher education in Europe, almost entirely dependent upon public tax support, is simply incapable of sustaining massification while achieving world-class quality. Currently the investment in higher education in European countries ranges from 0.9% to 1.8% of GDP, of which only approximately 10% comes from private sources (e.g., student fees). European university leaders express many concerns about the financial vulnerability of their institutions, still primarily dependent on tax support without appreciable student fees or gift income, and insufficiently entrepreneurial compared to the massive research universities in America.

Since tax revenues are already stretched thin sustaining Europe's strong social programs, it seems unlikely that the EU and other developed European nations will be able to provide the advanced educational opportunities required by a knowledge-driven economy without appreciable changes in tax policies (to encourage private philanthropy) and student/family expectations (to accept significantly higher student fees). It has also become increasingly clear that with public tax support of higher education constrained by the burdens of generous social services and weak economic growth, further massification will only erode the support of research universities. While increasing student fees and modifying tax policies to encourage philanthropic support of higher education will be challenging, there may no alternative to enhancing private support if Europe's universities are to remain competitive.

Yet there are similar fears that the more balanced financial model that has sustained American higher education for the past several decades is also

beginning to fray. Traditionally, the support of American higher education has involved a partnership among states, the federal government, and private citizens (the marketplace). In the past the states have shouldered the lion's share of the costs of public higher education through subsidies, which keep tuition low for students; the federal government has taken on the role of providing need-based aid and loan subsidies. However today the tuition and fees charged for private universities are now beyond the capacity of most families (e.g., \$35,000/year for tuition and \$50,000/year including housing). The tuition levels at public universities are also rising rapidly. For example, at both the Universities of California and U Michigan state residents pay \$12,000 a year while out-of-state students pay private tuition levels at \$35,000 a year.

A recent Brookings Institution study has concluded: "the traditional model of higher education finance in the U.S. with large state subsidies to public higher education and modest means-tested grants and loans from the federal government is becoming increasingly untenable." (Kane and Orzag, 2003) (It is worth noting that a co-author of this study, Steven Orzag, has recently been selected by President Obama as Director of the U.S. Office of Management and Budget where he will control the purse strings of our federal government. Hence he might be able to have significant impact on addressing his earlier concerns!)

#### Challenge 5: Public Policy vs. Markets

This combination of powerful economic, demographic, and technological forces could well drive a massive restructuring of the higher education enterprise on a global scale similar to that experienced by other economic sectors such as health care, transportation, communications, and energy. Nations are moving toward revenue-driven, market-responsive higher education systems because their current tax systems are increasingly unable to support the degree of universal access to post-secondary education required by knowledge-driven economies in the face of other compelling social priorities—particularly the needs of aging populations. Furthermore, there is growing willingness on the part of political leaders to use market forces as a means of restructuring higher education in an effort to increase both efficiency and quality. 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 society, is eroding. Higher education is increasingly viewed in many nations 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)

#### Challenge 6: Agility, Autonomy,...and Accountability

Many of the most powerful forces driving change in higher education come from the marketplace, driven by new societal needs, the limited availability of resources, rapidly evolving technology, and the emergence of new competitors such as for-profit ventures. Clearly in such a rapidly changing environment, agility and adaptability become important attributes of successful institutions.

Yet the governance and leadership of most universities throughout the world are far more inclined to protect the past than prepare for the future. Furthermore, all of higher education faces a certain dilemma related to the fact that it is far easier for a university to take on new missions and activities in response to societal demand than to shed missions as they become inappropriate, distracting, or too costly. This is a particularly difficult matter for public universities because of intense public and political pressures that require these institutions to continue to accumulate missions, each with an associated risk, without a corresponding capacity to refine and focus activities to avoid risk.

In both America and Europe there is increasing government and stakeholder pressure for capable governance, leadership, and accountability of higher education, particularly in view of the expansion of participation and the increasing importance of education to prospering in the global knowledge

economy. Paradoxically, in some states (and nations) even as relative government support has declined, the effort to regulate universities and hold them accountable has increased. Although some of this is rationalized by the sub-optimal activities of a relatively small number of institutions, it is perhaps also evidence of governments attempting to retain control over the sector through regulation even as their financial control waned. (SHEEO, 2005)

While it is certainly true that cost-containment and accountability are important issues, it is also the case that in many nations, particularly in Europe, universities can rightly counter-argue that the main problem for them is that they are overregulated and underfunded. In the United States most public university governing boards view their role as one of oversight to ensure public or political accountability rather than stewardship to protect and enhance the university so that it is capable of serving both present and future generations. Similarly faculties and students tend to resist change. (AGB, 2006)

In the United States there has been a recent chorus of demands for increased transparency, accountability and commitment to public purpose (meaning cost containment) in the operation of our institutions. Of particular concern was the need for more evidence-based assessment of educational outcomes, particularly in the accreditation process. There have been numerous attempts to use the accreditation process as more active mechanism for quality improvement rather than simply to determine whether institutions meet the minimum qualifications for accrediting academic programs. In contrast, the European approach of quality assurance actually seems better aligned to driving quality enhancement, although it is my understanding that even in Europe is a movement toward greater use of accreditation. From my experience with the bureaucracy that inevitably infects such accreditation efforts in the United States, my recommendation to our European colleagues can be captured in a single word: BEWARE!

#### Challenge 7: Research Strategies and Opportunities

European nations have adopted the Lisbon Agenda (2000) “to become the most competitive and dynamic knowledge-based economy with more and better

jobs and social cohesion by mobilizing the brainpower of Europe". Such initiatives are both pan-European like the European Higher Education Area (e.g., the Bologna process) or at the level of the European Commission (e.g., the Lisbon agenda) with initiatives such as the European Research Area (better integration of National and European research policies and the project of the European Research Council). The Lisbon agenda tends to use as a benchmark the United States investments in higher education and research (currently at levels of 2.6% and 3.0 % of GDP, respectively) while the Bologna process and ERC tend to emulate characteristics of the American research universities (e.g., standardizing university degrees upon the bachelors, masters, and PhD while basing the envisaged European Research Council research programs on competitive, peer-reviewed grants much like the U.S. National Science Foundation. While this establishes major investments in higher education and research as priorities, with the goal of bringing Europe up to the level of the United States by 2010, there are serious concerns that such an ambitious objective may be inconsistent with the low economic growth of national economies. It furthermore will likely require major structural changes in how European universities are organized, governed, and financed.

While the long-standing partnership among research universities, business, and government in the United States continues to maintain global leadership in measures such as the percentage of GDP invested in R&D, the number and productivity of researchers, the volume of high-tech production and exports, and the global rankings of its research universities, there are several worrisome trends that have developed over the past decade. These include the decline in federal funding for basic research and the imbalance in the national research portfolio, with roughly two-thirds of university research now in the biomedical sciences; the erosion of basic research in both corporate R&D laboratories and federal agencies; the increasing complexity of intellectual property policies; and the adequacy of the nation's supply of scientists and engineers in the wake of the changing immigration policies in the aftermath of the terrorist attacks of 2001.

The concerns raised by leaders of industry, higher education, and the scientific community, culminating in the National Academies' *Rising Above the*



*Gathering Storm* study (Augustine, 2005), stimulated the federal government to launch two major efforts aimed at sustaining U.S. capacity for innovation and entrepreneurial activities: the Bush administration's *American Competitiveness Initiative* and Congress's *America COMPETES Act* (the latter being including an awkward acronym for "Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science".) If fully implemented, over the next decade these efforts would involve doubling federal investment in basic research in physical science and engineering; major investments in science and engineering education; tax policies designed to stimulate private sector in R&D; streamlining intellectual property policies; immigration policies that attract the best and brightest scientific minds from around the world; and building a business environment that stimulates and encourages entrepreneurship through free and flexible labor, capital, and product markets that rapidly diffuse new productive technologies. Unfortunately, in a 2007 year-end budget skirmish between President Bush and Congress, the funding for the America COMPETES effort was eliminated, and federal R&D continued to decline across all agencies funding university research.

As noted earlier, however, President Obama is determined to restore adequate national investments in R&D with particular emphasis on doubling the research budgets of NSF and the Office of Science of the Department of Energy while continuing the growth of biomedical research through NIH. His success in achieving this will be determined in part by the economic environment and building adequate support in Congress, which still does not view R&D investment as a compelling priority comparable to national security or tax relief.

#### A Case Study: Higher Education in the United States, Circa 2009

To illustrate the stresses and strains imposed on higher education by these near term challenges, let me summarize the current situation in the United States as a case study. First let me remind you of some of its unusual characteristics: Higher education in the United States is characterized both by its great diversity in university profiles and an unusual degree of institutional autonomy—understandable in view of the limited role of the federal government in tertiary

education. As *The Economist* notes, "The strength of the American higher education system is that it has no system." (Economist, 2005) In the United States our colleges and universities, both public and private, are relatively free from government control, at least compared to institutions in other nations. We have no ministry of higher education or national system of education, relatively few federal regulations, and essentially no broad federal higher education policies.

The American university's constituencies are both broad and complex and include as clients of university services not only students but also patients of its hospitals; federal, state, and local governments; business and industry; and the public at large (e.g., as spectators at athletic events). To address this diversity—indeed, incompatibility—of the values, needs, and expectations of the various constituencies served by higher education, the United States has encouraged a highly diverse array of tertiary educational institutions to flourish. From small colleges to immense multi-campus universities, religious to secular institutions, vocational schools to liberal arts colleges, land-grant to urban to national research universities, public to private to for-profit universities, there is a rich diversity both in the nature and the mission of America's roughly 3,600 post-secondary institutions.

From an economic perspective, today the United States spends roughly 2.6% of its GDP on higher education (\$335 billion/year). Public sources provide 45% of this support: the states provide 24% (\$75 B/y) primarily through appropriations directly to public colleges and universities; the federal government provides the remaining 21% (\$70 B/y) through student financial aid, subsidized loans, and tax benefits (\$40 B/y) and research grants (\$30 B/y). Here it is important to stress that federal support of American higher education is primarily channeled to individuals (students and faculty research investigators) rather than to institutions. In contrast, the states play a more direct role in supporting and governing institutions, providing significant funding to their public universities and imposing governance structures ranging from rigidly controlled systems (e.g., New York and Ohio) to strategic master plans (e.g., California and Texas) to anarchy and benign neglect (e.g., Michigan).

Over 55% of the support of American higher education (\$190 B/y) comes from private support, including tuition payments (\$95 B/y), philanthropic gifts

(\$30 B/y), endowment earnings (\$35 B/y on the average), and revenue from auxiliary activities such as medical clinics and athletics (\$30 B/y). This very large dependence on private support—and hence the marketplace—is a major reason why on a per-student basis, higher education in America is supported at about twice the level (\$20,545 per year) as in Europe. There is a caveat here, however, since roughly half of this cost is associated with non-instructional activities such as health care, intercollegiate athletics, and economic development—missions unique to American universities. After subtracting the sources earmarked for nonacademic missions, one finds that the actual instructional costs of American higher education today are quite comparable to many European nations.

There are a few other characteristics of American institutions that should be mentioned. Beyond their fundamental purpose of teaching and scholarship, American colleges and universities have inherited from their British antecedents the mission of the socialization of young students, or in the words of Lord Rugby, transforming savages into gentlemen. Not only does this require a very substantial investment in residence halls, community facilities, and entertainment and athletic venues, but it can also distract the university from its more fundamental knowledge-based mission. Nevertheless it has become the expectation of American parents that “college is the place where we send our children to grow up”.

Furthermore, our colleges and universities are expected to compensate for the significant weaknesses currently characterizing primary and secondary education in the United States, even if that requires providing remedial programs for many under-prepared students. While many leaders of American universities wish they could shift to the “no-frills” approach of European universities and focus their activities on teaching and scholarship for adult students, this has proved difficult for all but the highly focused for-profit and on-line colleges designed for adult learners (e.g., the University of Phoenix and the Western Governors University).

The reality faced by most American universities is that the many of valuable academic services they provide to society—e.g., educating low income students, offering instruction in the arts and humanities, conducting research scholarship—are inherently unprofitable and hence must be subsidized either

through government support or through other activities capable of generating a profit. American universities are continually adding new activities only marginally related to their fundamental educational mission in an effort to generate new revenues, e.g., aggressive management of endowment assets and intellectual property, equity interest in spinoff high-tech companies, the conduct of commercial entertainment activities (football, concerts, theatre), and providing educational services to wealthy clients (e.g., oil-rich nations).

With this as background, let me now summarize briefly some of the current challenges faced by American higher education:

#### Problem 1: A Mature Enterprise

While public surveys still suggest strong support of higher education, numerous studies sponsored by government, business, foundations, the National Academies, and the higher education community have suggested that the past attainments of American higher education may have led our nation to unwarranted complacency about its future. (Callan, 2008) There is clear evidence of an increasing stratification of access to (and success in) quality higher education based on socioeconomic status. Many question whether our colleges and universities are achieving acceptable student learning outcomes (including critical thinking ability, moral reasoning, communication skills, and quantitative literacy). (Bok, 2007) Rising tuitions raise concerns about cost containment and productivity.

American higher education appears to be having difficulty responding to changes demanded by the emerging knowledge services economy, globalization, rapidly evolving technologies, an increasingly diverse and aging population, and an evolving marketplace characterized by new needs (e.g., lifelong learning), new providers (e.g., for-profit, cyber, and global universities), and new paradigms (e.g., competency-based educational paradigms, distance learning, open educational resources). Furthermore, while American research universities continue to provide the nation with global leadership in research, advanced education, and knowledge-intensive services such as health care, technology transfer, and innovation, this leadership is threatened by rising competition from

abroad, by stagnant support of advanced education and research in key strategic areas such as science and engineering, and by the complacency and resistance to change of the academy.

Of particular importance here was the National Commission on the Future of Higher Education (the so-called Spellings Commission), launched in 2005 to examine issues such as the access, affordability, accountability, and quality of our colleges and universities. (Here I must confess to having been a member of this group...) This unusually broad commission—comprised of members from business, government, foundations, and higher education—concluded that "American higher education has become what, in the business world would be called a mature enterprise: increasingly risk-averse, at times self-satisfied, and unduly expensive. It is an enterprise that has yet to address the fundamental issues of how academic programs and institutions must be transformed to serve the changing educational needs of a knowledge economy. It has yet to successfully confront the impact of globalization, rapidly evolving technologies, an increasingly diverse and aging population, and an evolving marketplace characterized by new needs and new paradigms." (Miller, 2006)

More specifically, the Commission raised two areas of particular concern about American higher education: social justice and quality. "Today too few Americans prepare for, participate in, and complete higher education. Notwithstanding the nation's egalitarian principles, there is ample evidence that qualified young people from families of modest means are far less likely to go to college than their affluent peers with similar qualifications." (Students from the highest income quartile are ten times more likely to graduate with college degrees than those from the lowest quartile!) "America's higher-education financing system is increasingly dysfunctional. Government subsidies are declining; tuition is rising; and cost per student is increasing faster than inflation or family income. Furthermore, at a time when the United States needs to be increasing the quality of learning outcomes and the economic value of a college education, there are disturbing signs that suggest higher education is moving in the opposite direction. Numerous recent studies suggest that today's American college students are not really learning what they need to learn." (Miller, 2006)

The Commission issued a series of sweeping recommendations to better

align higher education with the needs of the nation:

1. Reaffirming America's commitment to provide all citizens with the opportunity to pursue post-secondary education and calling for a major new engagement of higher education with primary and secondary education;
2. Restructuring financial student aid programs to focus upon the needs of lower income and minority students, placing a much higher priority on need-based financial aid programs;
3. Calling for a new degree of transparency, disclosure, and accountability in areas such as cost structures and educational outcomes in an effort to earn greater public trust and confidence in the commitment of our institutions to the public interest;
4. Adopting a culture of continuous innovation and quality improvement in higher education with a much higher priority given to experimentation and innovation;
5. Meeting the needs of an innovation-driven nation by increasing investment in areas key to economic competitiveness and national security in a global, knowledge-driven economy; and
6. Ensuring that all citizens have access to high quality educational, learning, and training opportunities throughout their lives, essentially establishing lifelong post-secondary education as a fundamental right for all Americans.

Although these were the recommendations of a Commission chartered by the Bush administration, there are signs that these recommendations are likely to remain a focus of the higher education policies of the new Obama administration, although hopefully approached with a less confrontational spirit.

## Problem 2: The challenge of diversity

American colleges and universities have long played an important role in providing educational opportunities and social mobility for a diverse society. As it has been so many times in its past, America is once again becoming a nation of immigrants, benefiting greatly from their energy, talents, and hope, even as such mobility changes the ethnic character of our nation. In fact, over the past decade, immigration from Latin America and Asia contributed 53% of the growth in the United States population, exceeding that provided by births. (National Information Center, 2006) This is expected to drive continued growth in our population from 300 million today to over 450 million by 2050, augmenting our aging population and stimulating productivity with new and young workers. Current projections suggest that by mid-century the United States will no longer have any single majority ethnic group (e.g., it will no longer be Euro-centric.)

But while the increasing diversity of the American population with respect to culture, race, ethnicity, and nationality is one of our greatest strengths, it is also one of the nation's most serious challenges since the imperatives of increasing diversity are complicated by social and economic factors that must be addressed by our educational institutions. The mechanisms used to achieve diverse campuses such as affirmative action have been challenged in the courts and through voter referenda. (In fact I have a bit of personal experience here, since I was a named defendant in the University of Michigan case that went before the U.S. Supreme Court in 2003. We won that battle, only to lose the war when Michigan voters passed a referendum in 2008 banning affirmative action!)

## Problem 3: Darwinian Competition

Although some would question whether American higher education truly functions as a market, high student and faculty mobility among its thousands of institutions does create strong competition for the best faculty, the best students, resources from public and private sources, athletic supremacy, and reputation that can drive quality, albeit with considerable inefficiency and rising costs.

However, it can also create an intensely Darwinian, winner-take-all ecosystem in which the strongest and wealthiest institutions can become predators, raiding the best faculty and students of the less generously supported and more constrained universities and manipulating federal research and financial policies to sustain a system in which the rich get richer and the poor get devoured.

This ruthless and frequently competition poses a particularly serious challenge to the nation's public research universities. These flagship institutions now find themselves caught between the rock of declining state support and the hard-place of the predatory rich private universities. As we have noted earlier, aging populations are not likely to give higher education a priority for state tax dollars for perhaps a generation or longer. Hence even as states are depending more on their public universities—expanding access to underserved communities, achieving world-class performance in research and graduate studies key to regional economic competitiveness—state appropriations are declining while demands for higher efficiency and accountability are intensifying.

In sharp contrast, due both to booming financial markets of the past decade and favorable federal financial aid and tax policies, many private universities have managed to build endowments so large (at least on a per student basis) that they have become independent of the education marketplace (e.g., student tuition, R&D grants, even private support). This creates a serious competitive imbalance in the marketplace for the best faculty, students, and perhaps resources, since the wealth gap between the rich privates and flagship publics is growing ever larger. This is aggravated by the political constraints on public universities that not only limit their flexibility and agility, but also hinder their capacity to compete (e.g., constraints on tuition, affirmative action, technology transfer, and globalization). To be sure, the recent collapse of the financial markets have set back the endowments of even the wealthiest private universities, yet they continue to maintain investments in faculty salaries, student support, and research environments at levels considerably beyond that of public research universities, also hindered by weakened state support.

The plight of America's public research universities is not only a serious challenge to the states but as well as to the nation, since these institutions represent the backbone of advanced education and research, producing most of



the scientists, engineers, doctors, lawyers, and other knowledge professionals, conducting most of the research, and performing most of the public service sought by states. It would be a national disaster if the public research university were to deteriorate to the point in which research and advanced education of world-class quality could only occur in the 20 to 30 wealthiest private universities, as suggested by one of our leading private university presidents!

This last possibility brings me to perhaps the most serious challenges of all to higher education in the United States:

#### Problem 4: The lack of a national strategy

While most nations are facing—or at least coping with—the ongoing challenges of massification, academic competition, and limited public resources, culture, tradition, and local politics shape their particular approach. Because of our origin as a federation of independent colonies (and then states), the United States continues to rely on a highly decentralized market-driven approach, consistent with the constitutional role that the states play in higher education and the autonomy of private institutions, with little strategic direction from the federal government. In fact, the United States is essentially the only developed nation without a national strategy for higher education in general and for research universities in particular. Of course our nation does have a well-organized national research system, based on competitive grants from federal agencies such as the National Science Foundation (NSF), the National Institutes of Health (NIH), the Department of Energy (DOE), and the National Aeronautics and Space Administration (NASA). But the budgets and control of our public research universities, which conduct most of the research and produce most of graduates of advanced degree programs, are at the state level, with only minimal influence by policies of the federal government.

Here is one area where Europe—and the rest of the world—has a very decided advantage over the United States. The Bologna Process and successors such as the European Research Area have been important elements of a strategy to sustain and enhance a constellation of world-class research universities, key both to the economic strength and integration of the European Community.

True, the current financial crisis has created some cracks where nationalism may seep through for a bit, but Europe's strategic approach to higher education and research through an ongoing process of engagement and integration has been a model that many of us in the New World greatly envy. (Zemsky, 2009)

Today, more than ever, the United States needs to develop a national strategy for sustaining (and perhaps expanding) a system of world-class research universities. Actually we have done this before, a century ago, with the Land-Grant Acts that provided the revenues from the sale of federal lands to the states to build the public universities that have provided educational opportunities to the working class and conducted both the basic and applied research to address key national priorities such as agriculture and industry. The federal government stepped in once again after WWII to create a partnership between the research universities and federal agencies through a peer-reviewed competitive grant system. Today many of us believe we need a new national strategy to sustain and enhance the quality of the nation's public research universities.

## Longer Term Issues: Paradigm Shifts Over the Horizon

### Paradigm Shift 1: Lifelong Learning

Today the shelf life of education provided early in one's life is shrinking rapidly in face of the explosion of knowledge in many fields. Furthermore, longer life expectancy and lengthening working careers create an ongoing need to refresh one's knowledge and skills through both formal and informal learning. Hence an increasing number of nations are setting the ambitious goal of providing their citizens with ubiquitous, lifelong learning opportunities.

Of course this will require not only a very considerable transformation and expansion of the existing post-secondary education enterprise but also entirely new paradigms for the conduct, organization, financing, leadership, and governance of higher education. Yet, if successful, it could also create true societies of learning, in which the sustained development of knowledge and human capital become the key paths to economic prosperity, national security, and social welfare.

## Paradigm Shift 2: The Global University

There is a strong sense that higher education is in the early stages of globalization, through the efforts of an increasing number of established universities to compete in the global marketplace for students, faculty, and resources; the rapid growth in international partnerships among universities; and the appearance for-profit organizations (e.g., Apollo, Laureate) that seek to expand through mergers and acquisition into global enterprises. In fact, some suggest that we may soon see the emergence of truly global universities that not only compete in the global market place for students, faculty, and resources but are increasingly willing to define their public purpose in terms of global needs and priorities such as environmental sustainability, public health, wealth disparities, and poverty. Such “universities in the world and of the world” might form through consortia of existing institutions (e.g., the U.K.’s Open University), new paradigms, or perhaps even existing institutions that evolve beyond the public agenda or influence of their region or nation-state to assume a truly global character. (Glion VI, 2008)

## Paradigm Shift 3: Cyberinfrastructure

The information and communications technologies enabling the global knowledge economy—so-called *cyberinfrastructure*, the current term used in the United States to describe ICT hardware, software, people, organizations, and policies (Europe calls this e-science)—evolve exponentially, doubling in power every year or so and amounting to a staggering increase in capacity of 100 to 1,000 fold every decade. (Atkins, 2003) It is becoming increasingly clear that we are approaching an inflection point in the potential of these technologies to radically transform knowledge work. To quote Arden Bement, Director of the U.S. National Science Foundation, "We are entering a second revolution in information technology, one that may well usher in a new technological age that will dwarf, in sheer transformational scope and power, anything we have yet experienced in the current information age." Many leaders, both inside and

beyond the academy, believe that these forces of change 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. (Bement, 2007)

Here I have a strong personal interest since my career as a nuclear scientist essentially overlapped the evolution of the digital computer. During the 1980s while I was president of the University of Michigan, we were approached by the federal government to join with IBM in extending a small regional computer network into a system, NSFnet, that would link scientists with the nation's supercomputers. We chose a standard communication protocol (TCP-IP), developed the necessary technologies (the "data concentrators" now renamed "routers" and software to build the network and found to our surprise that its use by scientists began to increase at the rate of 10% a month. In fact, over the decade that we managed the network, both its activity level and bandwidth expanded a million fold. As activity increased, the federal government suggested that we broaden our mission to connect together and manage as well other federal networks to form what we then called the "Internetwork". Well, we all know what happened next. CERN developed the World Wide Web, the browser appeared, the business world discovered the commercial value of the network, and our network (NSFnet → Internetwork → Internet) grew so large that we had to spin it off as a commercial enterprise in 1993.

More recently I have chaired several studies by our National Academies to understand the impact of this technology on universities. (Duderstadt, 2003) Today I currently chair the Advisory Committee on Cyberinfrastructure for our National Science Foundation. (NSF OCI, 2009)

Hence from these multiple perspectives I would like to offer a few observations and provocative speculations about the longer term impact of technology on the university. Ironically, while we generally think in terms of this in terms such as Terabit/sec networks and Petaflop supercomputers, I believe 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.

#### Paradigm Shift 4: Open Learning Resources

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. MIT led the way with its OpenCourseWare (OCW) initiative, placing the digital assets supporting almost 1,800 courses into the public domain on the Internet for the world to use. (Vest, 2006) Today, over 400 universities have adopted the OCW paradigm to distribute their own learning assets to the world, with over 7,000 courses now available online.

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, 2007 and Sakai, 2007). Others have explored new paradigms for open learning and engagement, extending the more traditional yet highly successful models provided by open universities. There are increasing efforts to open up both data collection and scholarly publication by both individual institutions and university organizations, including the European University Association and the Association of American Universities, although commercial publishers continue to resist these efforts to block this through government regulation and litigation. (Atkins, 2007)

To this array of open educational resources should be added efforts to digitize massive quantities of printed material. For example, the Google Book project is currently working with a number of leading libraries (26 at last count in 35 languages) around the world to digitize a substantial portion of their holdings, making these available for full-text searches using Google's powerful internet search engines. (Kelly, 2006) For example, roughly 50% of the University of Michigan's 8 million volume library has been already been digitized, with the completion of this effort projected in 2010.

More generally, Google now has digitized and made full-text searchable over 10 million books. It has recently negotiated 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 (25 thus far) have pooled their digital collections to create the HathiTrust, adding over 400,000 books a month to form the nucleus of what could become a 21<sup>st</sup> century analog to the ancient Library of Alexandria. (“Hathi” means “elephant” in Hindi...) While there are still many copyright issues that need to be addressed, it is likely that these massive digitization efforts will be able to provide full text search access to a significant fraction of the world’s written materials to scholars and students throughout the world within a decade.

Let me add into this array of ICT-based activities a few more elements: mobile communication, social computing, and immersive environments:

- We all know well the rapid propagation of mobile technology, with over 3.5 billion people today having cell-phone connectivity and 1.2 billion with broadband access. It is likely that within a decade the majority of the world’s population will have some level of cell-phone connectivity, with many using advanced 3G and 4G technologies.
- Today’s youth are digital natives, members of the “net generation”, comfortable with using the new technologies for building social communities—instant messaging, blogs, wiki’s, virtual worlds, FaceBook, MySpace, Wikipedia (which even their professors use). They have embraced and reshaped their lives with such highly interactive, social networking.
- Rather than access the vast knowledge resources provided through the open education resources movement through passive media such as books, this generation accesses knowledge and builds social communities through 3-D virtual reality environments such as Second Life, the World of Warcraft, and Croquet in which all of the senses are faithfully replicated to enable human interaction at a distance.

Paradigm Shift 5: The Future of the University? (Or something else...)

So what are the implications of these emerging technologies for the future of the university? John Seely Brown suggests that we might think of the contemporary university as an interconnected set of three core competencies: learning communities, knowledge resources, and the certification of knowledge skills. Social computing will empower and extend learning communities beyond the constraints of space and time. Open knowledge and education resources will clearly expand enormously the knowledge resources available to our institutions. And immersive environments will enable the mastery of not simply conventional academic knowledge but as well tacit knowledge, enabling our students to learn now only how “to do” but actually how “to be”—scholars, masters, professionals, whatever they wish! (Brown and Duguid, 2000)

But there is a possibility even beyond these. Imagine what might be possible if all of these elements are merged, i.e., Internet-based access to all recorded (and then digitized) human knowledge augmented by powerful search engines; open source software, open learning resources, and open learning institutions (open universities); new collaboratively developed tools (Wikipedia II, Web 2.0); and ubiquitous information and communications technology (e.g., cheap laptop computers or, more likely, advanced cell phone technology). 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. But it will enable the spontaneous emergence of new social structures as yet unimagined—just think of the early denizens of the Internet such as Google, MySpace, 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, and, in fact, during the lives of most of us in this gathering this evening. 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.

### Whence and Whither the Revolution

Yet today university today looks very much like it has for decades—indeed, centuries in the case of distinguished European universities such as the University of Vienna. We are still organized into academic and professional disciplines; we still base our educational programs on the traditional undergraduate, graduate, and professional discipline curricula; we are still finance, manage, and lead the university as we have for ages. (Duderstadt, 2000)

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. 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. Many have ceased publishing in favor of the increasingly ubiquitous preprint route. And, as we have suggested earlier, both student life and learning is 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.

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, e.g., “punctuated evolution”.

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 tidal wave that will swamp them.

An alternative viewpoint of the transformation of the university might be 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 now transforming scholarship or the communications technology enabling new forms of student learning and faculty scholarship 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.

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.

Certainly the monastic character of the ivory tower is 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. So too, both learning and scholarship will continue to depend heavily upon the existence of communities, since they are, after all, high 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. (Duderstadt, 2007)

Even in the near term, we should again recall Christensen's *innovators's dilemma*, (Christensen, 1997) 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. 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?

Hence, perhaps it is best to conclude by recalling the closing passage of the Glion Declaration, adopted by a group of leaders of European and American universities in 1998. "To be sure, there will be continuing need and value for the broader social purpose of the university as a place where both the young and the experienced can acquire not only knowledge and skills, but the values and discipline of an educated mind, so essential to a democracy; an institution that defends and propagates our cultural and intellectual heritage, even while challenging our norms and beliefs; the source of the leaders of our governments, commerce, and professions; and where new knowledge is created through

research and scholarship and applied through social engagement to serve society. But, just as it has in earlier times, the university will have to transform itself once again to serve a radically changing world if it is to sustain these important values and roles." (Rhodes, 1999)

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