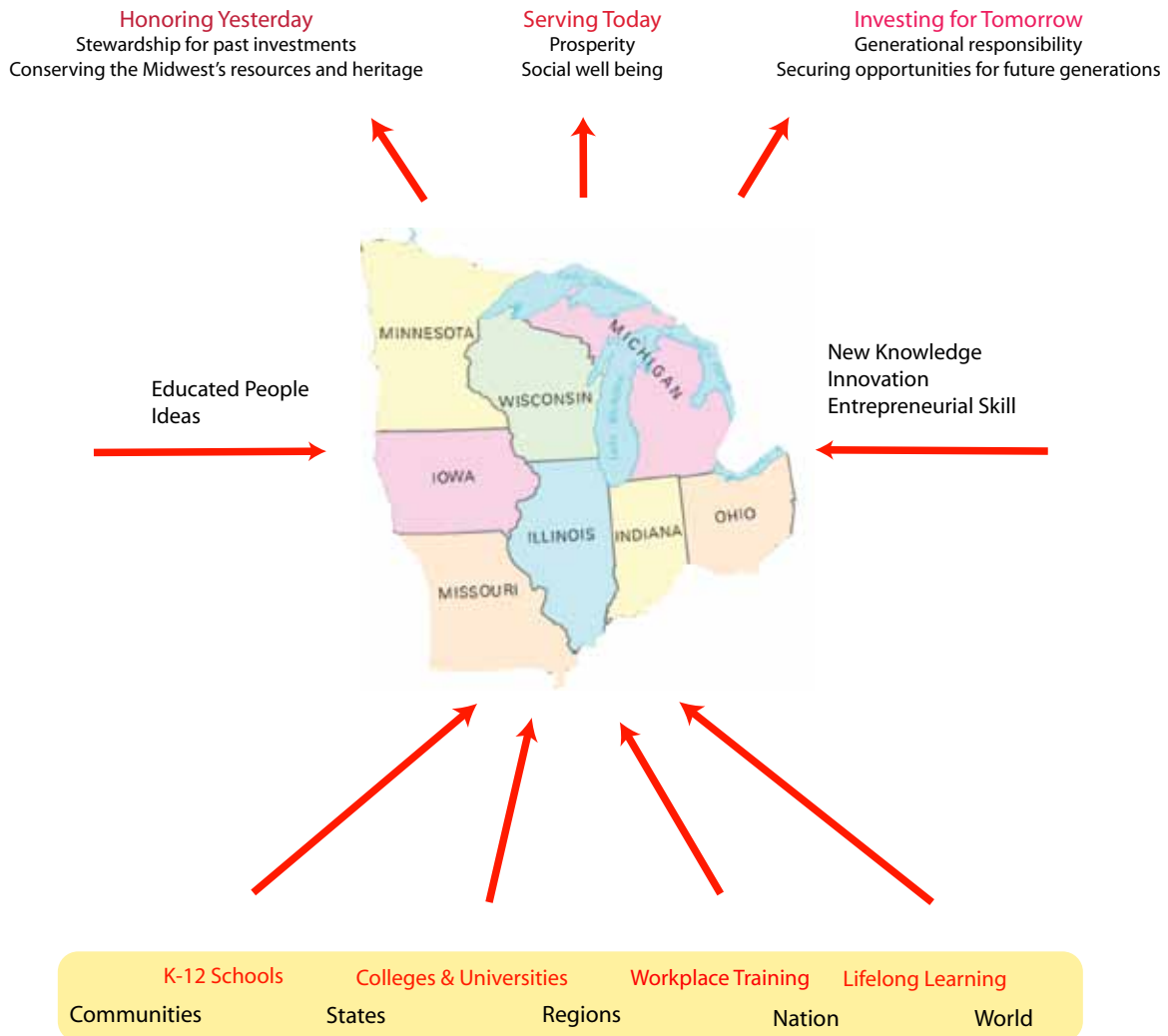


A Master Plan for Higher Education in the Midwest

A Roadmap to the Future of the Nation's Heartland



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Preface

In his recent book, *Caught in the Middle*, Richard Longworth portrays the challenge to the Midwestern United States in a compelling way: “Today, the Midwest region is in transition, struggling to retain the best of its social, cultural, and economic traditions while at the same time trying to reinvent itself for success in a very different economic milieu. Much of its current malaise reflects the passing of an agrarian and industrial economy that supported the region for a century. Part of it is the arrival of globalization and three billion new workers, most from Asia and Eastern Europe, each ready to do the heavy lifting and low-skill assembly-line work that once put bread on Midwestern tables. Part of it is the dawning of the knowledge economy in a region where a high school diploma used to buy a ticket to the middle-class life—and today is only the fare to poverty.”

To achieve prosperity and security in a hypercompetitive global, knowledge-driven economy, the American Midwest faces the challenge of transforming what was once the farming and manufacturing center of the world economy into what could become its knowledge center. Put another way, while the Midwest region once provided the muscle for the manufacturing economy that powered the twentieth century, now it must make the commitment and the investments necessary to become the brains of the twenty-first century knowledge economy.

For the past four decades, I have experienced (and endured) this wrenching transformation at ground zero as a faculty member and then president of the University of Michigan. From this experience, as well as many others at the national and international level, I have become convinced of several imperatives of the brave, new world facing the Midwest: First, knowledge and innovation are the drivers of the global economy today, and their importance will only intensify in the future. Second, and as a consequence, educated people, the

knowledge they produce, and the innovation and entrepreneurial skills they possess have become the keys to economic prosperity, public health, national security, and social well being. Third, while the characteristics of the American culture—a diverse population, democratic values, free-market practices, a predictable legal system—provide a fertile environment for innovation, history has shown that significant public and private investment is necessary to produce the key ingredients of innovation: new knowledge (e.g., research), world-class human capital (e.g., education), infrastructure (e.g., institutions, facilities, and networks), and policies (e.g., tax, investment, and intellectual property). And finally, I agree completely with Longworth and many others that while action at the state and national level will be important, the vision, power, and opportunity is shifting rapidly to the regional level driven by major metropolitan areas.

Hence when Richard Longworth approached me to prepare a report for the Chicago Council’s Heartland Papers series on the role of higher education could play—indeed, must play—in the transformation of the Midwest region into a learning- and innovation-driven society, I was pleased to respond. My first inclination was to approach this task very much in the spirit of the California Master Plan, developed by President Clark Kerr of the University of California and his colleagues during a period of extraordinary economic and demographic change in 1960. Yet, my own experience with both that state and the University of California made it clear that while a “master plan” focused on higher education made sense in the mid-twentieth century, today one must broaden considerations to include all stages of education—K-12, higher education, workplace training, lifelong learning—indeed, “cradle to grave” learning needs, opportunities, and experiences. Furthermore, such a study would have to encompass all of the missions of the contemporary university—education,

scholarship, engagement, health care, economic development, innovation, entrepreneurial activities, and, of course, traditional roles, such as preserving and transmitting culture and serving as a social critic. Finally, while the California Master Plan was an extraordinary success, setting simple albeit challenging and compelling goals that would guide public higher education in the state for decades, today it is likely that a “strategic process” will be more important than a “strategic plan.” Here my experience with the Bologna Process that is currently transforming higher education in Europe would be invaluable.

This report, then, should be viewed as one effort to develop not only a vision and plan to utilize the Midwest’s rather considerable higher education assets to enable its transformation into a learning and innovation society, but as well to suggest both tactics and a process required to sustain this effort for the long haul.

Acknowledgements

Although the conclusions and recommendations in this report should be viewed as the responsibility of the author, the content has benefited immensely from assistance from many others: John Austin and Britany Afolter-Caine of the Brookings Institute whose seminal work on Great Lakes economic development has stimulated many of these efforts, Richard Longworth of The Chicago Council, who encouraged the development of a Heartland Paper that stimulated this background report; Paul Courant and Edie Goldenberg, University of Michigan colleagues working on the future of public higher education; Lou Anna Simon, president of Michigan State University, who provided important feedback along with the concept of a “world grant” university; Barbara McFadden Allen of the Committee on Institutional Cooperation; Rick Detweiler and Greg Wegner of the Great Lake Colleges Association; and Mark Muro, who led the Brookings Institution effort to develop the innovation hubs proposal for the Midwest. The author would also like to acknowledge the efforts of and thank David Mickey-Pabello for his help in assembling key data characterizing the Midwest region.

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Executive Summary

Today our world has entered a period of rapid and profound economic, social, and political transformation driven by knowledge and innovation. Educated people, the knowledge they produce, and the innovation and entrepreneurial skills they possess have become the keys to economic prosperity, public health, national security, and social well being. It has become apparent that economic strength, prosperity, and social welfare in a global knowledge economy will demand a highly educated citizenry. It will also require institutions with the ability to discover new knowledge, apply these discoveries, and transfer them to the marketplace through entrepreneurial activities.

Today's economy no longer is locked within traditional geopolitical boundaries, such as states and nations. Instead, it spans larger multistate or multinational regions with common economic, demographic, and cultural characteristics. Furthermore, the centers of economic and political activities within such regions have become large metropolitan concentrations, capable of building and sustaining the learning and innovation infrastructure necessary to power the knowledge economy.

The states and cities of the American Midwest, with their common history, demographics, economy, and culture, comprise just such a region. Yet, today the American Midwest, a region that once powered the global economy, created the middle class, fed the world, and defended democracy, is floundering in a twenty-first century global economy driven by knowledge and innovation. The Midwest is struggling to make the transition from an industrial agricultural and manufacturing economy to a knowledge economy.

One of the Midwest's most valuable resources critical to this transformation is its extraordinary array of colleges and universities—local community colleges, regional universities, independent liberal arts colleges, research universities, and for-profit providers. To help the Midwest position and use these remarkable assets, this report has applied a common planning technique,

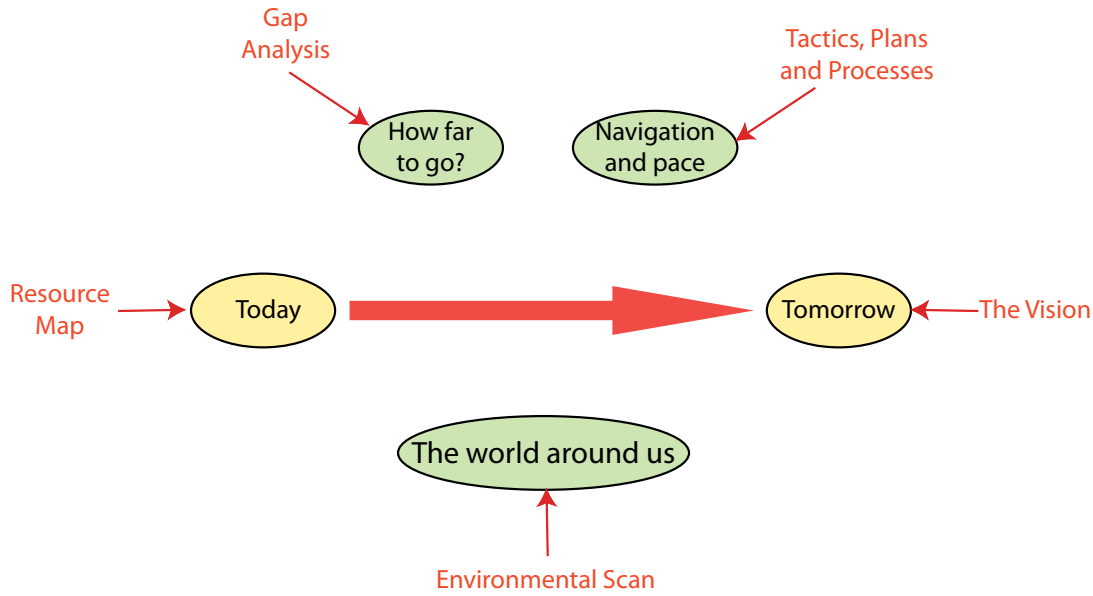
strategic roadmapping, to develop a higher education strategy for the Midwest region. Simply stated, the roadmapping process begins by asking where we are today and where we wish to be tomorrow, judges how far we have to go, and ends with a roadmap to get from here to there.

Building a twenty-first century learning and innovation infrastructure for a region clearly involves multiple players—institutions, states, and the nation more broadly. Furthermore while our focus is the role played by higher education, this cannot be detached from other elements of the education continuum including K-12, workplace training, and lifelong learning. Hence our roadmap must span the entire education spectrum and its various patrons.

The roadmap for higher education in the Midwest consists of a number of recommendations, some obvious, some seemingly radical, but all aimed at reinvigorating Midwestern education and applying it to the recovery of the Midwestern economy. These recommendations are organized into four groups corresponding to key responsibilities at the national, regional, state, and institutional levels. The urgency of each recommendation has been suggested by assigning to each a timescale of *now* (within months), *soon* (a few years), and *eventually* (a decade hence).



The Midwest and Great Lakes states



The Strategic Roadmapping Process

The Regional Roadmap

Regional to National to Global: While it is natural to confine policy to state boundaries, in reality such geopolitical boundaries are of no more relevance to public policy than they are to corporate strategies in an ever more integrated and interdependent global society. Hence the Midwest's strategies must broaden to include regional, national, and global elements. **(Now!)**

Competition to Collaboration: Midwestern states, governments, and institutions must shift from Balkanized competition to collaboration to achieve common interests, building relational rather than transactional partnerships most capable of responding to global imperatives. **(Now!)**

System and Strategic Perspectives: The Midwest needs to develop a more systemic and strategic perspective of its educational, research, and cultural institutions—both public and private, formal and informal—that views these knowledge resources as comprising a *knowledge ecology* that must be adequately supported and allowed to adapt and evolve rapidly to serve the needs of the state in a change driven world, free from micromanagement by state government or intrusion by partisan politics. **(Now!)**

Pre-College

All Students College- or Workplace-Ready: The Midwest region should set high goals that ALL students will graduate with a high school degree that signifies they are not only either college- or workplace-ready but furthermore prepared for a world that will require a lifelong commitment to learning. State governments and local communities should provide both the mandate and the resources to achieve these goals. **(Now!)**

Restructuring K-12 to Achieve World-class Performance: To achieve a quantum leap in student learning, Midwest school systems will have to restructure themselves to achieve world-class performance, including setting high standards for student and teacher performance, lengthening the school year, investing in modern learning resources, implementing rigorous methods for assessing student learning, preparing and rewarding outstanding teachers, and managing and governing school systems in an accountable fashion. **(Soon)**

Social Infrastructure: Beyond the necessary investments in K-12 education and the standards set for their quality and performance, raising the level of skills, knowledge, and achievement of the Midwest's workforce will require a strong social infrastructure of fami-



Get ready for the Millennials!

lies and local communities, particularly during times of economic stress. To this end, state and local governments must take action both to re-establish the adequacy of the Midwest's social services while engaging in a broad effort of civic education to convince the public of the importance of providing world-class educational opportunities to all of its citizens. (Soon)

Higher Education Engagement with K-12: Higher education must become significantly more engaged with K-12 education, accepting the challenge of improving the quality of our primary and secondary schools as one of its highest priorities with the corresponding commitment of faculty, staff, and financial resources. Each Midwest college and university should be challenged to develop a strategic plan for such engagement, along with measurable performance goals and should be encouraged to join in consortia to address the challenges of K-12 education. (Now!)

Linkages and Pathways: The Midwest must create clearer pathways among educational levels and institutions and removing barriers to student mobility and promoting new learning paradigms (e.g., distance education, lifelong learning, workplace programs) to accommodate a far more diverse student cohort. (Soon)

Higher Education

Demanding Zero-Defects Institutional Performance: All Midwest colleges and universities should be challenged to achieve a "zero-defects, total quality" perfor-



Embracing the diversity of the Millennial generation

mance goal in which all enrolled students are expected to graduate in the prescribed period. This will require not only adequate financial, instructional, and counseling support but as well strong incentives and disincentives at the individual and institutional level (e.g., basing public support on graduation rates rather than enrollments, demanding that faculty give highest priority to adequate staffing of required curricula, and setting tuition levels to encourage early graduation). (Soon)

Institutional Diversity: The Midwest should strive to encourage and sustain a more diverse system of higher education, since institutions with diverse missions, core competencies, and funding mechanisms are necessary to serve the diverse needs of its citizens, while creating a knowledge infrastructure more resilient to the challenges presented by unpredictable futures. Using a combination of technology and funding policies, efforts should be made to link elements of the Midwest's learning, research, and knowledge resources into a market-responsive seamless web, centered on the needs and welfare of its citizens and the prosperity and quality of life in the region rather than the ambitions of institutional and political leaders. (Soon)

Community Colleges and Regional Universities: Key will be enhanced support of the efforts of community colleges and regional universities to integrate the new knowledge developed by research universities into academic programs capable of providing lifelong learning opportunities of world-class quality while supporting their surrounding communities in the transition to



Restructuring Higher Education

knowledge economies by developing additional professional programs more suited to the needs and interests of adult students. **(Now!)**

Independent Colleges: The region should encourage affiliations among independent colleges stressing high quality undergraduate education based on the liberal arts and research universities capable of providing the vast resources for state-of-the-art education in advanced subjects such as science and engineering. **(Now!)**

For-Profit and Proprietary Providers: To meet the expanding needs of a knowledge-driven economy requiring lifelong learning opportunities, the Midwest should recognize the strategic importance of for-profit and proprietary higher education providers who not only have the capacity to access capital markets, but have developed successful paradigms for educating adult learners. Yet it is also important that the for-profit sector be held accountable for student success and employability. **(Now!)**

World Universities: As a component of the Midwest's higher education strategies, serious consideration should be given to encouraging the region's internationally prominent research universities to explore the possibility of evolving into truly world universities, capable of accessing global economic and human capital markets. Key in this effort will be a far more strategic approach to immigration, viewing the region's research universities as portals to attract talent from around the world. **(Soon)**



The emergence of "world universities"

Immigration: Immigration is vital to transforming the Midwest economy, as a source of both talent and energy and contributing to its innovation and entrepreneurship. The only immigration policy that will help the Midwest is one that opens the door as widely as possible. **(Now!)**

Expanding Educational Opportunities: The Midwest must recommit itself to the fundamental principles of equal opportunity and social inclusion through the actions of its leaders, the education of its citizens, and the modification of restrictive policies, if it is to enable an increasingly diverse population to compete for prosperity and security in a intensely competitive, diverse, and knowledge-driven global economy. **(Now!)**

Restructuring the Higher Education Enterprise: Serious consideration should be given to reconfiguring the Midwest's educational enterprise by exploring new paradigms based on the best practices of other regions and nations. For example, the current segmentation of learning by age (e.g., primary, secondary, collegiate, graduate-professional, workplace) is increasingly irrelevant in a competitive world that requires lifelong learning to keep pace with the exponential growth in new knowledge. More experimentation both in terms of academic programs and institutional types should be encouraged. Academic institutions should be provided with greater agility—albeit accompanied by greater accountability—to adapt and evolve to address new challenges and opportunities. **(Eventually)**

Adopting Best Practices from Abroad: Beyond strengthening and focusing the existing education infrastructure of the region—its schools, colleges, and universities—it is clear that a changing world will demand these be augmented by new institutions addressing emerging needs. Here the experience and practice of other nations should be considered as possibilities for the Midwest, e.g., European models such as the Gymnasias and Sixth-form colleges used for advanced college preparation; the Fachhochschulen and polytechnic institutes stressing rigorous education in the applied sciences; and the open universities used to provide broad educational opportunities for adults.

New Funding Paradigms: Alternative mechanisms for funding higher education should be explored, such as adopting a “reverse social-security” approach in which students pay for their education from future earnings, institutions align the funding of their multiple missions with key patrons, and “learn grants” from public or private sources that provide strong incentives for early learning by providing all students entering K-12 with college investment accounts. (Soon)

Innovation

Increased Investment in Innovation: The Midwest must invest additional public and private resources in initiatives designed to stimulate R&D, innovation, and entrepreneurial activities. Key elements would include reforming state tax policy to encourage new, high-tech business development, securing sufficient venture capital, state participation in cost-sharing for federal research projects, and a far more aggressive and effective effort by the Midwest state’s Congressional delegations to attract major federal research funding to the region. (Now!)

Importance of Science and Engineering Education: The increasing dependence of the knowledge economy on science and technology, coupled with the Midwest’s relatively low ranking in percentage of graduates with science and engineering degrees, motivates a strong recommendation to place a much higher priority on providing targeted funding for program and facilities support in these areas in state universities. (Now!)



The importance of science and engineering education

Innovation Infrastructure: Providing the educational opportunities and new knowledge necessary to compete in a global, knowledge-driven economy requires an advanced infrastructure: educational and research institutions, physical infrastructure such as laboratories and cyberinfrastructure such as broadband networks, and supportive policies in areas such as tax and intellectual property. The Midwest must invest heavily to transform the current infrastructure designed for a 20th-century industrial economy into that required for a 21st-century knowledge economy. (Soon)

Research Universities and Innovation: The quality and capacity of the Midwest’s learning and innovation infrastructure will be determined by the leadership of its research universities in discovering new knowledge, developing innovative applications of these discoveries that can be transferred to society, and educating those capable of working at the frontiers of knowledge and the professions. Because of the importance of research and graduate education to the region’s future, these universities should be encouraged to strike an appropriate balance between these activities, while undergraduate education remains the primary mission of the Midwest’s other colleges and universities. (Now!)

Engagement in Economic Development: The research universities of the Midwest must become more strategically engaged in both regional and statewide economic development activities. Intellectual property policies should be simplified and standardized; faculty and staff



Enhanced college participation and degree attainment

should be encouraged to participate in the startup and spinoff of high-tech business; and universities should be willing to invest some of their own assets (e.g., endowment funds) in state- and region-based venture capital activities. Furthermore, universities and state governments should work more closely together to go after major high-tech opportunities in both the private and federal sectors (attracting new knowledge-based companies and federally funded R&D centers). (Soon)

A Roadmap for the Midwestern States

Enhanced College Participation: The Midwest states must commit to increasing very substantially the participation of its citizens in higher education at all levels—community college, baccalaureate, and graduate and professional degree programs. This will require a substantial increase in the funding of higher education from both public and private sources as well as significant changes in public policy. This, in turn, will require a major effort to build adequate public awareness of the importance of higher education to the future of the state and its citizens. (Now!)

Higher Education Funding in the Top Quartile: To achieve and sustain the quality of and access to educational opportunities, the Midwest states should each set an objective to move into the top quartile in their higher education appropriations (on a per student basis). (Soon)



Preparing for Generation Z

Market-Smart Strategies: As powerful market forces increasingly dominate public policy, the Midwest's higher-education strategy should become market-smart, investing more public resources directly in the marketplace through programs such as vouchers, need-based financial aid, and competitive research grants, while enabling public colleges and universities to compete in this market through encouraging greater flexibility and differentiation in pricing, programs, and quality aspirations. (Soon)

Leveraging Federal and Private-Sector Investment: The Midwest should target its tax dollars more strategically to leverage both federal and private-sector investment in education and R&D. For example, a shift toward higher tuition/need-based financial aid policies in public universities not only leverages greater federal financial aid but also avoids unnecessary subsidy of high-income students. Furthermore greater state investment in university research capacity would leverage greater federal and industrial support of campus-based R&D. (Now!)

Changing State Higher Education Policies: Key to achieving the agility necessary to respond to market forces will be modernizing the policies that define the relationship between state governments and the Midwest's public colleges and universities to provide them with enhanced market agility in return for greater (and more visible) public accountability with respect to quantifiable deliverables such as graduation rates, student socioeconomic diversity, and intellectual property

generated through research and transferred into the marketplace. (Now!)

A Roadmap for Colleges and Universities

World-Class Learning: Colleges and universities should aspire to achieve world-class quality, nimbleness, innovation, efficiency, and the capability of providing our citizens with the higher order intellectual skills (critical thinking, moral reasoning, an appreciation of cultural and human values, commitment to lifelong learning, adaptive to change, tolerance of diversity) necessary for achieving national prosperity, security, and social well-being in a global, knowledge-driven society. (Now!)

Preparation for Unknown Futures: While colleges and universities should be responsive to the interests of students, their employers, and the nation, it is essential that they should also strive to prepare their graduates for the unknown challenges of careers and citizenship of tomorrow by providing the higher order intellectual skills necessary to cope with a future of continual yet unpredictable change (e.g., critical thinking ability, a commitment to lifelong learning, the ability to adapt to change, and the capacity to thrive in a world of increasing diversity). (Now!)

Focused Missions, Cost Containment, and Efficiency: Colleges and universities should develop the ability (through the necessary changes in governance, leadership, management, and culture) to control costs, focus resources on well-defined missions, and achieve new levels of efficiency while enhancing quality and capacity. (Now!)

Assessment of Educational Objectives: It is time to challenge the academy to redefine the purpose and nature of a college education in today's (and tomorrow's) world and develop methods to assess whether these objectives are being achieved. This will require the development of more sophisticated tools to assess the achievement of the more abstract goals of a college education (e.g., critical thinking, communication skills, inductive/deductive reasoning, quantitative skills, cultural appreciation, systems thinking). (Now!)



Preparing for unknown futures

Alliances: Colleges and universities should place far greater emphasis on building alliances that will allow them to focus on unique core competencies while joining with other institutions in both the public and private sector to address the broad and diverse needs of society in the face of today's social, economic, and technological challenges while addressing the broad and diverse needs of society. For example, research universities should work closely with regional universities and independent colleges to provide access to cutting-edge knowledge resources and programs. (Soon)

New Financial and Governance Models: Public colleges and universities need to develop new financial and governance strategies better able to adapt to declining state support and 21st century imperatives. (Eventually)

A Higher Education Roadmap for the Nation

Quality: The United States must demand and be prepared to support a world-class higher education system, utilizing market forces shaped by incentives, public-private partnerships, and requirements for evidence-based assessment of educational effectiveness to drive all elements of postsecondary toward higher quality, efficiency, innovation, and nimbleness. (Now!)

Access: Access to higher education should receive the highest priority for public funding, whether through

financial aid, state appropriations to colleges and universities, or tax policy (e.g., “tax expenditures”). Public funds should be targeted to those students with greatest need. **(Now!)**

Innovation: To support American innovation, the nation’s colleges and universities must embrace innovation themselves, by developing new learning pedagogies, academic paradigms, and educational forms that are more responsive to national priorities. This will require a very substantial increase in the support of research and development associated with learning and education by the federal government and higher education institutions. **(Soon)**

Research and Graduate Education: The erosion of state and private sector support of higher education in recent years makes it apparent that it is time for the federal government should assume the lead responsibility for sustaining the capacity of America’s research universities to conduct world-class research and graduate education. **(Soon)**

Coordination: Coordination among the various components of the nation’s educational enterprise, including K-12, higher education, workplace training, and lifelong learning—should be strongly encouraged and supported at all levels—national, regional, state, and institutional. **(Now!)**

Public Purpose: Higher education must take decisive action to address current concerns about quality, efficiency, capacity, and accountability if it is to earn the necessary level of public trust and confidence to enable it to pursue its public purpose. **(Now!)**

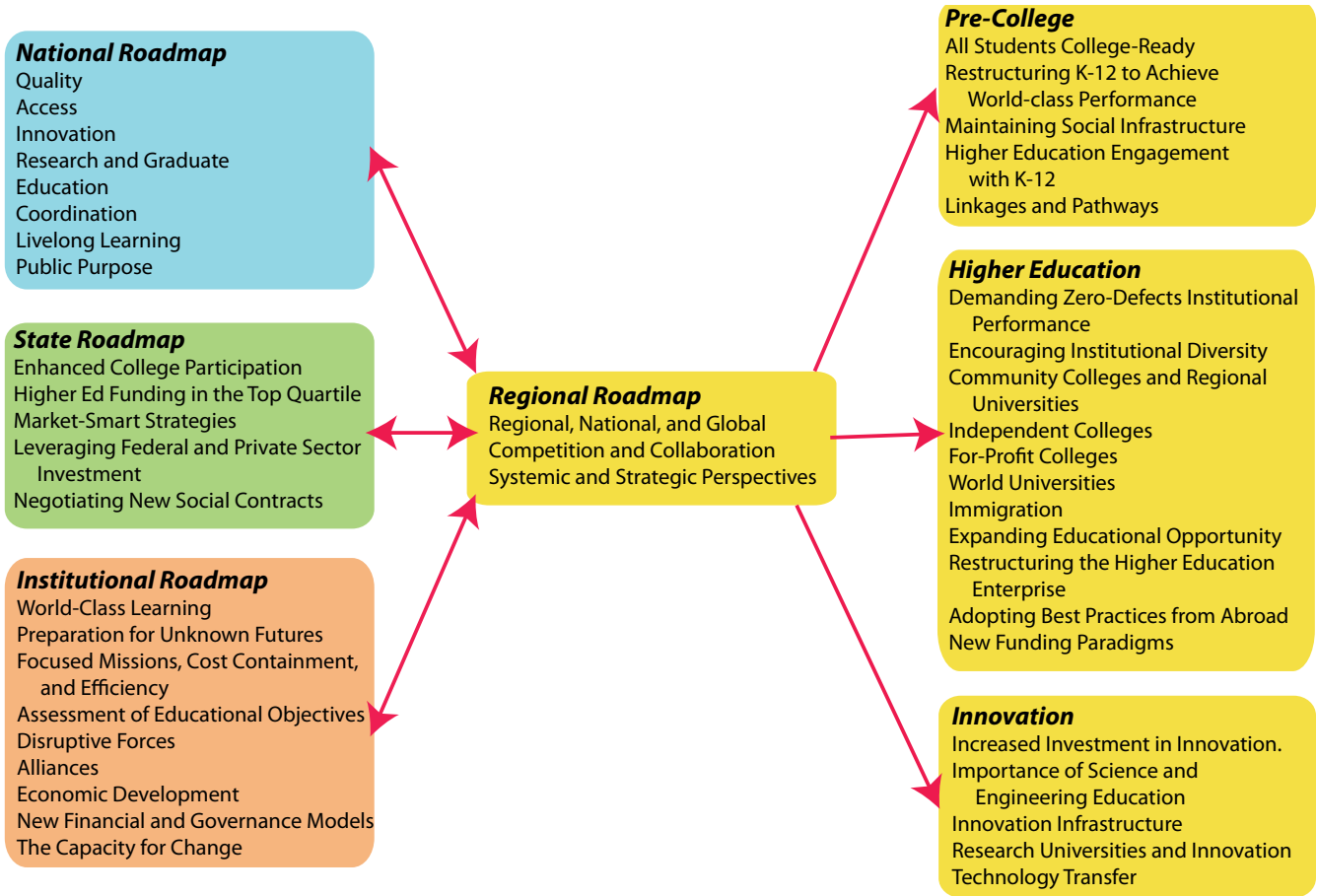
Of course, a roadmap is just that, a set of possible directions to the future. Setting a direction is far from arriving at one’s destination. Achieving the vision of a learning and innovation-driven economy will require a sustained commitment at all levels, e.g., government, business, labor, education, foundations, citizens, and media.

What is really at stake today is building the Midwest’s regional advantage, allowing it to compete for prosperity and quality of life in an increasingly compet-



A challenge to the nation

itive global economy. But today regional advantage is not achieved through politically popular devices, such as tax cuts for the wealthy, public subsidy of dying industries, or attempts to raid business from neighboring states. Instead it is achieved by creating a highly educated and skilled workforce. It requires public investment in the ingredients of innovation—educated people, new knowledge, and the infrastructure to support advanced learning and research. Put another way, it requires firm public purpose, visionary policies, and adequate investment to create a learning and innovation driven society.



The Layers of Strategic Roadmaps for the Midwest Region

Chapter 1

Introduction

*“It is not the strongest of the species that survive,
nor the most intelligent, but rather the ones
most responsive to change.” – Charles Darwin*

Our world has entered a period of rapid and profound economic, social, and political transformation driven by knowledge and innovation. Educated people, the knowledge they produce, and the innovation and entrepreneurial skills they possess have become the keys to economic prosperity, public health, national security, and social well-being. It has become increasingly apparent that economic strength, prosperity, and social welfare in a global knowledge economy will demand a highly educated citizenry. 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.

This world of an economy driven by education, knowledge, and innovation may be relatively new. But the Midwest already is behind. The purpose of this paper is to seek ways to close that gap and restore the Midwest to the status it enjoyed throughout the Industrial Era, as one of the economic engines of the world. To provide our citizens with the knowledge and skills to compete on the global level, we must broaden access to world-class educational opportunities at all levels: K-12, higher education, workplace training, and lifelong learning. We must also build and sustain world-class universities capable of conducting cutting-edge research and innovation and producing outstanding scientists, engineers, physicians, teachers, and other knowledge professionals essential to creating the new jobs of the twenty-first century. We must build the advanced learning and innovation infrastructure necessary to sustain economic leadership in the century ahead.

Yet the traditional institutions responsible for education and innovation—schools, colleges, universities, research institutes, business, and industry—are being

challenged by the powerful forces characterizing the global economy: hypercompetitive global markets, demographic change, increasing ethnic and cultural diversity, and disruptive technologies, such as information technology. Hence new strategies and investments are necessary to build the learning and innovation enterprises necessary for prosperity in a global economy. From California to North Carolina, Helsinki to Bangalore, other states, regions, and nations are shifting their public policies and investments to support the new imperatives of a knowledge economy: knowledge creation (e.g., R&D, innovation, and entrepreneurial activities), human capital (e.g., lifelong learning and advanced education, particularly in science and engineering), and infrastructure (e.g., colleges and universities, research laboratories, and broadband networks).

There is a second important theme that characterizes the emerging knowledge economy: the increasing connectivity enabled by modern communications and transportation technologies is rapidly shifting the locus of economic and political power away from conventional geopolitical areas. As Thomas Friedman puts it, “The world is flat! Globalization has collapsed time and distance and raised the notion that someone anywhere on earth can do your job, more cheaply. Can we rise to the challenge on this leveled playing field?” (Friedman, 2005)

Overburdened with legacy economic and political burdens, state governments are less and less influential in determining prosperity in the new economy. In today’s economy, any region in the world can be a locus for knowledge work. In a wired, interdependent global economy that allows people to choose where to live and work and where to make goods and services, regions are now challenged to identify and nurture their unique economic advantages. Today’s economic activi-

ties are no longer constrained by traditional geopolitical boundaries, such as states and nations. Instead, they span larger multistate or multinational regions with common economic, demographic, and cultural characteristics. Furthermore, the centers of economic and political activities within such regions have become large metropolitan concentrations, capable of building and sustaining the learning and innovation infrastructure necessary to power the knowledge economy.

The states and cities of the American Midwest, with their common history, demographics, economy, and culture, comprise just such a region. The farms and factories built by pioneers and immigrants transformed the Midwest. The region's innovative and entrepreneurial spirit in key industries, such as agriculture, manufacturing, and transformation made the Midwest the geopolitical, cultural, and economic heartland of twentieth century America.

But, more precisely, just what is the Midwest? It might be defined as those states in the midsection of the nation: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, and Missouri. More broadly, one could add portions of other states that also rim the Great Lakes and line the Ohio watershed, notably western Pennsylvania and New York, West Virginia, and northern Kentucky, comprising the "Great Lakes-Midwest" region. Or we could add the Great Plains states of North and South Dakota, Nebraska, and Kansas. In fact, one might even cross national boundaries to add the Canadian Great Lakes provinces of Ontario and Quebec, creating an international region with remarkably common histories, geographies, economies, and cultures.

Although we will focus most of our attention on the more narrowly defined eight-state Midwest region, our analysis and discussion will at times adopt a broader definition of the "Greater Midwest" that broadens to include additional states from the Great Lakes and Great Plains regions.

Some Symptoms of Our Plight

Today the American Midwest, the region that once powered the global economy, created the middle class, fed the world, and defended democracy, is floundering in a twenty-first century global economy driven by



One definition of the Midwest...

knowledge and innovation. The region is having great difficulty in making the transition from an industrial agricultural and manufacturing economy to a knowledge economy. A recent Brookings Institution study summarizes the state of the region as follows:

Still heavily reliant on mature industries and products, its aging workforce lacks the education and skills needed to fill and create jobs in the new economy. Its entrepreneurial spirit is lagging, hampering its ability to spur new firms and jobs in high-wage industries. Its metropolitan areas are economically stagnant, old and beat up, and plagued with severe racial divisions. Its landscape is dotted with emptying manufacturing towns, isolated farm, mining, and timber communities. It continues to bleed young, mobile, educated workers seeking opportunities elsewhere. Its legacy of employee benefits, job, and income security programs—many of which the region helped pioneer—has become an unsustainable burden, putting its firms at a severe competitive disadvantage in the global economy. And most important, the culture of innovation that made it an economic leader in the 20th century has long since vanished. (Austin, 2008)

The Midwest has many assets—the immense fresh water resources of the Great Lakes watershed, the region's limited vulnerability to natural disasters, such as earthquakes and hurricanes, its forests and fertile fields. Other characteristics have more questionable

value. Its highways and factories, communications and urban infrastructure, and even its public priorities, evolved to serve a factory-based economy, not a knowledge economy, and today represent more of a liability than an asset.

Yet it is with the most important assets driving the global economy where the Midwest region has the greatest challenge. Our world today has entered an era in which educated people, the knowledge they produce, and the innovation and entrepreneurial skills they possess have become the keys to economic prosperity, public health, national security, and social well-being. Unfortunately, many of the workforce skills of the Midwest region are no longer at world-class levels, both because of aging and declining populations and because of the relatively low priority given to education by an agricultural and factory-based economy. Furthermore, the region has lost much of the zeal for risk-taking and innovation that led to its remarkable economic leadership in agriculture and industry in earlier times.

For years now the Midwest has seen its low-skill, high-pay factory jobs outsourced and replaced by low-skill, low-pay service jobs—or in too many cases, no jobs at all (Glazer, 2010). Other states, regions and nations, from Europe to Asia, invest heavily in high-skill, high-wage jobs in areas, such as information services, financial services, trade, and professional and technical services. Yet in much of the Midwest—among its political leaders, its media and opinion makers, and its people—there is a deafening silence about the implications of a global, knowledge-driven global economy for the region’s future. There is little evidence of effective

policies, new investments, or visionary leadership capable of reversing the downward spiral of our industrial economies (Power, 2009).

Leaders in both the public and private sectors continue to cling tenaciously to past beliefs and practices, preoccupied with obsolete and largely irrelevant issues (e.g., the culture wars, entitlements, tax cuts or abatements for dying industries, and gimmicks, such as casinos and cool cities) rather than developing strategies, taking actions, and making the necessary investments to achieve economic prosperity and social well-being in the new global economic order. Assuming that what worked before will work again, the Midwest today is sailing blindly into a profoundly different future.

Perhaps nowhere is this inability to read the writing on the wall more apparent than in the Midwest region’s approach to education. Our strategies and policies aimed at providing our citizens with the education and skills, the innovative and entrepreneurial spirit, so necessary today for personal well-being and economic prosperity, have been woefully inadequate, all too often political in character, and largely reflecting a state of denial about the imperatives of the emerging global economy.

It may seem surprising that a region, which a century and a half ago led the nation in its commitment to building great public education systems aimed at serving all of its citizens, would be failing today in its human resource development. Indeed the guiding principle of the Northwest Ordinance of 1787 that shaped the new Midwest states preparing to enter the Union stated firmly that: “Religion, morality, and knowledge



The farm towns are disappearing...



And our cities are decaying.

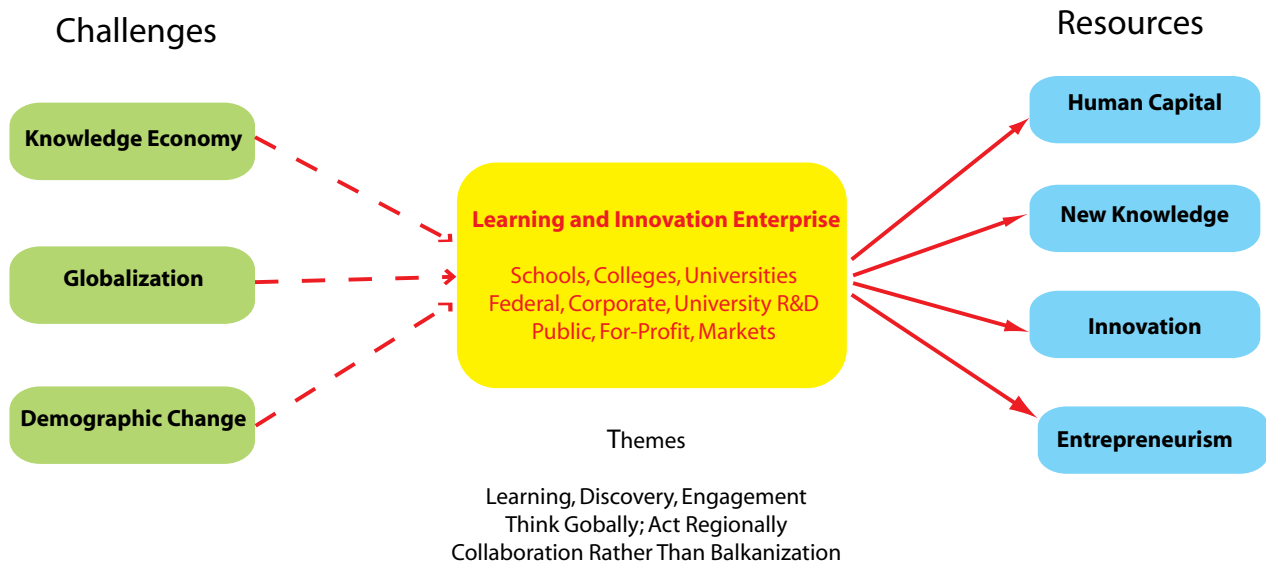
being necessary to good government and the happiness of mankind, schools and the means of education shall forever be encouraged” (Thorpe, 1909). During the early half of the nineteenth century, the religious revival movement known as the Great Awakening stimulated the efforts of religious denominations to establish hundreds of small religious colleges across the Midwestern United States that today have become some of the nation’s finest independent colleges. The Morrill Act of 1863 put federal lands at the disposal of states to build the land-grant universities that would extend educational opportunity to the working class in the nineteenth and twentieth centuries and today comprise the world’s greatest concentration of comprehensive research universities. In the late nineteenth century, the public secondary schools first appeared in the Midwest both to provide the further education needed by an increasingly industrial society and to prepare students for further study at the university level, thereby defining and implementing the principle of universal educational opportunity for the nation.

The strength of the Midwest—its capacity to build and sustain such extraordinary institutions—arose from its ability to look to the future and its willingness to take the actions and make the investments that would yield prosperity and well-being for future generations. Yet, today this spirit of public investment for the future has disappeared. Decades of failed public

policies and inadequate investment now threaten the extraordinary educational resources built through the vision and sacrifices of past generations.

Beyond educational opportunities, there is another key to economic prosperity in today’s global economy: technological innovation. As the source of new products and services, innovation is directly responsible for the most dynamic areas of the U.S. economy and is estimated to have provided roughly 50 percent of America’s economic growth since World War II (Augustine, 2005). It has become even more critical to our prosperity and security in today’s hypercompetitive, global, knowledge-driven economy. But history shows that significant public investment is necessary to produce the essential ingredients for innovation to flourish: new knowledge (e.g., research), human capital (e.g., education), infrastructure (e.g., facilities, laboratories, communications, and networks), and policies (e.g., tax and intellectual property).

Again, the irony of the region’s plight today is that the Midwest led the world in technological innovation throughout much of the 20th century (Longworth, 2008). The automobile industry concentrated in Michigan because of the skills of our craftsmen, engineers, technologists, and technicians and the management and financial skills of corporate leadership as the industry grew to global proportions. Modern agriculture and the commodity markets were defined in both the



A framework for a Midwest renaissance

farming communities of the Midwest and great trading and manufacturing centers such as Chicago. While the workforce skills required by factory manufacturing required only minimal formal education, technological excellence and skillful management enabled Midwestern corporations to achieve global impact. Basic research was also key, funded both by industry in world-class laboratories such as the Bell Laboratories, the Ford Scientific Laboratory, and the General Motors Research Laboratory, by national laboratories in areas such as nuclear research and high energy physics (e.g., Argonne National Laboratory and Fermi National Laboratory), and by the emergence of one of the most formidable concentrations of outstanding research universities in the world.

Yet by the late twentieth century, the Midwestern economic picture had changed. Short-term planning cramped innovation. Restructuring led to the loss of hundreds of thousands of manufacturing jobs. The Midwest's Washington influence was used more to promote farm subsidies and to block federal regulation in areas, such as automobile emissions standards and fuel economy than to attract additional federal R&D dollars to the region. And state governments shifted public funding away from the support of higher education and research and instead to the priorities of aging populations, such as safety from crime (e.g., prison construction), social services (e.g., health care), and tax relief. As a consequence, at a time when other states and nations were investing heavily in stimulating the technological innovation to secure future economic prosperity, much of the Midwest was missing in action, significantly under-investing in the seeds of innovation.

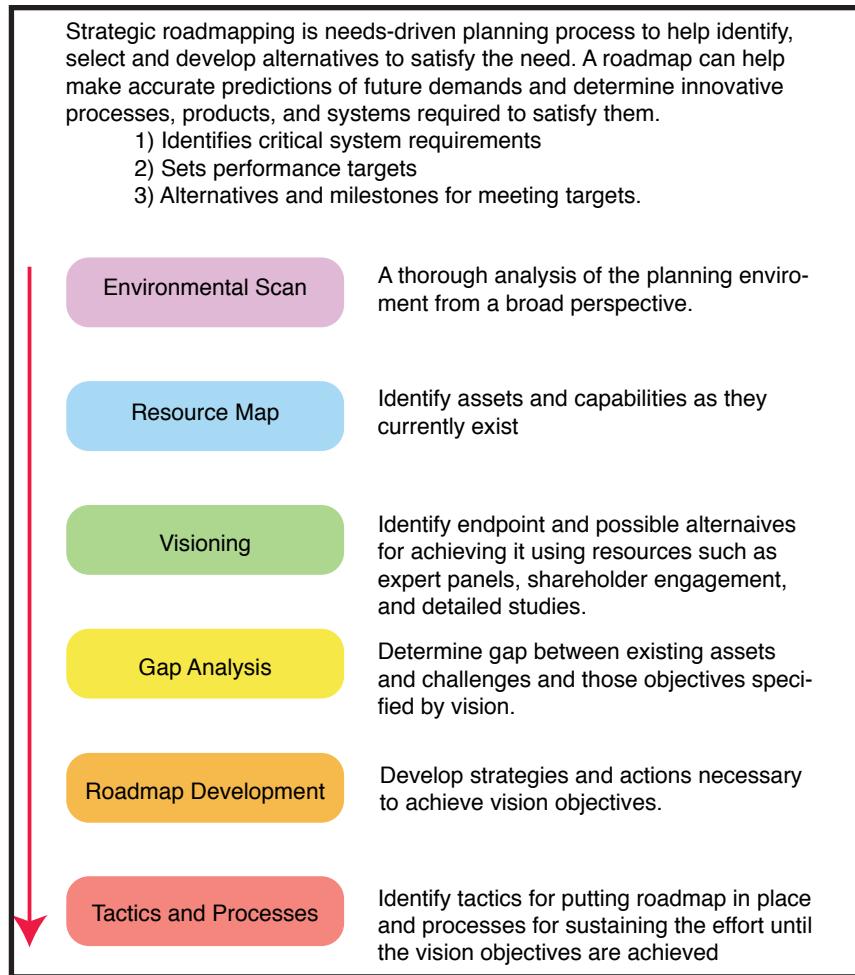
Strategic Roadmapping

So, what to do? That is the goal of this study: to develop a plan for building a learning and knowledge infrastructure for the Midwest region. The plan needs to address the life-long educational needs of its citizens and the workforce skills necessary to compete and flourish in a global, knowledge-intensive economy. In addition, it needs to address how to build the sources of new knowledge, innovation, and entrepreneurial spirit necessary to create world-class companies and a world-class living environment.

Since advanced education and research provide the key human and knowledge resources critical to prosperity in the global economy, colleges and universities will play a central role in this effort. Yet, this study differs from earlier education planning efforts, such as the "master plan" for higher education developed by California in the early 1960s. Today any such effort must consider the educational needs of the region from a broader perspective embracing pre-college, lifelong learning, and workplace-training activities—that is, education from "cradle to grave." The role of higher education in generating knowledge, enabling innovation, and stimulating entrepreneurial activities must similarly be examined not only from the perspective of both private enterprise and public policy but also within a context that extends beyond the region to encompass national and global concerns.

There are many approaches to such a study. Most common are strategic planning exercises, which progress through the usual sequence of proposing a mission and vision, then assessing available assets and challenges through an environmental assessment, stating goals, proposing strategic actions and a process of tactical implementation, and finally performing assessment and evaluation. In this study we have adopted a common technique used in industry and the federal government: *strategic roadmapping* (Garcia, 1997). In roadmapping exercises, one uses expert panels to assess needs, then constructs a map of existing resources, performs an analysis to determine the gap between what currently exists and what is needed, and finally develops a plan or roadmap of possible routes from here to there, from now to the future. Although sometimes confused with jargon such as environmental scans, resource maps, and gap analysis, in reality the roadmapping process is quite simple. It begins by asking where we are today and where we wish to be tomorrow, then assesses how far we have to go, and concludes by developing a roadmap to get from here to there. The roadmap itself usually consists of a series of recommendations, sometimes divided into those that can be accomplished in the near term and those that will require a sustained effort.

To provide context, we begin Chapter 2 with an environmental scan of the imperatives of the global knowledge economy, where robust telecommunications connectivity has empowered billions of new



The strategic roadmapping process

knowledge workers to compete for jobs and prosperity, regardless of location or nationality, provided they have developed the skills and infrastructure.

In Chapter 3 we turn to a discussion of the Midwest today. We review both its knowledge assets and liabilities and assess why the region is having great difficulty in making the transition from a farming and manufacturing to a knowledge economy. In recent years Midwest states have led the nation in unemployment; the out-migration of young people in search of better jobs is severe; our educational systems are underachieving with one-quarter of the adults in the Midwest without a high school diploma and only one-third of high-school graduates college-ready. While the Midwest still has, at least for the moment, high quality systems of colleges and universities, including many of the nation's leading research universities, the erosion of public support over the past two decades and most seriously over the

past several years has not only driven up tuition but put the quality and capacity of our public universities at great risk. Primary and secondary education is of equal concern, not so much because of funding, but rather because of poor achievement, particularly in the preparation of students for higher education.

In Chapter 4 we suggest a vision for the Midwest tomorrow as a region well-positioned for economy prosperity and leadership in the 21st Century global economy; a workforce characterized by world-class skills, innovation, and entrepreneurial zeal; and a knowledge infrastructure capable of generating new knowledge and economic opportunities through a strategic utilization of the very technology that is reshaping our world. Put another way, we suggest those skills, educational opportunities, and research and innovation assets needed by the region.

In Chapter 5, by comparing this vision with the cur-

rent reality, we can determine how far the Midwest must travel to reach a prosperous future. We can also identify the resource gap that exists between what we have now and what we will need for the future, between the obsolete institutions, policies and programs of today and the globally competitive resources the Midwest must build for tomorrow. (Note here that Chapters 4 and 5 might also be interpreted, respectively, as the “strengths and opportunities” and “weaknesses and threats” analysis of the popular SWOT approach used in corporate planning exercises.)

In Chapter 6 we conclude with the development of the Midwest Roadmap itself, a set of goals and strategies designed to move the Midwest region toward this future. Since building a 21st century learning and innovation infrastructure for a region will clearly involve multiple players—institutions, states, and the nation more broadly—this roadmap is developed in a layered fashion, setting out the goals and strategies for each of the key players and patrons.

In Chapter 7 we turn to the tactics, plans, and processes necessary to achieve the objectives set by the roadmap studies. Here we adopt both the approach of pulling the various roadmaps (national, regional, state, and institutional) into a “master plan” (similar to that taken by the California Master Plan) and suggest a process of continued engagement, action, and refinement to build and sustain momentum (similar to the Bologna Process designed to integrate higher-education strategies for the European Union).

Finally, in Chapter 8 we take a longer-term perspective by considering bolder visions that exploit truly over-the-horizon opportunities and visions. To this end, we conclude this roadmapping exercise with a series of bolder proposals that would act as game changers to challenge and change the entire learning and innovation infrastructure of the Midwest region. Included in this consideration are new types of institutions and practices that depart quite radically from the status quo to create a culture of learning and innovation in the heartland of America.

A Call for Leadership

In his recent book, *Caught in the Middle*, Richard Longworth portrays the challenge of regional econom-

ic development in a compelling way: “As the Midwest moves toward the future, leaving the past behind, the social disruption is going to be enormous. Hard decisions must be made. State governments, unsupported, cannot make them. Someone else must lead. But lead where. Globalization changes everything in economics and in life. Nothing remains the same. No real future exists except the future that the Midwest creates for itself. New England and the South have already learned this. So have many regions inside the European Union. This future must be crafted regionally, by the Midwest acting as a single unit, not as a *mélange* of hostile states but as one region that shares not only a past but a future.” (Longworth, 2008)

To be sure, it is difficult to address issues such as building world-class schools and colleges, developing a tax policy for a 21st century economy, or making the necessary investments for future generations when the body politic and its political leaders seem determined to cling tenaciously to past beliefs and practices. Yet the realities of a flat world will no longer tolerate procrastination or benign neglect. For this effort to have value, we believe it essential to explore openly and honestly where the Midwest is today, where it must head for tomorrow, and what actions will be necessary to get there.

This report is aimed at several audiences. Certainly it is intended for leaders in the public sector (governors, legislatures, mayors, and other public officials), the business community (CEOs, labor leaders), higher-education leaders, and the nonprofit foundation sector. However, the report is also written for interested and concerned citizens who have become frustrated with the myopia that characterizes our public, private, and education sectors.

The Midwest region faces a crossroads, as a global knowledge economy demands a new level of knowledge, skills, and abilities on the part of our citizens. The goal is to transform what was once the farming and manufacturing center of the world economy into what could become its knowledge center. Put another way, while the Midwest region once provided the muscle for the manufacturing economy that powered the 20th century, now it must make the commitment and the investments necessary to become the brains of the 21st century knowledge economy.

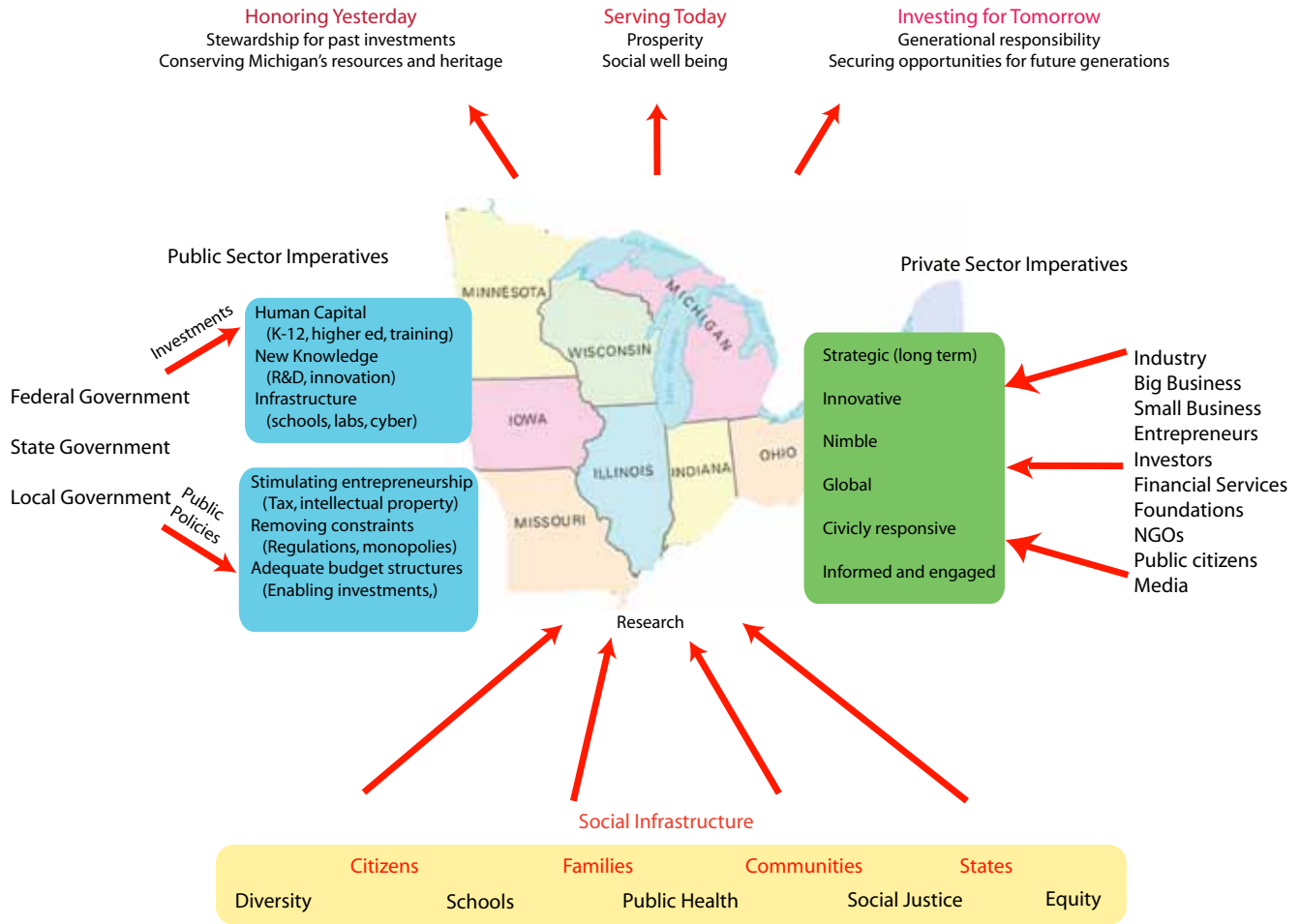
While there are many components to transforming

the American Midwest into a learning- and innovation-driven economy—tax policy, providing adequate social services, government restructuring, and, of course, political transformation—this report focuses particular attention on the role played by colleges and universities. In earlier critical moments in our nation’s history, public initiatives gave high priority to expanding educational opportunities as a route to prosperity, security, and social well being. The states took action to ensure universal access to secondary education. The Land Grant Acts in the 19th century extended college education to the working class. The G. I. Bill provided the returning veterans of World War II with college educations while the Truman Commission proposed extending college opportunities to all Americans. The partnership developed between the federal government and faculty researchers on the campuses created the American research university as a source of much of the basic research and innovation that powered the global economy in the post WWII years.

A half-century ago, during a period of similar demographic and economic challenge and opportunity, the state of California responded with a master plan that not only broadened the opportunity for a college education to all Californians but also created the finest university in the world, the University of California. As one of the architects of that plan, UC President Clark Kerr, emphasized: “The future of California no longer depends upon the gold in the hills, or the fertility of the valleys, or the climate in Southern California producing Hollywood as a place that can operate all year round and provide a favorable place for artists, for actors and actresses to live. We can no longer count on the physical resources of the state. From here on out, our future depends upon how well we develop our human resources, how well we develop our research and development efforts, how well we develop the skills of our labor force as currently in electronics and biotechnology. So let me conclude with these final words. As goes education, so goes California.” (Kerr, 2001)

Today the challenges and opportunities confronting the American Midwest demand a similarly profound vision and commitment. To paraphrase President Kerr: The future of the Midwest region no longer depends on our factories and farms or a labor force possessing physical strength and determination, but limited skills

and education. Nor will our region’s remarkable natural resources, our forests and fertile fields, our rivers and inland seas, determine our future. From here on out, our future depends on how well we develop our human resources and how we create and apply new knowledge through innovation and entrepreneurial zeal. So let us conclude with final words: *As goes higher education, so goes the Midwest!*



A roadmap to the future of the American Midwest

Chapter 2

Setting the Context: An Environmental Scan

The trouble with our times is that the future is not what it used to be.

– Paul Valery

Looking back over history, one can identify certain abrupt changes, discontinuities in the nature, the fabric, of our civilization. Clearly we live in just such a time of very rapid and profound social transformation, a transition from a century in which the dominant human activity was transportation to one in which communication technology has become paramount, from economies based upon cars, planes, and trains to one dependent upon computers and networks. We are shifting from an emphasis on creating and transporting physical objects such as materials, commodities, and energy to knowledge itself; from atoms to bits; from societies based upon the geopolitics of the nation-state to those based on diverse cultures and local traditions; and from a dependence on government policy to an increasing confidence in the marketplace to establish public priorities.

Each of these profound transformations in our world not only challenges the status quo but raises the requirements for skills, knowledge, and innovation in determining economic prosperity, security, and social well being. The coin of the realm in the brave new world of the 21st century has become *education*. Put another way, to prosper societies must accept the responsibility to provide all of their citizens with the educational and training opportunities they need, throughout their lives, whenever, wherever, and however they need it, at high quality and at affordable prices.

In this chapter we will review the major forces driving change in our world today and analyze their implications for education.

The Knowledge Economy

Today the most highly developed and prosperous economies are shifting rapidly from the production of material- and labor-intensive products and processes

to knowledge-intensive products and services. A radically new system for creating wealth has evolved that depends upon the creation and application of new knowledge and hence upon educated people and their ideas and institutions such as research universities, corporate R&D laboratories, and national research agencies where advanced education, research, innovation, and entrepreneurial energy are found (Drucker, 1999, Glazer, 2010).

Unlike natural resources, such as iron and oil, which have driven earlier economic transformations, knowledge is inexhaustible. The more it is used, the more it multiplies and expands. But knowledge can be created, absorbed, and applied only by the educated mind. The knowledge economy is demanding new types of learners and creators and new forms of learning and education. As a survey in *The Economist* put it, “The value of ‘intangible’ assets—everything from skilled workers to patents to know-how—has ballooned from 20 percent of the value of companies in the S&P 500 to 70 percent today. The proportion of American workers doing jobs that call for complex skills has grown three times as fast as employment in general” (*The Economist*, 2006).

Nations are investing heavily and restructuring their economies to create high-skill, high-pay jobs in knowledge-intensive areas such as new technologies, financial services, trade, and professional and technical services. From Paris to San Diego, Bangalore to Shanghai, there is a growing recognition throughout the world that economic prosperity and social well being in a global knowledge-driven economy require public investment in knowledge resources. That is, regions must create and sustain a highly educated and innovative workforce and the capacity to generate and apply new knowledge, supported through policies and investments in developing human capital, technological innovation, and entrepreneurial skill. Nations both

large and small, from China to Finland, are reaping the benefits of such investments aimed at stimulating and exploiting technological innovation, creating serious competitive challenges to American industry and business both in the conventional marketplace (e.g., automobiles) and through new paradigms such as the off-shoring of knowledge-intensive services (e.g. Bangalore).

In the knowledge economy, the key asset driving corporate value is no longer physical capital or unskilled labor. Instead it is intellectual and human capital. An increasingly utilitarian view of higher education is reflected in public policy. The National Governors Association concludes that "The driving force behind the 21st Century economy is knowledge, and developing human capital is the best way to ensure prosperity." Some governors are even taking the courageous step of proposing tax increases to fund new investments in higher education, research, and innovation (NGA, 2007).

Globalization

Whether through travel and communication, through the arts and culture; or through the internationalization of commerce, capital, and labor; or through common environmental concerns, the United States is becoming increasingly linked with the global community. The liberalization of trade and investment policies, along with the revolution in information and communications technologies, has vastly increased the flow of capital, goods, and services, dramatically changing the world and our place in it. Today globalization determines not only regional prosperity but also national and homeland security. A truly domestic economy has ceased to exist. It is no longer relevant to speak of the health of regional economies or the competitiveness of American industry, because we are no longer self-sufficient or self-sustaining. Markets unleashed by lowering trade barriers are by the instantaneous flows of knowledge, capital, and work. Such markets are creating global enterprises based upon business paradigms such as out-sourcing and off-shoring, a shift from public to private equity investment, and declining identification with or loyalty to national or regional interests. Our economy and many of our companies are inter-

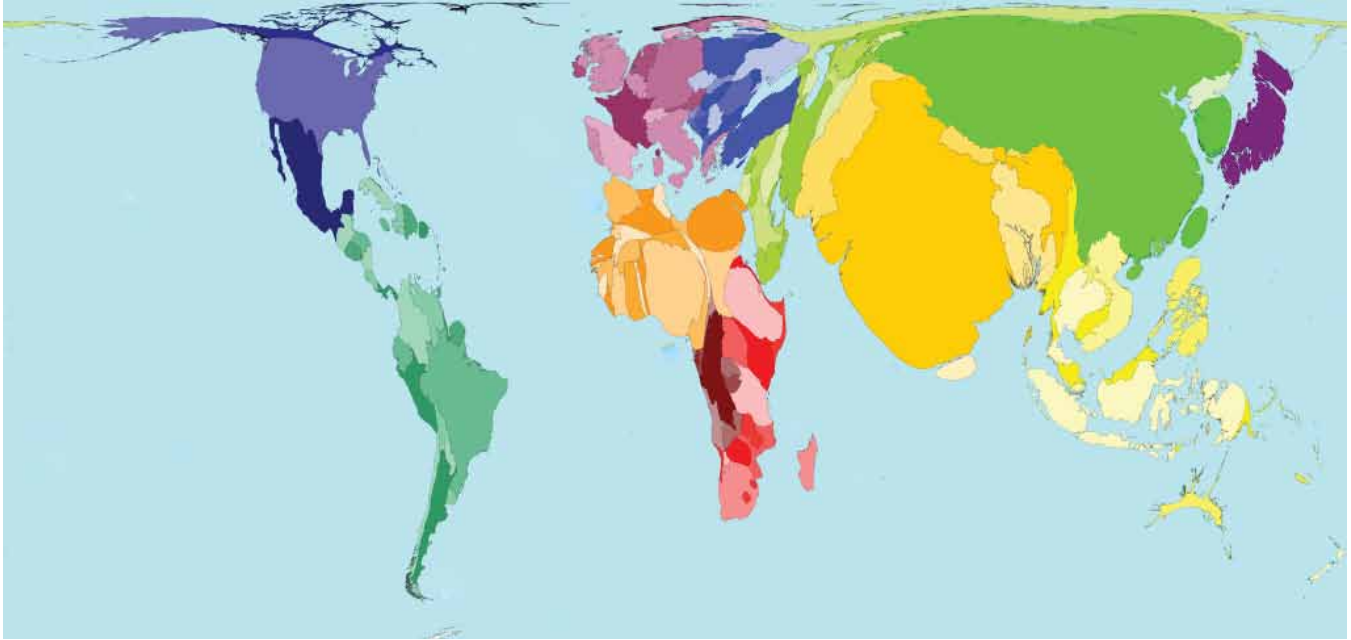


Globalization will define our 21st century society.

national, spanning the globe and interdependent with other nations and other peoples. Worldwide communication networks have created an international market, not only for conventional products, but also for knowledge professionals, research, and educational services.

As the recent report of the National Intelligence Council's 2020 Project concluded, "The very magnitude and speed of change resulting from a globalizing world—apart from its precise character—will be a defining feature of the world out to 2020. During this period, China's GNP will exceed that of all other Western economic powers except for the United States, with a projected population of 1.4 billion. India and Brazil will also likely surpass most of the European nations. Globalization—growing interconnectedness reflected in the expanded flows of information, technology, capital, goods, services, and people throughout the world—will become an overarching mega-trend, a force so ubiquitous that it will substantially shape all other major trends in the world of 2020" (National Intelligence Council, 2004).

While once the Midwest achieved economic prosperity through applying mass production and organizational innovation to achieve the lowest costs in the nation, today it must be competing with the low-cost workforces in the rapidly developing economies of Asia and Latin America. Simply improving the productivity of low-skill farms and factories are no longer adequate. Instead the Midwest will require an economy built on high skill, knowledge-based activities that will sustain America's high standard of living in a global market.



A map reflecting national populations by area (Worldmapper, 2005).

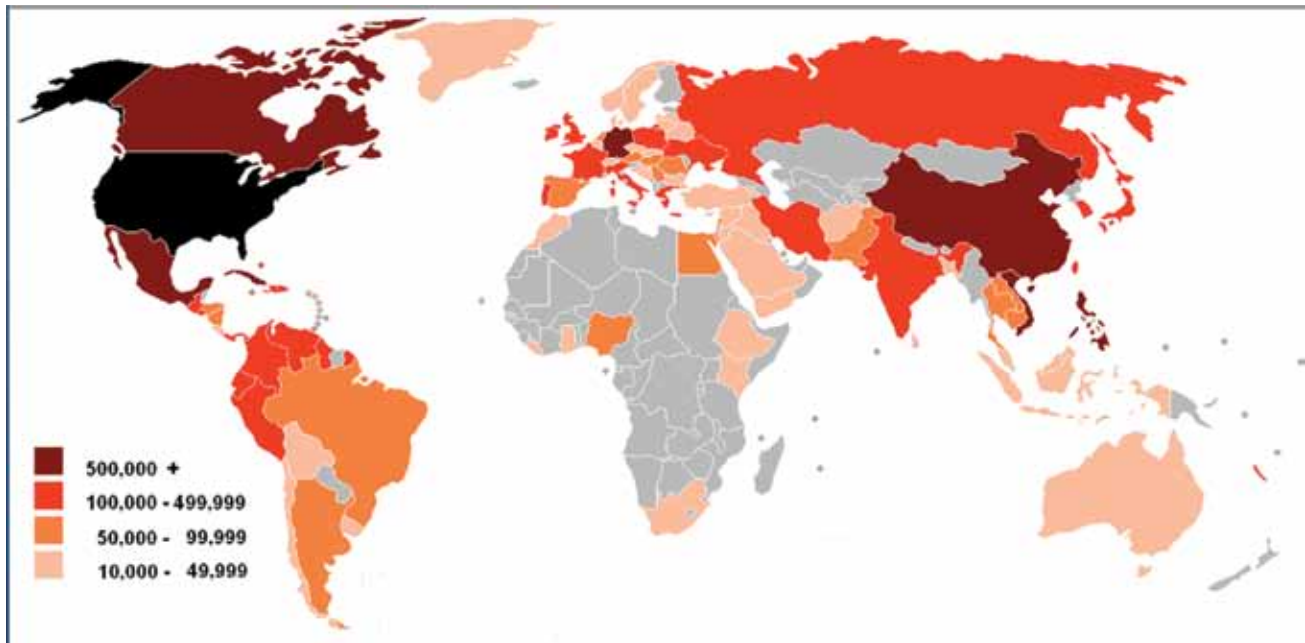
In such a global economy, it is critical that regions not only have global reach into markets abroad, but also have the capacity to harvest new ideas and innovation and to attract talent from around the world. Interestingly enough, higher education becomes a critical asset in providing access to such global markets of commerce and human capital. American universities have long enjoyed a strong international character among their students, faculty, and academic programs. These institutions stand at the center of a worldwide system of learning and scholarship, providing powerful regional magnets to attract new talent, new industry, and new resources from around the world.

Yet globalization implies a far deeper interconnectedness with the world—economically, politically, and culturally—that goes far beyond the international exchange of students, faculty, and ideas and the development of international partnerships among institutions. It requires thoughtful, interdependent and globally identified citizens. And it requires the mastery of the powerful new communications technologies that are transforming modes of learning, collaboration and expression. Hence the same forces of globalization that are challenge our regional economies and cultures will also challenging our educational institutions—and particularly our universities.

Demographics

America's population is changing rapidly. One of the most significant demographic trends is the aging of our population. The baby boomers are approaching retirement, and the number of young adults is declining. In the U.S., there are already more people over the age of sixty-five than teenagers in this nation, and this situation will continue for decades to come. More generally the populations of most developed nations in North America, Europe, and Asia are also aging rapidly, where over the next decade the percentage of the population over 60 will grow to over 30% to 40%. Half of the world's population today lives in countries where fertility rates are not sufficient to replace their current populations, e.g. the average fertility rate in the EU has dropped to 1.45, below the 2.1 necessary for a stable population. Aging populations, out-migration, and shrinking workforces are seriously challenging the productivity of developed economies throughout Europe and Asia. (National Intelligence Council, 2004; Baumgardt, 2006).

Yet here the United States stands apart because of a second and equally profound demographic trend: immigration. As it has been so many times in its past, America is once again becoming a highly diverse nation of immigrants, benefiting immensely from their



Resident American citizens in 2000 by country of birth (2000 Census, OECD)

energy, talents, and hope. Such population mobility is rapidly changing 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). Immigration is expected to drive continued growth in the U.S. population from 300 million today to over 450 million by 2050, augmenting our aging population and stimulating productivity with new and young workers.

Because America is characterized by great diversity in geography, regional economics, and cultures, immigrants have an incredible array of choice (*The Economist*, 2009). The proportion of Americans who are foreign-born, at 13%, is higher than the rich-country average of 8.4%. In absolute terms, the gulf is much wider. America's foreign-born population of 38 million is nearly four times larger than those of Russia or Germany, the nearest contenders. It dwarfs the number of immigrants in Japan (below 2 million) or China (under 1 million).

Immigration is vital to growing a regional economy. Although one usually thinks of immigrants taking low-skill jobs in poorly paid services, manufacturing, and agriculture, in reality much of the immigrant population is very high skill. Today's immigrants tend to fall into two classes. At the top are scientists, doctors, engineers, and managers largely from Asia. At the bottom

are the laborers, often poorly educated and largely Hispanic, who perform the very low skill jobs that keep our society functioning. Historically, immigrants and multinational populations have been the greatest contributors to urban population and growth, including growth in major U.S. cities over the past 20 years. They are the source of new enterprises, and they stimulate the innovative and entrepreneurial culture that creates diverse, multi-ethnic, urban communities that are attractive to talented, educated, and young residents (Longworth, 2008).

Yet even without immigration the minority population in the United States will continue to grow for decades to come, rising from 35% today to 42% by 2050 (Frey, 2010; Brownstein 2010). Minorities now comprise 44% of the children under the age of 18, the "Millennial" generation of students now entering our colleges. By 2023 minorities will comprise the majority of American children (and eventually our population).

The increasing diversity of the American population with respect to race, ethnicity, gender and national origin is both one of our greatest strengths and one of our most serious challenges as a nation. A diverse population gives us great vitality. However, the challenge of increasing diversity is complicated by social and economic factors. Far from evolving toward one America, our society continues to be hindered by the segregation

and non-assimilation of minority cultures, as well as a backlash against long-accepted programs designed to achieve social equity (e.g., affirmative action in college admissions). Furthermore, since most current immigrants are arriving from developing regions with weak educational capacity, new pressures have been placed on U.S. educational systems for the remedial education of large numbers of non-English speaking students.

The full participation of currently underrepresented minorities will be of increasing concern as we strive to realize our commitment to equity and social justice. Yet the achievement of this objective also will be the key to the future strength and prosperity of America, since our nation cannot afford to waste the human talent presented by its minority and immigrant populations. If we do not create a nation that mobilizes the talents of all of our citizens, we are destined for a diminished role in the global community and increased social turbulence. Most tragically, we will have failed to fulfill the promise of democracy upon which this nation was founded.

Technological Change

The new technologies driving such profound changes in our world—information technology, biotechnology, and nanotechnology—evolve at an exponential pace. For example, the information and communications technologies enabling the global knowledge economy double in power for a given cost every year or so, amounting to a staggering increase in capacity of 100 to 1,000 fold every decade. Computer scientists and engineers believe this trend will continue for the foreseeable future, suggesting that these technologies will become a thousand, a million, and a billion times more powerful as the decades pass. (Reed, 2005; Kuzweil, 2006). 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 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” (Bement, 2007).

Beyond acknowledging the extraordinary and unremitting pace of such exponentially evolving technolo-



The Jaguar XT5 Supercomputer
at Oak Ridge National Laboratory

gies, it is equally important to recognize that they are disruptive in nature. Their impact on social institutions such as corporations, governments, and learning institutions is profound, rapid, and quite unpredictable. As Clayton Christensen explains in *The Innovator's Dilemma*, while many of these new technologies are at first inadequate to displace today's technology in existing applications, they later explosively displace the application as they enable a new way of satisfying the underlying need (Christensen, 1997). If change is gradual, there will be time to adapt gracefully, but that is not the history of disruptive technologies. Hence organizations—and states, regions, and nations—must work to anticipate these forces, develop appropriate strategies, and make adequate investments if they are to prosper—indeed, survive—such a period. Procrastination and inaction (not to mention ignorance and denial) are the most dangerous of all courses during a time of rapid technological change.

Innovation

In its National Innovation Initiative, the Council on Competitiveness, a group of business and university leaders, highlights innovation as the single most important factor in determining America's success throughout the 21st century. “America's challenge is to unleash its innovation capacity to drive productivity, standard of living, and leadership in global markets. At a time when macro-economic forces and financial constraints make innovation-driven growth a more ur-

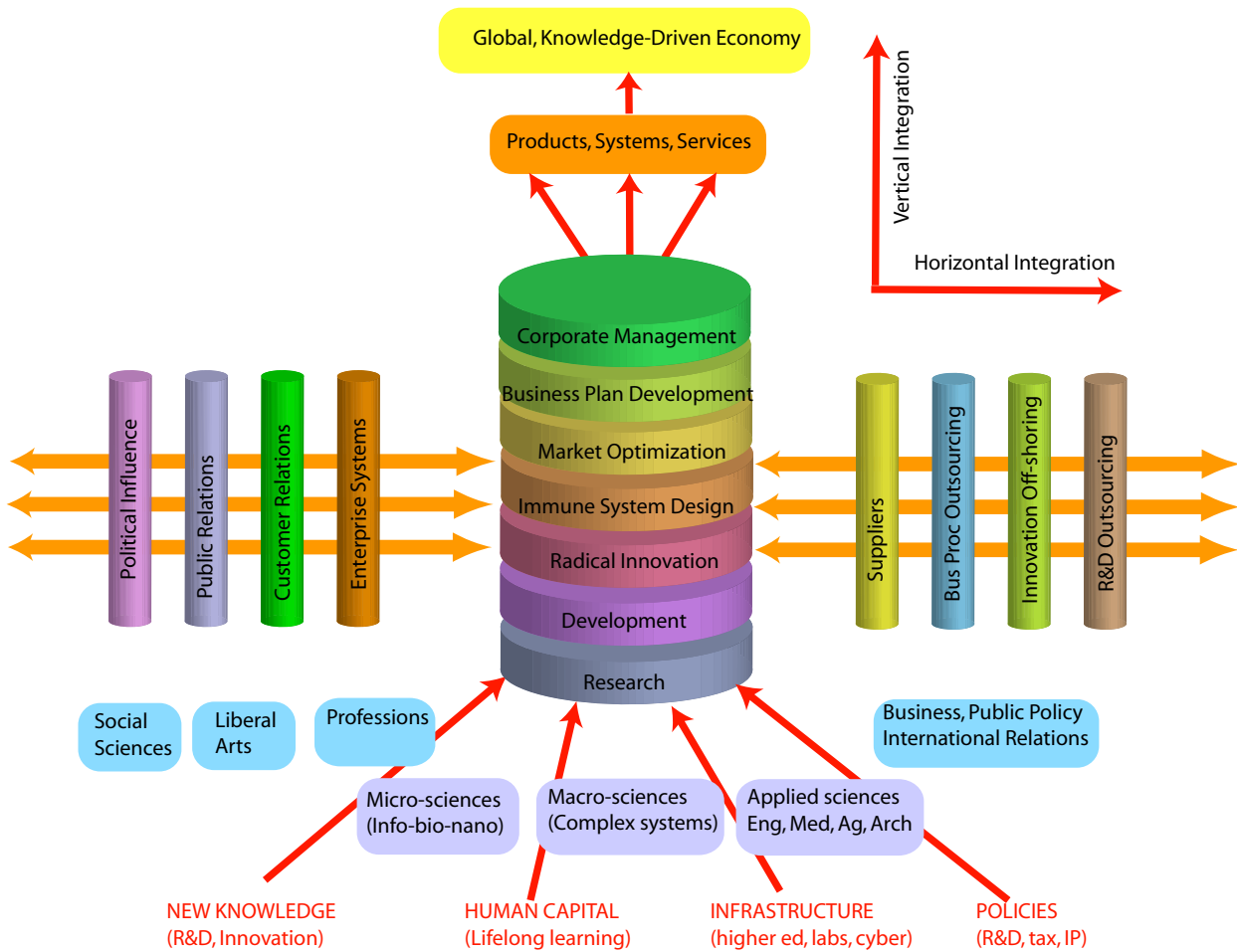
gent imperative than ever before, American businesses, government, workers, and universities face an unprecedented acceleration of global change, relentless pressure for short-term results, and fierce competition from countries that seek an innovation-driven future for themselves. For the past 25 years we have optimized our organizations for efficiency and quality. Over the next quarter century, we must optimize our entire society for innovation” (Council on Competitiveness, 2005).

In terms of increases in new resources, economists estimate that 40 to 60 percent of economic growth each year is due to research and development activity, particularly in American universities. Another 20 percent of the increased resources each year are based upon the rising skill levels of our population. In other words, 60 to 80 percent are really dependent upon higher education in terms of research and development and skills of the labor force (Augustine, 2005).

Of course innovation is more than simply new tech-

nologies. It involves how business processes are integrated and managed, how services are delivered and –more broadly–how public policies are formulated, and how markets and more broadly society benefit. However it is also the case that in a global, knowledge-driven economy, technological innovation–the transformation of new knowledge into products, processes, and services of value to society–is critical to competitiveness, long-term productivity growth, and an improved quality of life.

The National Intelligence Council’s 2020 Project concludes, “the greatest benefits of globalization will accrue to countries and groups that can access and adopt new technologies” (National Intelligence Council, 2004). This study notes that China and India are well positioned to become technology leaders, and even the poorest countries will be able to leverage prolific, cheap technologies to fuel–although at a slower rate–their own development. It also warns that this transition



The way the world works in a global, knowledge-driven economy. (Duderstadt, 2007)

will not be painless and will hit the middle classes of the developed world particularly hard, bringing more rapid job turnover and requiring professional retooling. Moreover, future technology trends will be marked not only by accelerating advancements in individual technologies but also by a force-multiplying convergence of the technologies—information, biological, materials, and nanotechnologies—that have the potential to revolutionize all dimensions of life.

In summary, the 2020 Project stresses that “A nation’s or region’s level of technological achievement generally will be defined in terms of its investment in integrating and applying the new globally available technologies—whether the technologies are acquired through a country’s own basic research or from technology leaders. Nations that remain behind in adopting technologies are likely to be those that have failed to pursue policies that support application of new technologies—such as good governance, universal education, and market reforms—and not solely because they are poor.”

But here the United States appears to be falling behind. A recent analysis ranked the global competitiveness of 40 leading nations according to the following measures (Atkinson, 2009):

1. Human capital: higher education attainment in the population ages 25–34, and the number of science and technology researchers per 1,000 employed.
2. Innovation capacity: corporate investment in research and development (R&D), government investment in R&D, and share of the world’s scientific and technical publications.
3. Entrepreneurship: venture capital investment and new firms.
4. Information technology (IT) infrastructure: e-government, broadband telecommunications, and corporate investment in IT.
5. Economic policy: effective marginal corporate tax rates, and the ease of doing business.
6. Economic performance: trade balance, foreign direct investment inflows, real GDP per working-age adult, and productivity.

While the United States ranked sixth overall among 40 leading nations in current global competitiveness

according to these measures, it ranked dead last, 40th out of 40, in the progress made over the past decade. The study also noted the degree to which the United States was falling behind in higher education, ranking currently 9th among nations in baccalaureate degree participation and 15th in change over the past decade.

Here part of the problem appears to be that many policy makers in Washington and at the state level simply assume that we will continue to be world leaders in innovation without a national strategy for further progress, while most other nations, particularly in Asia and the Europe, are making major investments in education, R&D, and knowledge infrastructure. When global corporations are polled and asked to identify the most attractive country locations for locating new R&D facilities, China ranks higher than the United States by 61% to 41%, and India is in third place with 29%. Between 1998 and 2003, the share of R&D investment by U.S. firms and affiliates grew twice as fast overseas (52%) as it did domestically (26%). Thus, foreign markets and the climate they provide for investment appear to be outpacing us.

Yet the innovation paradigm continues to shift. The old model was the traditional multinational assembly of wholly-owned subsidiaries, each producing for local markets. IBM’s CEO Sam Palmisano described IBM’s change from a “multinational” to a “global network enterprise” this way: “Just as hub-and-spoke architecture for communications networks gave way to the peer-to-peer structure of the Internet, so too global businesses are relying less on decisions made by management from corporate headquarters and more on the initiatives of partner firms around the world” (Palmisano, 2006). The global enterprise is, increasingly, a flexible assembly of firms around the world, with skills that can provide the most efficient combination of business processes for a global market.

In testimony to Congress, Nicholas Donofrio, senior executive of IBM, described today’s global knowledge economy as driven by three historic developments: “the growth of the Internet as the planet’s operational infrastructure; the adoption of open technical standards that facilitate the production, distribution, and management of new and better products and services; and the widespread application of these applications to the solution of ubiquitous business problems. In this increas-

ingly networked world, the choice for most companies and governments is between innovation and commoditization. Winners can be innovators—those with the capacity to invent, manage, and leverage intellectual capital—or commodity players, who differentiate through low price economics of scale and efficient distribution of someone else’s intellectual capital” (Donofrio, 2005).

The Implications for Education

The forces driving change in our world today—economies increasingly based upon the application of new knowledge and innovation, globalization, changing demographics, and rapidly evolving technologies—make clear why the keys to regional prosperity have become educated people, the capacity to generate new knowledge, innovation, and an entrepreneurial culture. These imperatives have important implications for education at all levels.

The Educational Needs of 21st-Century Citizens

Historically, people have always looked to education as the key to prosperity and social mobility. Education in America has been particularly responsive to the changing needs of society during major periods of social transformation, e.g., the transition from a frontier to an agrarian society, then to an industrial society, through the Cold War tensions, and to today’s global, knowledge-driven economy. Our schools, colleges, and universities evolved from the educational paradigms of the 18th century serving only the elite, to the public institutions of the 19th century serving the working class, and then once again to knowledge-intensive institutions of the 20th century such as the research university, critical to the economic prosperity, public health, and security of the nation. As our society changed, so too did the necessary skills and knowledge of our citizens: from growing to making, from making to serving, from serving to creating, and today from creating to innovating. With each social transformation, an increasingly sophisticated world required a higher level of cognitive ability, from manual skills to knowledge management, analysis to synthesis, reductionism to the integration of knowledge, invention to research, and today innovation, and entrepreneurship.

Now more than ever, people see education as their hope for leading meaningful and fulfilling lives. The level of one’s education has become a primary determinant of one’s personal economic security. Just as a high school diploma became the passport to participation in the industrial age, today, a century later, a college education has become the requirement for economic security in the age of knowledge. In fact, the recent White House Task Force on the Middle Class concludes, “the most effective means of helping American families secure economic stability is increasing access and affordability to higher education” (Biden, 2010).

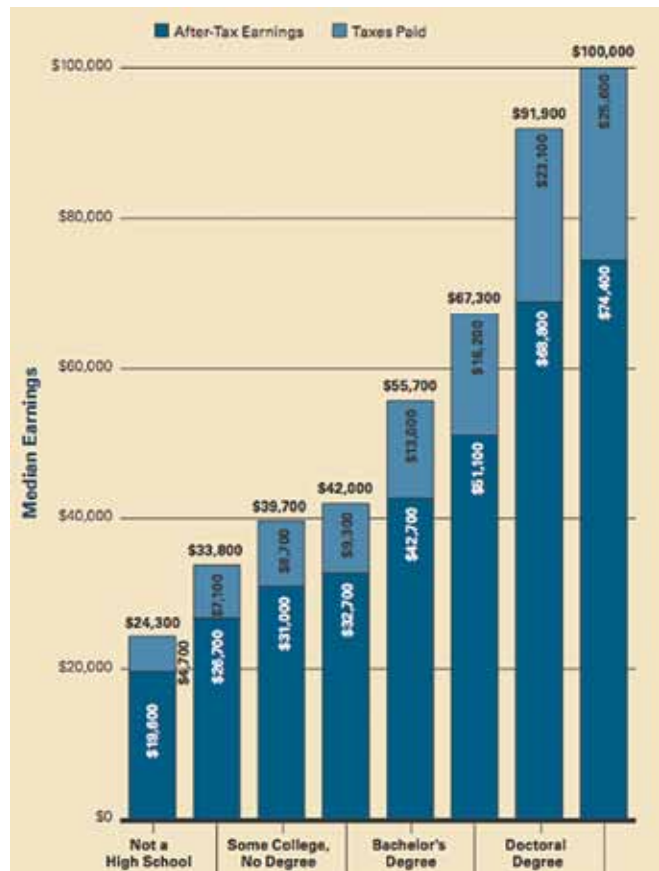
The hyper-competitive, global, knowledge-driven economy of the 21st Century is stimulating powerful forces that will reshape our society and our knowledge institutions. Today, a college degree has become a necessity for most careers, and graduate education desirable for an increasing number. The pay gap between high school and college graduates continues to widen, more than doubling from a 50% premium in 1980 to 130% today (College Board, 2010). Not so well known is an even larger earnings gap between baccalaureate-degree holders and those with graduate degrees. This should not be surprising given that in the knowledge economy, the key asset driving corporate value is no longer physical capital or unskilled labor but rather intellectual and human capital. In fact, there is an even more pragmatic way to look at the importance of advanced education. Today we invest about \$100,000 of public funds to produce a high school graduate (K-12). Yet statistics indicate that the careers available to those with only a high school diploma will never repay in state and local taxes the cost of their education. It is only at the bachelor’s-degree level and above that the public can expect to regain its investment in education from tax revenues (Wiley, 2003).

Today over 80 percent of the new jobs created by our knowledge-driven economy require education at the college level (Glazer, 2009), and for many careers, a baccalaureate degree will not be enough to enable graduates to keep pace with the knowledge and skill-level required for their careers. The knowledge base in many fields is growing exponentially. In some fields such as engineering and medicine the knowledge taught to students becomes obsolete even before they graduate! Hence a college education will serve only as a stepping-

stone to a process of lifelong education. The ability to continue to learn and to adapt to—indeed, to manage—change and uncertainty are among the most valuable skills of all to be acquired in college.

Yet many people—and most politicians—continue to think of a college education much as they envision secondary school, with young students listening to professors lecturing about history or economics. It is important to challenge these old-fashioned perspectives with a dose of the current realities, e.g., students studying intricate subjects such as software engineering, biotechnology, neuroscience, or global supply chain management, since these are the disciplines of today preparing students for rewarding careers tomorrow. The skills of these disciplines are not mastered in the lecture hall but in the laboratory, surgery suite, or through international experience. Clearly such advanced education does not come cheap. But it also has never been more important.

Although a growing population will necessitate growth in higher education to accommodate the projected increases in traditional college-age students, even more significant will be the growing demand of working adults, who increasingly realize that in the high-performance workplace, without further education they are only one paycheck away from the unemployment line. Less than 20 percent of today's college students fit the stereotype of eighteen- to twenty-two-year-olds living on campus and attending college full-time. Today most college students are adults—in fact, one-quarter are over the age of thirty. A college degree has become key to a decent job in our knowledge-driven society, and most of today's students see a college education as critical to their future quality of life, the key to a good job, financial security, and well-being. Most adult students have definite career objectives and are majoring in professional or pre-professional programs. And while they may have strong academic abilities and enjoy learning, both financial and family responsibilities motivate a far more utilitarian approach to their education. Since the residential college experience is not as central to adult lives, they seek a different kind of relationship with the university, much as they would other service providers such as banks or filling stations. They approach their education as consumers, seeking convenience, quality, relevance, and affordability—hence the rapid expansion of for-profit higher education providers such as the



2008 Median Earnings and Tax Payments of Full-Time Workers 25 and Older by Education Level (College Board, 2010)

University of Phoenix and DeVry Institutes.

As we move further into an age of knowledge, a region's workforce will require even more sophisticated and sustained education and training to sustain its competitiveness. Today's graduates will change careers many times during their lives, requiring additional education at each stage. Furthermore, with the ever-expanding knowledge base of many fields, along with the longer life span and working careers of our aging population, the need for intellectual retooling will become even more significant. Even those without college degrees will soon find that their continued employability requires advanced education. It is estimated that just to keep an individual on pace with evolving workplace skills and knowledge will require a time commitment of roughly one day of education per week (Dolence, 1995). This translates to one-fifth of the workforce in college-level educational programs at any time, or roughly 28 million full-time-student equivalents—compared to the

18 million students currently enrolled in our colleges and universities.

Both young, digital-media savvy students and adult learners will likely demand a major shift in educational methods, away from passive classroom courses packaged into well-defined degree programs, and toward interactive, collaborative learning experiences, provided when and where the student needs the knowledge and skills. There will be a shift from “just in case” learning, in which formal education is provided through specific degree programs early in one’s life in the hope that the skills learned will be useful later, to “just in time” lifelong learning, in which both informal and formal learning will be expected to occur throughout one’s life, when it is relevant and needed (Duderstadt, 2000). This suggests that most of one’s learning will occur after the more formal K-16 experience, either in the workplace or other learning environments.

Knowledge workers are likely to make less and less distinction between work and learning. In fact, continuous learning, just as continuous quality improvement in industry, will be a necessity for workforce relevance and security. Employers will seek individuals who can consistently learn and master new skills to respond to new needs. They will place less emphasis on the particular knowledge of new employees than on their capacity to continue to learn and grow intellectually throughout their careers. From the employee’s perspective, there will be less emphasis placed on job security with a particular company and more on the provision of learning opportunities for acquiring the knowledge and skills that are marketable more broadly. The increased blurring of the various stages of learning throughout one’s lifetime—K-12, undergraduate, graduate, professional, job training, career shifting, lifelong enrichment—will require a far greater coordination and perhaps even a merger of various elements of our knowledge infrastructure. Lifelong and “life-wide” learning will become the norms (Atkins, 2010).

America’s Higher Education Enterprise

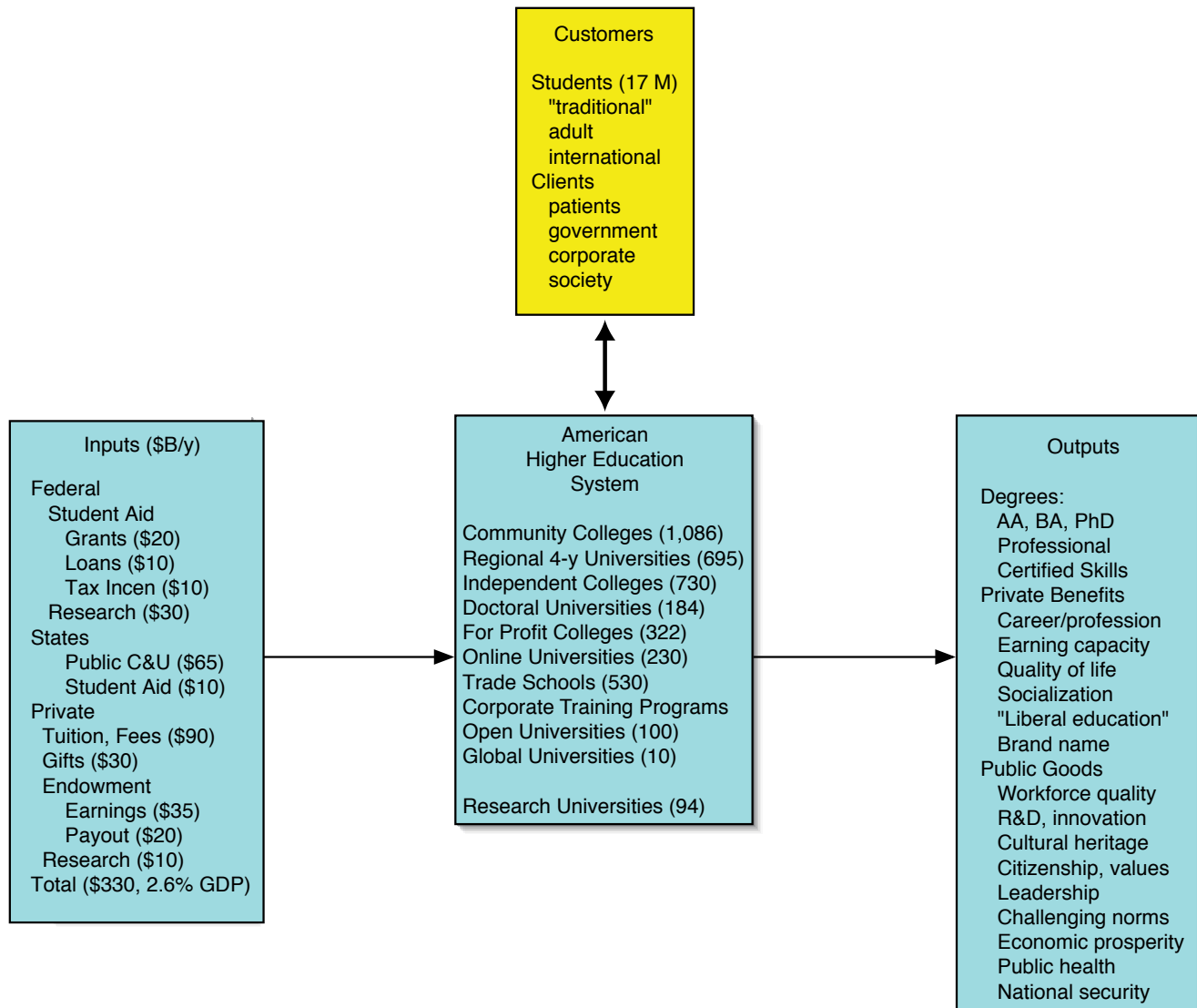
To illustrate the stresses and strains imposed on education by these near term challenges, it is first useful to begin by summarizing the current state of American colleges and universities. Higher education in the

United States is characterized both by its great diversity in colleges and universities and an unusual degree of institutional autonomy—understandable in view of the limited role of the federal government. As *The Economist* notes, “The strength of the American higher education system is that it has no system” (*The 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.

Characteristics of American Higher Education

- The great diversity among institutions and missions
- The balance among funding sources (public vs. private)
- The influence of market forces (for students, faculty, resources, reputation)
- The global character (international students, faculty)
- The absence of a centralized system that leads to highly decentralized, market-sensitive, and agile institutions and mobile students and faculty
- Supportive public policies (academic freedom, institutional autonomy, tax and research policies)
- The research partnership among universities, government, and industry

The American university’s constituencies are both broad and complex. Clients of university services include 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 uni-



The American higher education enterprise

versities, there is a rich diversity in both 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) (Duderstadt, 2008). 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 individu-

als (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 depen-

dence 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 sponsored research, health care, student housing, 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 those of many European nations.

A few other characteristics of American institutions 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 American parents now see college as “the place where we send our children to grow up”.

Furthermore, American 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 sometimes wish they could shift to the “no-frills” approach of European universities and focus their activities on teaching and scholarship for more mature 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 many of the valuable academic services they provide to society—e.g., educating low income students, offering instruction in the arts and humanities, and conducting research and 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, conducting commercial entertainment activities (football, concerts, theatre), and providing educational services to wealthy clients (e.g., oil-rich nations).

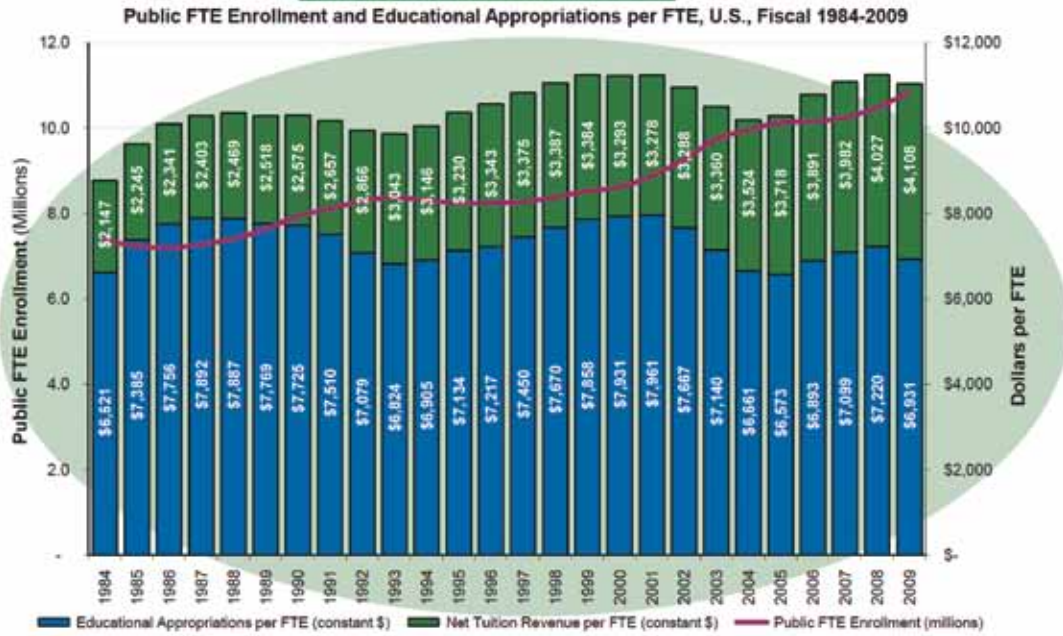
With this as background, let us summarize briefly some of the current challenges faced by American higher education.

Strained Budgets

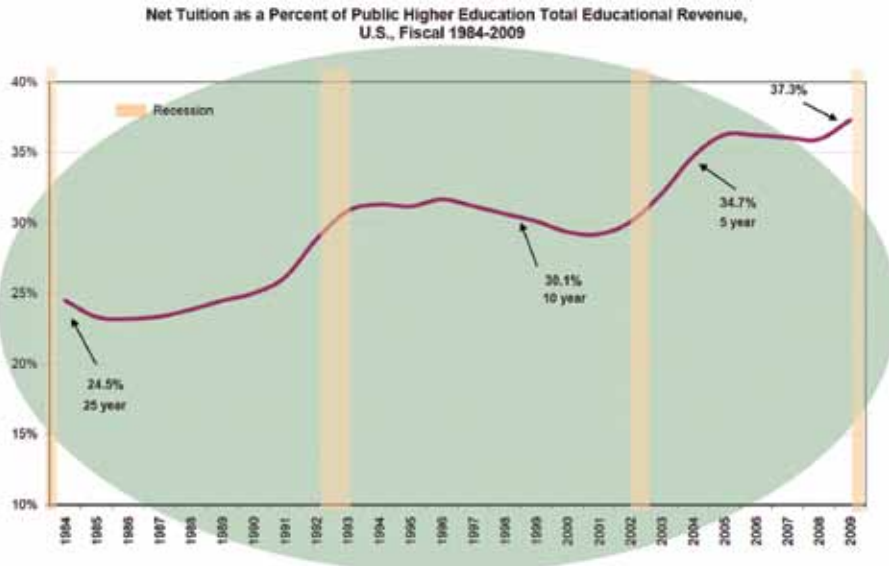
Foremost on the minds of most university leaders these days are the devastating cuts in appropriations as the states struggle to cope with crushing budget deficits or the erosion of private support from gifts and endowment income associated with a weak economy. As the global recession has deepened, state after state began to project tax revenue declines and warn their public universities of deep budget cuts 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.

Of course, the optimist might suggest that this is just part of the ebb and flow of economic cycles. In bad times, state governments and donors cut support, hoping to restore it once again in good times. But this time it may be different. As one state budget officer noted: “College leaders are fooling themselves if they think the end of this recession will be like all the others. What we’re seeing is a systematic, careless withdrawal of concern and support for advanced education in this country at exactly the wrong time.” As a nation that once viewed education as critical to national security and economic prosperity, we now seem more concerned with sustaining the social benefits (and tax policies) demanded by an aging baby boomer population, a situation unlikely to change for several decades (Selengo, 2003).

This reality is particularly important for the leaders of America’s public universities. Today in the face of limited resources and more pressing social priorities, the century-long expansion of public support of higher education has slowed. While the needs of our society



State support goes down while enrollment goes up...



...and hence so does tuition! (SHEEO, 2009)

for advanced education can only intensify as we evolve into a knowledge-driven world culture, it is not evident that these needs will be met by further growth of our existing system of public universities. We now have at least two decades of experience that would suggest that the states are simply not able—or willing—to provide the resources to sustain growth in public higher education, at least at the rate experienced in the decades following World War II. In many parts of the nation,

states will be hard pressed to even sustain the present capacity and quality of their institutions.

But the current financial challenges faced by public universities send a deeper message. Vital national needs for world-class performance in research and graduate training are no longer top state priorities. Yet this is a time when the strength, prosperity, and welfare of a nation demand a highly educated citizenry and institutions with the ability to discover new knowledge,

develop innovative applications of discoveries, and transfer them into the marketplace through entrepreneurial activities. The state-based funding model of graduate training made sense when university expertise was closely tied to local natural resource bases—e.g., agriculture, manufacturing, and mining. But today’s university expertise has implications far beyond state boundaries. Highly trained and skilled labor has become more mobile and innovation more globally distributed. Many of the benefits from graduate training—like research—are public goods that provide only limited returns to the states in which they are located; the bulk of the benefits are realized beyond state boundaries. Hence, it should be no surprise that many states have concluded that they cannot, will not, and probably should not invest to sustain world-class quality in graduate and professional education, particularly at the expense of other priorities such as broadening access to baccalaureate education. Today, not only is state funding woefully inadequate to achieve state goals, but state goals no longer accumulate to meet national needs. (Courant, 2010).

There is a growing sense that the 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 University of California and the University of Michigan, state residents pay \$12,000 a year while out-of-state students pay private tuition levels of \$35,000 a year. A 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).



The National Commission on the Future of Higher Education (the Spellings Commission)

A Mature Enterprise

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) (Bok, 2006). 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 (Levine, 1997; Callan and Immerwahr, 2008).

Of particular importance here was the National Commission on the Future of Higher Education (the Spellings Commission), launched in 2005 to examine issues such as the access, affordability, accountability, and quality of our colleges and universities. This unusually broad commission—comprising members from business, government, foundations, and higher educa-

tion—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 Challenge Before Us

Throughout the 20th century, the Midwest and America have been leaders in the world economy. Democratic values and free-market practices, coupled with institutional structures such as stable capital markets, strong intellectual property protection, flexible labor laws, and open trade policies, positioned the region well for both economic prosperity and security. With a highly diverse population, continually renewed and re-energized by wave after wave of immigrants, the

Midwest became the source of the technology and innovation that shaped the 20th century global economy.

Yet today the Midwest’s manufacturing and agricultural economies, so powerful and prosperous during the 20th century, are dying, slowly but surely, putting at risk the welfare of tens of millions of citizens across the region. For years we have seen our low-skill, high-pay factory jobs increasingly outsourced and replaced by low-skill, low-pay service jobs—or in too many cases, no jobs at all and instead the unemployment lines. Thus far much of the Midwest has been in denial, assuming our low-skill workforce would remain competitive and our factory-based manufacturing economy would be prosperous indefinitely. Yet that 20th-century economy will not return. The region, its workers and families, factory and farms, towns and cities, must come to realize and accept the permanence of this economic transformation.

Of course Midwest America is certainly not alone in facing this new economic reality. There is a growing recognition throughout the world that economic prosperity and social well being in a global knowledge-driven economy require public investment in knowledge resources. That is, regions must create and sustain a highly educated and innovative workforce, supported through policies and investments in cutting edge technology, a knowledge infrastructure, and human capital development.

What is really at stake today is building the Midwest’s regional advantage, allowing it to compete for prosperity and quality of life, in an increasingly competitive global economy. In a knowledge- and innovation-intensive economy, regional advantage is not achieved through popular political devices such as tax cuts for the wealthy, regulatory or public subsidy of dying industries. A knowledge-based, globally competitive economy is achieved by creating a highly educated and skilled workforce. It requires public investment in the ingredients of innovation—educated people and new knowledge—and the infrastructure to support advanced learning, research, and innovation. Put another way, it requires public purpose, policy, and investment to create a learning- and innovation-driven society.

Chapter 3

The Midwest Today: A Knowledge Resource Map

Today, the Midwest region is at a critical economic juncture. This once economic giant is standing precariously—with one foot still planted in a waning industrial era, and the other striding the emerging global knowledge economy. The giant could step either way: forward to a future of economic and population growth, as a hub of research and innovation, a corporate R&D and decision center, a university led global research hothouse, and a talent magnet and immigrant gateway; or, backward to a future of distressed cities, depopulated rural communities, out-migration, and closing plant doors—increasingly a backwater in the world economy.

John Austin, The Vital Center, Brookings Institution

The Midwest's frontier history has given it a priceless legacy of pioneering spirit, gritty courage, and self-reliance. Our ancestors made our farms and our factories the best in the world. The region's state and local governments believed in their people and invested heavily in their education and training, catapulting the region into a position of global leadership in innovation, productivity, and trade. There was broad recognition that it was our people—their character, knowledge, skill, and ability to innovate—that would give the region the competitive edge.

A century ago, the Midwest led the nation in building institutions to provide such knowledge resources. State governments created great education systems aimed at serving all of their citizens, demonstrating a remarkable capacity to look to the future and a willingness to take the actions and make the investments that would yield prosperity and well being for future generations. Midwest companies invested heavily in R&D and technological innovation, working closely with the region's research universities. Our leaders understood well the importance of investing with both public tax dollars and private capital in those areas key to prosperity in an industrial economy. The payoff was enormous, as the Midwest led the world in productivity, technology, and prosperity.

Yet today the region is struggling, overtaken by a fiercely competitive global economy and hindered by a culture of denial that seeks to restore the low-skill agricultural and industrial economies of the past at the expense of the investment needed to create a highly

educated workforce and entrepreneurial culture for the future. A brief review of the characteristics and assets of the region today will serve as an appropriate starting point for the development of a roadmap to prosperity tomorrow.

Characteristics of the Midwest

Natural Features

The Midwest region is blessed with unique natural and environmental attributes and features that both enhance the area's quality of life and have the potential to support vibrant economic development. Of course, the most distinctive natural features are the Great Lakes themselves. They contain one-fifth of the world's volume of freshwater, making the Great Lakes the single greatest freshwater resource on the planet. Their watershed includes 11,000 miles of coastline along with rivers, forests, and scenic and recreation areas that rival any of America's other coasts. With fast-growing coastal areas of the U.S. prone to natural disaster (the "North Coast" of the Great Lakes is decidedly not)—and many fast-growing sunbelt regions facing serious water scarcity issues—the Great Lakes are a tremendous asset for the region, and a vital resource for the entire country (Austin, 2006).

The region also includes large forests in the north and tall grass prairies in the south. Thousands of inland lakes complement the five Great Lakes. The region is home to the world's richest arable lands, making the



The Midwest's greatest natural asset:
the Great Lakes (NASA, 2004)

Midwest the world's breadbasket. Although many of the forests have been leveled, the vast copper and iron ore deposits mined out, and the family farms replaced by industrial agriculture, the natural resources of the Midwest region are still immense. (Austin, 2006)

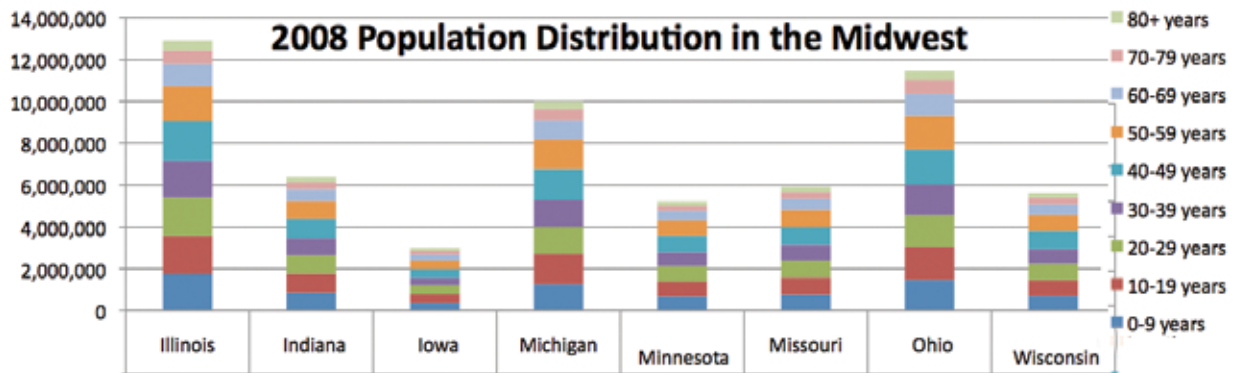
Given its abundant water, fertile land, and the fact that it is largely immune to hurricane and other natural disasters, this "hazard free" third, or "freshwater" coast of the continent can support economic and population growth other parts of the continent and world cannot. As significantly, people choose and prefer locations to live and work with scenic, environmental, and recreational amenities. The magical quality of water and other nature features are important factors in location desirability, and are a factor in the real choices people make for where to live, work, and locate a business.

Demographics

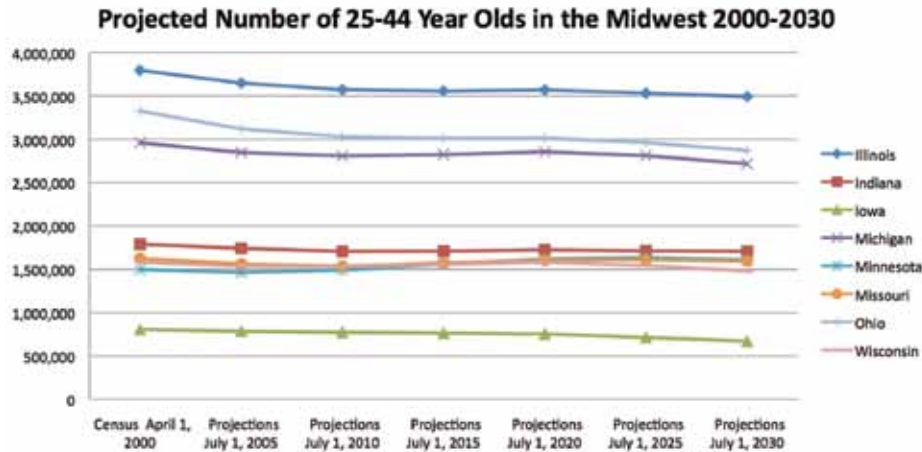
The Midwest region has a significant population of 60 million people. Furthermore the population of the major metropolitan areas clustered in the Great Lakes region alone approaches 40 million, making it second only to the U.S. Eastern seaboard as a highly integrated, urbanized economic "mega-region." This has enabled it to become one of the largest industrial production centers and consumer marketplaces in the world. (Austin, 2005)

Yet the region has experienced slower population growth than the rest of the nation over the past two decades. Although in part due to the aging of the baby boomers and the low birthrates characterizing Midwest states, this has been aggravated by an anticipated loss of 12% in its 25- to 44-year old population from 2000 to 2025 as this group seeks new experiences and more dynamic regional economies in other regions of the nation. Much of the Midwest—particularly rural areas and small- to medium sized manufacturing-based communities—face a significant "brain-drain" of young educated workers (the fourth largest percentage decline in the nation), as they flee to the faster-growing, more dynamic urban economies both within and outside of the region. Michigan, Illinois, and Ohio have been particularly hard hit by the out-migration of young, educated adults to other regions. One sees this in the hollowed-out cores of many Midwestern cities as they lose population (Longworth, 2008).

The final demographic characteristic with great implications for the future of higher education in the region is the anticipated decline in the number of college



The age distribution of Midwestern states
(U.S. Census Bureau, 2008)



Projection of number of young adults in Midwest (Mickey-Pabello)

age students over the next decade, anticipated to be as large as 15% or more in some states. Like many northern states, the Midwest is once again sliding down the backside of the post-WWII baby boom and bust cycle, in contrast to the southern and western states where immigration has provided the population growth to compensate for these cycles. Already many areas have had to downsize K-12 education, e.g., Detroit, where the population of school age children has declined from 150,000 to 30,000 and Kansas City, where the decline has been from 76,000 to 18,000. As this decline propagates to college age students, it will present a formidable challenge to many four-year colleges and universities in the Midwest, which are likely to see declining enrollments and perhaps even be pushed to financial collapse. (The numbers of high school graduates are projected to drop by 2016 by 16% in Wisconsin, 6.6% in Minnesota, 6.3% in Ohio, 3% in Michigan, and 1.6% in Missouri and Iowa.)

The aging population in the Midwest has other implications. Health care costs are increasing rapidly. Productivity is declining as retirements increase. Furthermore, an aging voter cohort is shifting the priorities for public funds to health care, retirement security, safety from crime, and tax relief rather than giving high priority to investment in the future through education.

The Midwest Economy

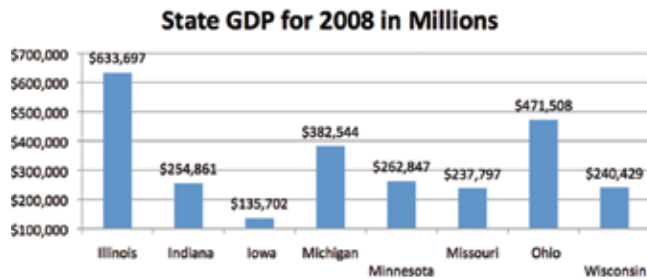
The sheer size of the Midwest's region's economy is a huge asset. With over 32 percent of U.S. GDP, the region is one of the largest wealth generators and market-

places in the world. And if it stood alone as a country it would be the 2nd biggest economic unit on earth, second only to the U.S. economy as a whole and larger than Japan, the rising powers of China and India, and the traditional heavyweights of Germany, France, and the United Kingdom. The Midwest is a national leader in fast-growing global trade, generating 30 percent of all U.S. merchandise exports. The region's exports dwarf that of the West and the Northeast, and are exceeded only by exports from the South. (Austin, 2008)

The Midwest had traditionally relied on two enterprises for a living—farming and heavy industry. It is both the breadbasket and foundry of America—a cultural bellwether and engine of the American economy. Although the number of manufacturing firms and jobs in the Great Lakes region has declined considerably over the past several decades, the sector is still a major driver of the economy. Twenty percent of jobs in the region are in manufacturing, compared to less than 11 percent nationally. In fact, the region boasts 44 percent of the nation's manufacturing jobs, while its overall share of employment is just 37 percent (Austin, 2006).

Given its rich history of new industry creation and its number of globally connected firms, the region remains a decision and research and development center in key sectors of the economy. Over 30 percent of North American corporate headquarters, including 300 of the nation's Fortune 1000 firms, are located in the region, serving as the brains for new business, product, and technology development.

The major cities that factory-based agriculture and manufacturing have created have certain advantages



GDP for Midwestern states
(Bureau of Economic Analysis, 2008)

in the new, knowledge-intensive and innovation-based economy if those advantages are properly exploited. Large and dense metropolitan areas are attractive to high-wage employers because firms tend to locate in places that are big enough to offer easy access to an educated workforce, to take advantage of the specialized suppliers that develop in response to the presence of similar firms; and to promote innovation, which in turn enables industry in that region to grow and prosper.

Today all of Midwestern states have been pulled into the maelstrom of globalization. The region faces many challenges transitioning from the industrial era, which it once dominated, to the knowledge age. It is still heavily reliant on mature industries and products, with a workforce ill prepared to obtain or create jobs in the new economy. Its landscape is dotted with hollowing city centers, emptying manufacturing towns, and isolated farm, mining, and timber communities, which continue to bleed mobile, educated knowledge workers.

As an example consider the plight of Michigan, the state that once was the leader of American industry yet today has become poster child for the impact of globalization and the knowledge economy. The economy of Michigan is approximately \$308 billion per year, which ranks it 16th in the world, greater than Argentina, Belgium, Switzerland, and Russia. There are approximately 4.7 million workers in Michigan. While the economy has seen the most growth in the service sector (+32.7%), Michigan's economy is still highly reliant on factory-based manufacturing. The state's share of earnings from manufacturing is the third highest in the nation, while Michigan's share from high-paying, knowledge-based industries was 3.5% below the national level (21st in the nation). Furthermore, Michigan



Auto assembly plants in the Midwest (MDLEG, 2005)

is one of only 15 states where manufacturing provides a greater share of employment earnings than high-pay knowledge-based industries.

The implications of Michigan's dependence on a 20th century factory-based are disturbing indeed. Today the state ranks:

- 50th in personal income growth
- 50th in GDP growth
- 50th in unemployment rate
- 50th in employment growth (only state with a decline)
- 48th in corporate tax rate
- 48th in cost of doing business
- 48th in CEO rankings
- 50th in index of economic momentum (population, personal income, employment)
- 50th in the support of higher education over the past decade

Michigan's largest city, Detroit, now ranks as the nation's poorest, dropping in population from 2 million in the 1960s to less than 800,000 today. Key companies have been pushed over the brink by the global economy. Half of the jobs lost in the United States since 2000 have been in Michigan.

The state's educational system is underachieving with one quarter of Michigan adults without a high school diploma and only one-third of high school graduates college-ready. Less than one-quarter of Michigan citizens have college degrees (Glazer, 2010).

Furthermore, the out-migration of young people in search of better jobs is the fourth most severe among the states. Michigan will be the only state in the 2010

census that will actually see a population drop. (Glazer, 2008; Rothwell, 2009)

And note that all of this happened BEFORE THE FALL—before General Motors, Chrysler, and many of the state’s smaller companies filed for bankruptcy!

High concentrations in high-pay knowledge based industries and a higher proportion of 25- to 44-year-old college graduates are associated with the high and rapidly growing per capita income of the dominant regions of the more successful states such as California, Massachusetts, and New York. These regions are characterized by small concentrations of manufacturing, has they have evolved into post-industrial economies. By contrast, Michigan’s two largest metropolitan regions have substantially lower per capita incomes with far slower growth rates, more concentrated in manufacturing and less in high-pay knowledge industries, and lower in the portion of young college graduates.

The contrast between the characteristics of Midwestern states, still heavily dependent upon agriculture and factory-based industry, can be show by comparing characteristics such as per capita income and unemployment with those states characterized by knowledge economies.

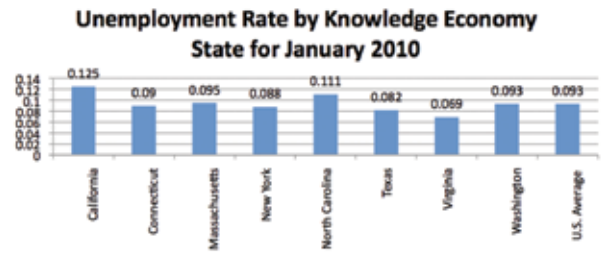
This not only illustrates the importance of a post-industrial economy, but it also suggests that Michigan’s efforts to retain manufacturing jobs may be at cross-purposes to achieving prosperity in the global knowledge economy. As Glazer and Grimes suggest, these

data raise serious doubts about the wisdom of current strategies to save manufacturing jobs as the state’s top economic priority. Beyond the difficulty in countering the powerful forces of trade and technology that are driving manufacturing jobs offshore, clinging to its manufacturing past could well leave the state a back-water in the developing knowledge economy. (Glazer, 2010.)

Yet here it is appropriate to note one other comparison between the characteristics of Midwestern states and their knowledge-intensive counterparts: the tax burden on state citizens. In some sense, this represents the willingness of a state both to not only provide adequate social services but to invest in the future through education. Such a comparison demonstrates that states characterized by knowledge-intensive economies not only benefit from higher per capita income and employment but also have higher tax burdens. This suggests that those states that willing to impose taxes sufficient to invest heavily in priorities such as education, workforce skills, and social services are also likely to reap the benefits of higher prosperity—not at all surprising in today’s knowledge-driven global economy.

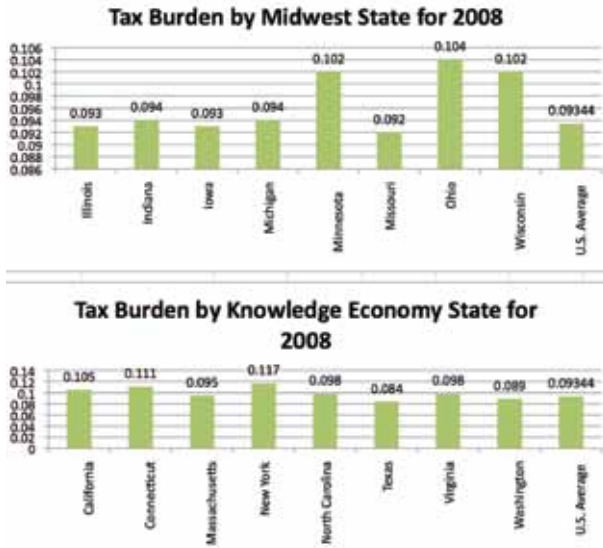
Workforce

Research by Glazer and Grimes shows that the most thriving regions and metropolitan areas are those with a high proportion of adults with four-year degrees that



Per capita income (Tax Foundation, 2008)

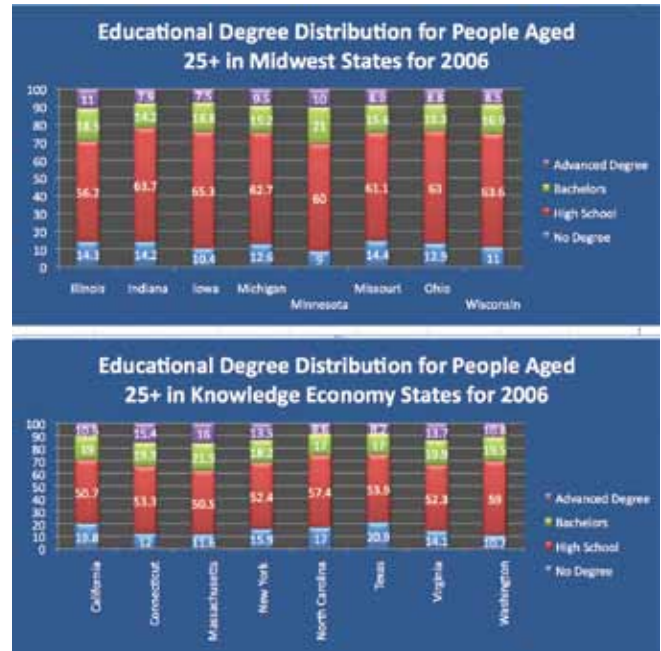
Unemployment rate (Rothwell, 2010)



Tax burdens (Tax Foundation, 2008)

are creating and working in high-pay, knowledge-based industries such as information, finance and insurance, professional and technical services, management of companies, education, health care, and government (Glazer, 2010). Yet today the Midwest region is hampered by serious human capital deficits, reflected in a population that generally lacks the postsecondary degrees and credentials essential to succeed in the global economy. This is largely due to the region's significant brain drain, its aging workforce, and the legacy of an industrial economy that once provided good jobs and wages without a college degree.

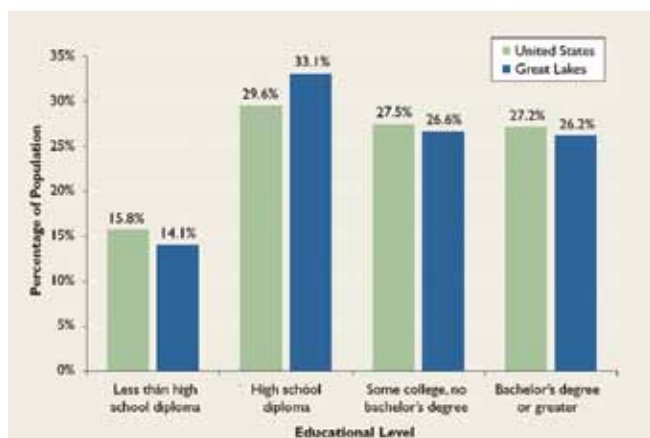
The overall lack of an educated workforce represents a significant challenge for the Midwest economy. While a high school education was sufficient for the 20th century industrial economy, today 80 percent of new jobs requiring some form of postsecondary education or training. Yet, only two Midwestern states—Minnesota and Illinois—rank high in the fraction of their populations holding a bachelor's degrees or higher. Low-skill (e.g., without college degrees) middle-aged and older workers make up the fastest growing share of the states' total population and available workforce, and constitute a larger share of Midwest state population than in the U.S. as a whole. The skills of many of these workers have already become obsolete. Many others are high school dropouts, uneducated, some virtually illiterate. They are totally unqualified for any job other than the ones they just lost. Similarly while the



A comparison of educational degree distribution (U.S. Census Bureau)

workforces of small Midwestern towns are comprised of hardworking high school graduates, they simply do not have the skills or education that the new economy demands and may be increasingly unemployable.

Yet another challenge arises from the generous employee benefits, job security, and income practices negotiated that powerful labor unions have negotiated with profitable companies over the years. While this was instrumental in creating a prosperous middle class, it now has saddled the Midwest with costs that can no longer be supported by the current economy (*The Economist*, 2006). The impact of legacy costs such as pensions, health care benefits, and unemployment compensation have bankrupted many companies—including, of course, General Motors and Chrysler—and in turn swelled the welfare burdens of state governments. Ironically, it was just these generous benefits that also persuaded low skill factory employees that there was little reason to invest the time or effort in a college education, both for them and, unfortunately, for their children as well. If a high school diploma was all one needed to get an assembly line job making \$70,000 a year with generous health, pension, and employment contracts, then why bother with more education. As a result, a culture developed over generations that no longer valued the importance of education either as a



Comparison of workforce education levels
(Austin, 2008)

family responsibility or a public investment—a blue-collar mentality that today haunts much of the Midwest.

Back to Michigan one more time. Although Michigan's age distribution is very much at the national average, there is an anticipated peak in high school graduates in 2008, with a slight drop from 2008 to 2011 (although adult-learner demand will almost certainly compensate for this). In postsecondary education, Michigan is very similar to the national average with a 56.5% women enrollment (the national average is 56.1%), though minority enrollment in higher education is lower than the national average with 17.9% in Michigan compared to 28.2% nationally (Almanac, 2004). As we noted earlier, not only is Michigan's population aging, but the out-migration of the 25- to 44- year old population creates a brain drain with very serious implications.

Equally disturbing is the clear failure in achievement at all levels of the state's educational system. Despite the fact that Michigan ranks as a national leader in measures such as teacher salaries, the performance of its K-12 system over the past several decades has been inadequate. An estimated 44% of Michigan adults currently function at a literacy level one or two in the national Adult Literacy Survey, levels considered too low to function adequately in today's society. 23% of Michigan's current adult population does not have a high school diploma. Only 73% of Michigan 9th graders graduate from high school four years later. Furthermore, only 42% of high school freshmen in Michigan enroll in college four years later, although 90% of 8th graders say they want to go to college, while only 32% of Michigan high school students graduate with

college-ready transcripts, putting the state below the national average of 36% and well behind lead states at 49%.

Although Michigan's system of higher education is generally regarded as one of the nation's best, here too there are challenges. The state's college graduation rates rank below the national average and far below competitor states such as California, Massachusetts, and Minnesota. Although Michigan is home to over 100 colleges, universities, and vocational technical institutions with more than 632,000 students enrolled, half of the students entering Michigan's colleges will not complete a college degree (more than 300,000 dropouts!). Despite high graduation rates at its flagship universities (UM at 90% and MSU at 70%), all other public colleges are at less than 50%.

Michigan's current population has a 22% level of bachelor's or advanced degrees, 4% below the national average, ranking Michigan 34th nationally. Michigan ranks below the national average in the fraction of science and engineering degrees (27% compared to 30%), with this fraction continuing to drop over the past three decades. The share of its workforce trained in science and engineering is also below national averages (6.9% compared to 8.2%) and has been dropping over the past decade. Fortunately despite the out-migration of young knowledge workers, Michigan's research universities have demonstrated the capacity to attract science and engineering students from other states and nations. Furthermore, Michigan has a relatively high rate of retaining high-tech graduates of its universities (79% of instate and 55% of outstate graduates).

This latter statistic is very important. We have noted the growing evidence that a skilled-worker shortage, created by low birthrates, out-migration of young adults, and poor performance of our educational system, poses a serious threat to Michigan's economy. Michigan faces a serious shortage in the human capital required for a knowledge economy, particularly in areas such as science, engineering, information technology, and other knowledge-intensive disciplines.

A recent report from the Michigan State Board of Education states the case: "Michigan's biggest economic challenge is that the state is 34th in four-year degree attainment. As long as that is the case, it is highly likely that Michigan will be one of the poorest states in the na-

tion. As the economy has become increasingly knowledge-based, Michigan has fallen from 18th in per capita income in 2000 to 37th in 2008. To reverse the trend of falling farther and farther behind the nation, nothing matters more than increasing the human capital—the education and skills—of the people of Michigan.” (Michigan State Board of Education, 2010)

Communities

Although many imagine the Midwestern life to consist of small towns and cornfields, in reality over 80% of the region’s population live in large metropolitan areas. Cities such as Chicago, Cleveland, Pittsburgh, Detroit, and St. Louis evolved first as trading and transportation centers and later as industrial concentrations (Longworth, 2008). Of course there is also a small town life in the Midwest; towns that once were market towns for farmers sprinkled across the townships established by the Northwest Ordinance. But today Midwest states such as Ohio, Illinois, Michigan, and Indiana are quite urban, with economies based on heavy manufacturing, with rural communities based primarily on farming largely only a memory. It is likely that with the continuing industrialization of agriculture, most small farming towns will continue to shrink and eventually disappear unless they are the location of a major food-processing plant or close enough to a metropolitan area to draw suburbanites.

Midwestern cities face a different challenge: to globalize their economies and cultures (through immigra-

tion) or slowly fade away. Chicago provides a good example of a city that has managed to turn the corner and enter the new economy based on global trade and business services, enabled by a growing knowledge workforce and a large immigrant population (30%).

Yet here Chicago is unique in the Midwest, currently listed 6th on the Global Cities Index 2010 (along with 8 other U.S. cities) among the top 65 global cities in the world (Foreign Policy, 2010). Unfortunately none of the other cities in the Midwest region have managed to move to the global scale. In fact, several are sliding rapidly backwards. Detroit provides the case study for the other extreme, a city that has seen its population shrink from over 2 million to 800,000, with acre after acre of abandoned neighborhoods and empty factories, burdened by the legacy costs of entitlement practices that can no longer be afforded, a deteriorating infrastructure, dysfunctional public schools, and unable to attract either young knowledge workers or immigrants (only 7%).

Culture

Perhaps because of the farming cultures characterizing their pioneer and immigrant ancestors, Midwesterners have long taken pride in their self-sufficiency, seeking to sustain their communities with hard work and traditional values. In decades past there was a sense of generational responsibility, best illustrated by the strong investment in schools and colleges to provide their children with outstanding education oppor-



The choice before us: global cities or abandoned factory towns

tunities. The Midwest was able to embrace the innovation and risk-taking of men like Ford, Durant, and Kettering as they built great the industries that provided the region with prosperity (Longworth, 2008).

Ironically, however, because of this wealth and prosperity, a culture of expectation and entitlement evolved during the past century that turned the Midwest culture away from innovation and entrepreneurship. People and firms began to believe that prosperity would long endure, high wage jobs with great benefits would continue, without effort or education. Openness, engagement, and comfort with new ideas and people were not valued traits, nor was cooperation among cities, states, companies, and universities. Safety and the status quo were more prized than risk-taking and change. And as this new culture took root in the post WWII economic boom, the Midwest began its slow economic descent. The family farms vanished, the steel mills closed, and the automobile companies began to experienced strong competition from Asia. The decline of the Midwest economy dropped off precipitously with the Internet and the emergence of a truly global, knowledge driven economy, culminating in the bankruptcy of icons such as General Motors in 2009. Today this decline of the Midwest economy continues—yet, unfortunately, so does its denial of the changes required by the global imperatives.

In their panic to save their deteriorating cities, dying industries, and low skill yet well-compensated jobs, Midwest states have declared economic war on one another, launching a barrage of tax cuts and abatements to raid companies and jobs, even though these desperate efforts unbalanced their budgets and destroyed their capacity to invest in the future, e.g., in schools and colleges. The Balkanization of the Midwest intensified with every state—and city—for itself. As Longworth summarizes the current situation “[today]... the industrial Midwest amounts to a wasteland of empty factories, corroding cities, and crumbling neighborhoods. Most of the Midwest remains in denial. Other regions of the world, from New England to India, know they are in global competition and off and running. The truth is just beginning to dawn on much of the Midwest. Heavy manufacturing, the family farm, small towns...all going, going, gone...” (Longworth, 2008)



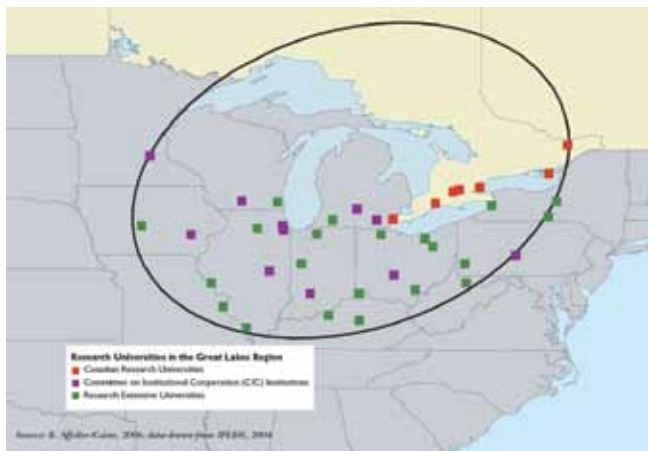
The GM building: a symbol of Michigan's past, but hopefully not its future!

Educational Resources

Numerous studies have established that in the knowledge economy, education has become the key to not only to economic prosperity but as well to one's personal standard of living and quality of life. The breakpoint between those who graduate from secondary and continue on to succeed in college and those who fail is perhaps the most critical decision point in one's life (McPherson and Schapiro, 2005).

With their commitment to “an uncommon education for the common man,” the settlers of the Midwest region built what was once arguably the strongest educational infrastructure in the nation characterized by outstanding schools, colleges, and universities. The region established nation's first secondary school systems, founded many of the nation's leading independent colleges, and created the land-grant public universities to educate the working class and further industry and commerce.

Of particular relevance to the region's future is the presence of perhaps the strongest concentration of research universities in the world. At its core are the Big Ten universities, or more correctly, the C. I. C. (Committee on Institutional Cooperation) group, which consists of the eleven Big Ten universities plus the University of Chicago (CIC, 2008). These twelve universities conduct more research, produce more scientists and engineers, doctors and lawyers, business executives and teachers, than any collection of universities in the world, includ-



The Midwest's concentration of research universities
(Austin, 2008)

ing the University of California, the Ivy League, Oxford and Cambridge, and the other concentrations of leading universities in Europe and Asia. According to Institute of Higher Education at Shanghai Jiao Tong University, 19 of the top-ranked 100 universities in the world are Midwest institutions—compared with only 15 in the Northeast/Mid-Atlantic, and 13 on the West Coast.

Midwest universities are among the nation's leading creators and exporters of talent. With 33 percent of the U.S. population, the Great Lakes states produce 38 percent of the country's bachelor degree holders, 36 percent of all science and engineering degrees, and 37 percent of all advanced science and engineering degrees in 2003—far outstripping any other region of the country. The region's research universities conduct over \$6 billion/year of R&D, enroll over 300,000 undergraduates and 76,000 graduate students, award roughly one-fifth of the nation's doctorates in fields such as engineering, chemistry, mathematics, and computer science. When one adds to these institutions other leading research universities of the Great Lakes regions such as the University of Missouri, Washington University, Cornell, Carnegie Mellon, Pittsburgh, Case-Western Reserve, and Iowa State, one has a significant fraction of the world's top research universities.

As the flagship universities of their states, these institutions already set the pace for broader educational activities, both at the post-secondary and K-12 levels. Each of these universities has built world-class excellence in unique areas (e.g., Illinois in computer technology, Minnesota in chemistry and chemical technology,

Ohio State in materials science and technology, Michigan State and Penn State in agricultural technology, Wisconsin and Michigan in engineering, the natural and social sciences, and biomedical science, Northwestern in medicine and business administration, and Chicago in the humanities and sciences). (Hollis, 2007)

Midwestern universities are strong competitors for federal funds and use these federal dollars to educate students, perform cutting-edge research, and catalyze local economic development. In federal support for university R&D, Midwestern universities capture 16 percent of total federal support for university R&D. Both the University of Michigan and the University of Wisconsin-Madison rank among the top five recipients of federal R&D funds, and the breadth of the region's excellence can be seen by the presence of 11 institutions, at least one from each of the Midwest states, among the top 50 recipients.

The rapid evolution of digital technologies provide powerful new paradigms to integrate together the programs and activities of these institutions. Midwest universities have led the development of this technology for the nation, e.g., University of Minnesota developing the supercomputer, University of Illinois introducing the web browser (Netscape), University of Michigan building the backbone of the Internet, and the University of Indiana today managing the development of Internet2.

Because of their land-grant traditions, Midwestern universities also have a long history of public service and extension, not only within their states but throughout the world. These institutions are characterized by a long tradition of global outreach and international development that might enable them to coalesce into a true "world university", reaching into all parts of the globe to open up new markets and access world-class human capital. Perhaps most important, there is a long-standing tradition of cooperation among these institutions (in addition to their highly visible competition through the Big Ten Athletic Conference). They work together on both regional and national agendas, merging library and research resources, and sharing curricula and instructional resources with faculty and students. Aggregating these "spires of excellence" by linking these institutions would give the region the world's leading programs in a broad range of key knowledge

areas.

While the flagship public research universities in the Great Lakes region face similar challenges today as their state's budgets struggle to cope with staggering costs for health care, corrections, security, and infrastructure in the face of political forces demanding tax relief, this has made them lean and mean.

The Midwest is also characterized by a concentration of many of the nation's leading independent colleges, coordinated through organizations such as the Great Lakes College Association, and committed to providing undergraduate education of exceptional quality within the liberal arts tradition. These colleges have a remarkable record of sending their graduates on to further study at the graduate and professional level to become some of the nation's leading scientists, physicians, lawyers, teachers, and public leaders.

The strong commitment of the Midwest states to broaden opportunities for higher education have led to an extensive network of regional universities and community colleges. Many of these evolved from specialized institutions such as the normal colleges focused on teacher education to become comprehensive universities with substantial offerings at the graduate level. The region's community college have also evolved over time beyond their original role to provide young high school graduates with local access to professions requiring associate degrees or transitional curriculum to enable admission to baccalaureate programs offered by universities. Today these community colleges play a critical role in providing college level instruction to adults seeking to expand their skills and track the ever-changing requirements of the workplace. Since independent colleges, regional universities, and community colleges play a critical role in extending college opportunities—what the Europeans call “massification”—they must be an essential element of any educational strategy for the Midwest. We will return in Chapter 6 to consider both their role and the likelihood that they will continue to evolve, broadening and deepening their educational mission, to serve the emerging knowledge economy.

Research, Development, and Innovation

Although much of the culture of innovation that helped make the Midwest an economic leader has been lost, the region continues to possess strong and powerful assets needed to compete in today's economy, assets that, if built upon, could accelerate its transformation. The region remains the advanced manufacturing cockpit of the world, with the sector becoming more competitive, productive, and of better quality even as it employs far fewer people. At the same time, it is a globally significant center of new knowledge creation, talent, and innovation, with an unrivaled network of private and public research and higher education institutions; globally engaged businesses, cities, and civic institutions; a huge, strategically located marketplace; and unique water and natural resource attributes. Finally, as the pioneer in the creation of today's social welfare system, the Great Lakes states are an ideal laboratory for remaking public policy to more effectively and efficiently support economic success and security, helping workers adapt to a more unpredictable economic environment than that of the past.

Research and development is an integral part of the Midwest's regional economy (Koizumi, 2008). In 2004, the latest year for which comprehensive figures on industrial as well as federal R&D expenditures are available, \$53 billion was spent on R&D in these seven states, accounting for 18 percent of the national effort. This is roughly proportional to the Midwest's one-fifth share of the U.S. population. Private industrial firms dominate R&D in the Midwest. Of the \$53 billion in R&D performed in the Midwest in 2004, \$43 billion was funded by industry. Taken together, the Great Lakes states perform 29 percent of the nation's total public and private research and development (Koizumi, 2008).

This region received \$8.1 billion in federal R&D funds in fiscal year (FY) 2005, 7.3 percent of the national total. Over time, the Midwest's share of total federal support for R&D has been mostly steady at around 7 percent, except for fluctuations in Ohio's defense R&D. The result is that the flow of R&D funds to the region has mirrored national trends in R&D funding. The Midwest's steady share of total R&D is a result of the diversity of the region's R&D institutions and federal funding sources, detailed earlier in this report, and this



University of Michigan



University of Wisconsin



University of Illinois



University of Minnesota



Michigan State University



University of Iowa



Purdue University



Penn State University



Northwestern University



University of Indiana



Ohio State University



University of Chicago

The CIC (Committee on Institutional Cooperation) Universities



Cornell University



University of Missouri



Case Western Reserve University



Iowa State University



Notre Dame University



University of Pittsburgh



University of Rochester



SUNY Buffalo



Syracuse University



University of Illinois Chicago



Washington University



University of Toronto

The Midwest-Great Lakes region has many other world class universities.



Oberlin College



Allegheny College



Dennison College



Depauw University



Earlham College



Hope College



Kalamazoo College



Kenyon College



Ohio Wesleyan



Wabash College



Wooster College



Antioch

The Great Lakes College Association



Eastern Michigan University



Indiana State University



Miami University



Michigan Tech



Missouri State University



Ohio University



Southern Illinois University



Wayne State University



Western Michigan University



Kalamazoo Community College

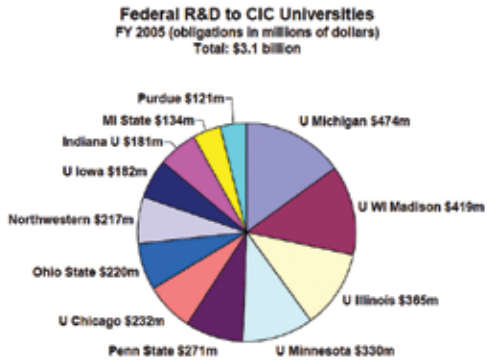


Lansing Community College



Oakland Community College

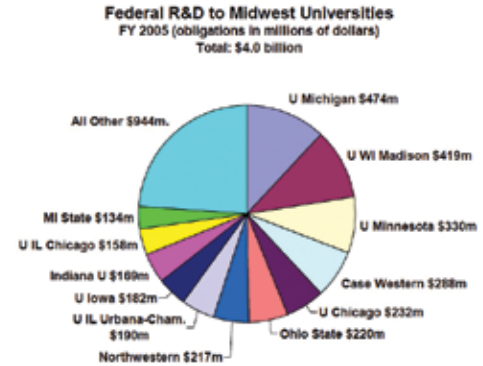
Comprehensive Universities and Community Colleges



Source: National Science Foundation, Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions, FY 2005, 2007.
R&D = conduct of R&D and R&D plant.
MAY '08 © 2008 AAAS



The Midwest's concentration of research universities
(Koizumi, 2008)



Source: National Science Foundation, Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions, FY 2005, 2007.
R&D = conduct of R&D and R&D plant.
MAY '08 © 2008 AAAS



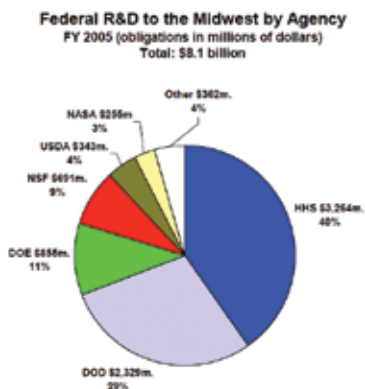
The Midwest's concentration of research universities
(Koizumi, 2008)

consistency suggests that the future of R&D in the Midwest will continue to closely track national trends. But in recent years, the share has trended downward and broke through 8 percent in 2004 down to a new low of 7.3 percent in 2005, just when the overall federal R&D investment grew slower than the rate of inflation in 2005 for the first time in a decade. As in the nation as a whole, federal support of R&D in the Midwest has helped to build a strong R&D enterprise. Federal support for R&D has been especially important for the region's universities, which are world-class centers of excellence that not only perform research at the frontiers of knowledge but attract faculty and students from all over the world. Federal funds have also helped to sustain the region's privately funded R&D, through the support of graduate education of scientists and engineers at the region's universities who go on to staff industrial R&D labs and also through linkages between federal and private R&D, especially evident in the Midwest in the links between commercial agriculture and federally funded agricultural research.

The Midwest is home to a number of companies with strong R&D investments, such as GM, Ford, 3M, and Motorola, all of which have large R&D laboratories in the region. 24 percent of the nation's industry-funded R&D, now approaching \$180 billion a year, is performed in the Midwest. The Midwest has traditionally relied on industrial R&D for the strength of its R&D enterprise, but the federal role is also crucial in sustaining the knowledge and science bases that are the foun-

ation of future discoveries and industries. In FY 2005, the latest year for which statistics on federal government obligations are available, the federal government obligated \$8.1 billion in funds for R&D to the Midwest. Of this amount, the largest share (\$3.9 billion) went to the region's universities, followed by industrial firms (\$1.8 billion), government labs (\$1.1 billion), and three federally funded research and development centers in Illinois and Iowa (\$670 million). Although the flow of federal R&D funds to the region is significant, it is less than what one might expect based on the region's population and economic strength. For the past few decades, federal R&D to the Midwest has remained fairly steady at about 8 percent of total federal R&D, although in recent years this share has dipped toward 7 percent. This is less than the Midwest's 17 percent share of the U.S. population and is far less than the Midwest's 24 percent share of industry-funded R&D.

Federal support for R&D is especially important to the region's network of large research universities, many of which were founded as land-grant institutions nearly 150 years ago. Together, the Midwest's universities received nearly \$4 billion in R&D funds from the federal government in FY 2005 (see Table 3), and received even more in federal funds when training grants, student aid, and other funds are counted. Nearly two thirds of the federal funds for university R&D came from the Department of Health and Human Services (HHS), home of the National Institutes of Health (NIH; see Chart 4). NIH funds nearly two thirds of total



Source: National Science Foundation, Federal Funds for Research and Development, Fiscal Years 2005, 2006, and 2007, 2008.
R&D = conduct of R&D and R&D plant.
6/17/08 © 2008 AAAS



Federal R&D support to the Midwest by agency
(Koizumi, 2008)

federal support for university research, and that is true for the Midwest as well. In FY 2005, HHS sponsored \$2.6 billion in R&D in Midwestern universities, nearly four times as much as the next-largest sponsor, the National Science Foundation with \$666 million. Other important sponsors are the Department of Defense (DOD, \$234 million), the National Aeronautics and Space Administration (NASA, \$87 million), the Department of Energy (DOE, \$152 million), and the U.S. Department of Agriculture (USDA, \$133 million).

Midwestern firms receive only 4 percent of total federal support for R&D, chiefly because the largest defense contractors, who receive over half of all federal support for industrial R&D, are located outside the region in the South and the West. Similarly, government labs in the region receive only 5 percent of total federal support for government labs. The three Midwest national labs operated account for 7 percent of total federal spending on such facilities.

Working together, this public and private basic and applied research base contributes a significant share of both nations' new ideas and new intellectual property—cornerstones of productivity gains and new products and firms. For example, the Great Lakes states produce nearly a third of the nation's new intellectual property in the form of patents.

The Midwest is home to three federally funded research and development centers, which performed \$679 million in federal R&D in FY 2005, mostly for the Department of Energy (DOE). Argonne National Labo-

ratory and Fermi National Accelerator Laboratory, both in Illinois, performed \$333 million and \$319 million in R&D, respectively, and Ames Laboratory in Iowa performed \$27 million in FY 2005. DOE is the third-largest federal sponsor of R&D in the Midwest with a total of \$855 million.

Yet despite its strong network of higher education institutions, the Great Lakes region has not been terribly successful spurring new firms, jobs, and industries. Overall, the region has not created enough jobs in high-wage advanced services industries to offset declines in factory jobs, and has struggled to commercialize and develop locally the fruits of its research products and innovations. But while once the hotbed of innovation, much of the region lacks the entrepreneurial, churning, change-oriented economic culture needed to translate ideas into jobs. Minneapolis-St. Paul is the only large Great Lakes metro that ranks among the top 20 percent of the nation's most entrepreneurial areas.

The region's lagging entrepreneurialism is likely a product of several forces. First, small business creators and owners are better educated and more likely to be longer-term community residents. Low overall education levels in the region and the continued out-migration of young talent could thus be hindering the development of new enterprises. Venture capital firms want to have their investments nearby and today is concentrated largely on the coasts, leaving a void in the middle part of the country. Another impediment to entrepreneurialism in the Great Lakes region may be the change-averse culture that has been nurtured through several generations of industrial employment.

Ultimately, it may simply be that the Great Lakes culture as it has evolved does not today promote or encourage entrepreneurial behavior. Openness, engagement, and comfort with new ideas and people are central features of innovative communities.

Lessons from the Past, Challenges for the Future

In *Alice Through The Looking Glass*, the Red Queen warns: "Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!" (Brown, 2007) Such is life in today's hypercompetitive global, knowledge-driven economy where only

world-class products and services survive. What assets of the Midwest region are sufficiently world-class to compete, to run twice as fast, particularly if today's artificial barriers were removed (e.g., trade restrictions, tax subsidies, perhaps even time and space if Moore's Law continues to rule)? Our companies? The quality of our workforce? The quality of our business environment? The quality of our government? Our universities? Our weather? Or none of the above?

Certainly the natural assets of the Midwest region are immense positives—the Great Lakes, its fertile farmlands, the forests now re-emerging after a century of exploitation, and of course, the relative safety from natural disasters such as hurricanes or earthquakes (leaving aside the New Madrid fault for the moment). Its geographic location, at the center of one great nation and across the border from another, and its role as a transportation and telecommunications nexus for the work are also great assets.

However much of its civic infrastructure such as its transportation systems, urban infrastructure, and industrial facilities evolved long ago to serve a factory-based manufacturing economy that is now dying. The same can be said for its policy environment—state and local governments that originally evolved to serve regions drawn on maps long ago that made little geographic or economic sense and today have demonstrated an extraordinary resistance—indeed, incompetence—in adapting to the imperatives of a global, knowledge economy.

But perhaps the greatest weakness of the Midwest, its Achilles' heel, is its human capital, an aging workforce, inadequately educated and skilled for the global economy, addicted to entitlements and stability, resisting the key characteristics that will determine the future of the region, innovative skills, entrepreneurial zeal, immigration, risk, and change. Today many have forgotten or ignored the remarkable history of the Midwest, the great creativity and innovation of wave after wave of immigrants who build the farms, factories, and cities that both sustained and defended a 20th century world, and who invested heavily and sacrificed so that their descendants could benefit from world-class educational opportunities and enjoy a life better than theirs.

The Midwest must embrace, not hide from globalization and the emerging world economy. It has be-

come increasingly clear that it can thrive only if it meets its global challenges on a regional basis. It must cast aside 19th century political and social structures and 20th century entitlement cultures and practices and look to the future. It must remember and embrace the philosophy that once made the region an economic and social leader: its strength lies in its people, in their skills and diversity, in their ambition and drive, and in their hopes and their dreams. For it is only by investing in its people, in their learning and skill and creativity, can the Midwest restore and sustain its prosperity and leadership in an ever more competitive knowledge-drive world.

Chapter 4

The Midwest Tomorrow: A Vision for the Future

The dogmas of the quiet past are inadequate to the stormy present. The occasion is piled high with difficulty, and we must rise to the occasion. As our case is new, so must we think anew.

—Abraham Lincoln, signing the 1862 Morrill Act providing for federal land-grant colleges.

Clearly the future of the Midwest states will be determined by the region's success in building a world-class learning and innovation infrastructure for its citizens. But just what is the nature of such a challenge? This can be most easily framed in terms of three important questions:

1. What skills and knowledge are necessary for individuals to thrive in a 21st century, global, knowledge-intensive society?

Clearly a college education has become increasingly mandatory for most careers in the knowledge economy, probably at the bachelors level, and for many, at the graduate level. Beyond this goal, a region should commit itself to providing high quality, cost-effective, and diverse educational opportunities to all of its citizens throughout their lives, since during an era of rapid economic change and market restructuring, the key to employment security has become continuous education.

2. What skills and knowledge are necessary for a population (workforce) to provide regional advantage in such a competitive knowledge economy?

Here it is important to stress that the concern is no longer competition among cities and states within the Midwest region for prosperity or with other states such as California or Texas. More serious is the competition from the massive and increasingly well-educated workforces in emerging economies such as China, India, and Central Europe.

3. What level of new knowledge generation (e.g., R&D, innovation, entrepreneurial zeal) is necessary to sustain a 21st century knowledge economy, and how is this achieved?

It has become increasingly clear that innovation is the key to global competitiveness in regions aspiring to a high standard of living. And the keys to innovation are new knowledge, human capital, infrastructure, and forward-looking public policies. Not only must a region match investments made by other states and nations in education, R&D, and infrastructure, but it must recognize the inevitability of new innovative, technology-driven industries replacing old obsolete and dying industries as a natural process of "creative destruction" (à la Schumpeter) that characterizes the hypercompetitive global economy.

But such inquiries only scratch the surface. There are also deeper, critical questions: What does it mean to be "an educated person" in the 21st century? What does it mean to be "literate"? What will be our needs for the deeper purposes of academic institutions, such as their capacity to generate new knowledge, to preserve and transfer the cultural achievements of our civilization from one generation to the next, to serve as a constructive social critic, and to produce the human capital and innovation necessary for prosperity and security?

Clearly, the implications of a global, knowledge-driven economy for discovery-based learning and knowledge institutions—schools, colleges, and universities—are particularly profound. The knowledge economy is demanding new types of learners and creators. Globalization requires thoughtful, interdependent and globally identified citizens. New technologies are

changing modes of learning, collaboration and expression. And widespread social and political unrest compels educational institutions to think more concertedly about their role in promoting individual and civic development. Institutional and pedagogical innovations are needed to confront these dynamics and insure that the canonical activities of universities – teaching, research, and engagement – remain rich, relevant and accessible.

Implications for Workforce Development

Today and ever more so in the future, the knowledge content of jobs will increasingly determine their value and hence compensation at levels determined by a global marketplace. Highly educated, high-skill knowledge workers will become the backbone of the workforce of the most prosperous economies. The low-skill but generously compensated factory jobs that once powered the Midwest's economy and sustained its middle class will disappear as these jobs continue to be off-shored to regions characterized by labor costs more competitive in the global economy. To be sure, Midwest industry will continue to manufacture products. But tomorrow's factories will likely employ only a handful of workers, e.g., highly trained engineers to program the robots performing the tasks that once employed millions of the Midwest's workforce. Instead most of the region's manufacturing jobs will be in knowledge-intensive areas such as R&D, design, global supply chain management and logistics, marketing, sales, and service. These are the high-pay jobs that will sustain the middle class, and they will all require not only a college education but furthermore a commitment to lifelong learning. (Glazer, 2010)

Yet what about those in the Midwest's current workforce whose education and skills have been swept aside by a hypercompetitive global economy? Here the region faces a serious dilemma. The reality is that the Midwest is no longer capable of supporting its current population with an economy based upon low-skill yet highly compensated manufacturing jobs that are rapidly being off-shored. It is clear that the legacy costs of the old entitlement culture can no longer be sustained without a dramatically restructured economy capable of generating wealth in the global, knowledge-driven



The workplace of the old economy



The workplace of the new economy

economy.

Hence the most immediate priority of the Midwest region—its governments, cities, and towns—is to make the investments today that will create the knowledge and human resources capable of competing and prospering in a global knowledge-driven economy. But this will take time. We must first elevate our educational, research, and innovation resources to the world-class levels. Then we must utilize these assets to provide future generations with world-class education opportunities, innovative skills, and entrepreneurial spirit. The Midwest must take bold actions to recapture the resources necessary to upgrade the quality of its workforce, to provide its citizens with the educational opportunities and skills demanded by the global economy. Put more bluntly, the regions must shrink the burdens of a workforce no longer competitive in the global economy



The Midwest's future!

if it is to free up the resources necessary to invest in its future. It must downsize its public and private commitments and legacy costs (e.g., health care, pensions, corrections, social services) to levels more appropriate for a smaller population, particularly in those cities experiencing major economic decline and population loss. It must restructure its tax, expenditure, entitlement, and legacy cost structures to align with this "smaller but better educated" population.

How can we jump-start this process? It is estimated that the majority of new jobs created in the knowledge economy will require not only a college degree but also education in science and mathematics necessary to master the new technologies driving the global economy, e.g., computers, networks, biotechnology, and engineering. Yet today in the Midwest, less than one quarter of our workforce have such educational credentials or skills. Sadly, it is unrealistic to expect that the skills of much of our current workforce can be upgraded to world-class levels. The reality is those workers with skills and education no longer competitive in the global, knowledge economy will face the choice of either accepting the few remaining jobs compatible with their skills at far lower compensation or migrating elsewhere to economies less burdened by entitlement cultures and

legacy costs. Hence even if we are able to free up the resources necessary to invest in educational opportunity for our future workforce, we will still face the challenge of building a globally competitive workforce for today.

Immigration

There is only one way to rapidly upgrade the quality of our workforce: immigration. The Midwest must simply set aside its xenophobic tendencies and embrace once again immigration as absolutely essential for its future prosperity—just as it has been, of course, for its past successes. We should remember that the Midwestern United States was settled and built by generation after generation of immigrants. In fact, nearly all Americans are descended from people who came from other parts of the world in the past couple of centuries. They built our farms and cities, our companies and industries, providing our spirit and drive, shaping our culture and values, and establishing this region as the economic engine of the work.

Today immigrants are needed once again not only to do the work that must be done to keep the Midwest functioning, but to provide it with the knowledge workers and entrepreneurs so essential to its future.

Fortunately, today the immigrants are coming again, to take the jobs offered by global cities. It is estimated that during the past two decades 25% of new U.S. ventures (and 50% of Silicon Valley firms) were created by immigrants. A disproportionate number of U.S. breakthrough inventions have come from immigrant inventors. And, of course, the massive flow of refugees from war-torn Europe during the 20th century brought many of the scientists and engineers who not only helped the Allies win WWII, but also have been the Nobel Prize winners and inventors sustaining American science and technology. (*The Economist*, 2009)

It is abundantly clear that cities and regions that are booming today all have large and growing foreign-born populations, for example New York and San Francisco at 35% and Chicago at 30%. Cities in trouble do not—such as Detroit at 7.5%, Cleveland at 3%, Indianapolis at 3.5%, and St. Louis at 3%. In fact it might even be suggested that one way to assess whether a metropolitan area will be capable of surviving as a global entrepot in today's hypercompetitive economy is to consider its attractiveness to immigration. Unfortunately, with the exception of Chicago, most Midwestern cities face a serious challenge (Foreign Policy, 2010; Longworth, 2008.)

Yet there is another lesson here that can be learned from our neighbors to the north. One key reason that Canada fares better than the United States in international measures of college attainment is that it attracts a better-educated mix of immigrants. Although a larger share of Canada's population is foreign-born (20% com-

pared to 12% in the U.S.), the regions of origin are much different. About 52% of US immigrants and 11% of Canadian immigrants come from Latin American nations with relatively weak educational infrastructure. In contrast, about 14% of US immigrants and 37% of Canadian immigrants come from Europe. (*Chronicle*, 2009) People from Asia and the Middle East also account for a larger share of the Canadian immigrant stream. About a third of immigrants in the US over the age of 25 do not have a high-school diploma, compared to only 10% of Canadian immigrants.

In summary, immigration is vital to growing the regional economy and can increase innovation and entrepreneurship, grow talent, and transform the culture of the Midwest. The region needs all the immigrants it can get. This is particularly true of more educated Asians, Europeans, and Africans but also true of poorly educated Latinos. The Midwest needs to speak with one voice in demanding that its needs for more workers and citizens are met. The only immigration policy that will help the Midwest is one that opens the door as widely as possible (Longworth, 2008).

Learning in the Digital Age

Today's students are citizens of the digital age. They have spent their early lives surrounded by robust, visual, interactive media—not the passive broadcast media, radio and television of our youth, but rather Wii's, iPhones, Facebook, and virtual reality. They are "digital



Today's college students



The Millennial Generation

natives”, comfortable learning, working, and living in the digital world, unlike those of us who are “digital immigrants” who are struggling to keep pace with digital technologies (Pensky, 2001). This is not an easy task for educators, who for the most part remain reluctant to embrace the new technologies in their teaching and hence are increasingly detached from today’s students (Gura and Percy, 2005).

Today’s students are no longer the people our current educational system was designed to teach. Rather they learn by experimentation and participation, not by listening or reading passively. They are indeed the “plug and play” generation. They embrace interactivity and demand the right to shape and participate in their learning. They are comfortable with the uncertainty that characterizes their change-driven world. These students will increasingly demand new learning paradigms more suited to their learning styles and more appropriate to prepare them for a lifetime of learning and change.

New knowledge media are forcing us to rethink the nature of literacy. We have seen the definition of literacy shift before in history, from the oral tradition to the written word to the images of film and then television and now to the computer and multimedia. Of course there are many other forms of literacy: art, poetry, mathematics, science itself, etc. But more significantly, the real transformation is from literacy as “read only, listening, and viewing” to composition in first rhetoric, then writing, and now in multimedia. Both young, digital-media savvy students and adult learners will likely demand a major shift in educational methods, away from passive classroom courses packaged into well-defined degree programs, and toward interactive, collaborative learning experiences, provided when and where the student needs the knowledge and skills. Emerging technologies that enable social networking to form learning communities and immersive virtual environments for simulation and play facilitate the “deep tinkering” that provides the tacit knowledge necessary to “learn to be”, tools already embraced by the young if not yet the academy. In the language of the digital generation, learning has become “hanging out” (knowing), “messaging around” (playing), and “geeking out” (creating) (Ito, 2009; Brown, 2009).

From a broader perspective, our society increas-

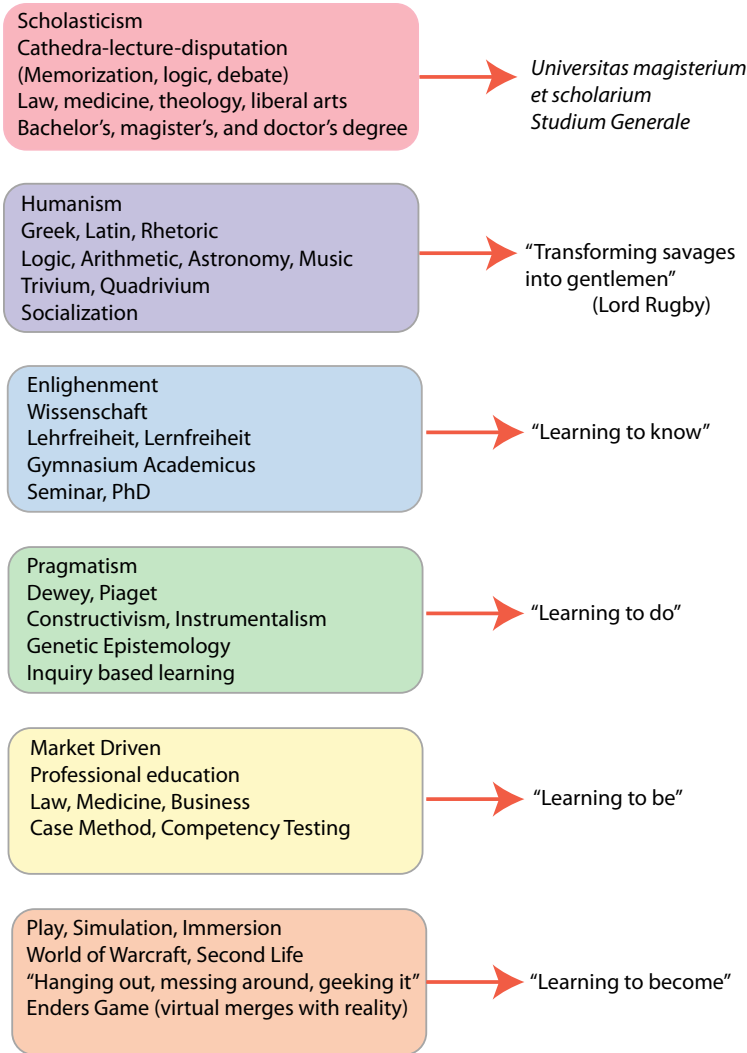


Time to prepare for “Generation Z”

ingly values not just analysis but synthesis, enabled by the extraordinary tools of the digital age. Learning occurs not simply through study and contemplation but through the active discovery and application of knowledge. From John Dewey to Jean Piaget to Seymour Papert, we have ample evidence that most students learn best through inquiry-based or “constructionist” learning. As the ancient Chinese proverb suggests “I hear and I forget; I see and I remember; I do and I understand.” To which we might add, “I teach and I master!” (Brown, 2009)

Lifelong Learning

Today, learning has become a lifelong activity since a changing world will demand that students continue to learn, through both formal and informal methods, throughout their lives. Of course, K-12, college, or even graduate and professional education was never intended to provide all of the knowledge needed for a lifetime. But in years past, most of the additional knowledge necessary for a career could be acquired informally, through on-the-job learning or self-study. Today, however, both rapid growth of knowledge and the multiple career transitions facing graduates demand a more strategic approach to lifetime learning. We need to rethink educational goals from this lifetime perspective. We should view K-12 and college as just steps—important step to be sure—down the road of a lifetime of learning. This would allow us to better match learning content and experiences with both the intellectual



Pedagogy continues to evolve,
demanding evolution in our institutions

maturity and the needs of the learner.

The needs for lifelong learning opportunities in a knowledge society are manifold. The shelf life of education acquired early in one's life, whether K-12 or higher education, is shrinking rapidly in face of the explosion of knowledge in many fields. Today's students and tomorrow's graduates are likely to value access to lifelong learning opportunities more highly than job security, which will be elusive in any event. They understand that in the turbulent world of a knowledge economy, characterized by outsourcing and off-shoring to a global workforce, employees are only one paycheck away from the unemployment line unless they commit to continuous learning and re-skilling to adapt to every changing work requirements. Furthermore, longer life

expectancies and lengthening working careers create additional needs to refresh one's knowledge and skills.

Today's college graduates expect to change not simply jobs but entire careers many times throughout their lives, and at each transition point, further education will be required—additional training, short courses, degree programs, or even preparation for new professions. 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.

In fact, we might even make the case that it is time for the nation to step up to its responsibility as a democratic society to enable all of its citizens to take advantage of the educational, learning, and training opportunities they need and deserve, throughout their lives, thereby enabling both individuals and the nation itself to prosper in an ever more competitive global economy. While the ability to take advantage of educational opportunity always depends on the need, aptitude, aspirations, and motivation of the student, it should not depend on one's socioeconomic status. Access to lifelong learning opportunities should be essentially a civil right for all rather than a privilege for the few if the nation is to achieve prosperity, security, and social well-being in the global, knowledge- and value-based economy of the 21st century.

Of course, establishing universal access to lifelong learning as a national goal would require not only a very considerable transformation and expansion of the existing education enterprise, but it would also require entirely new paradigms for the conduct, organization, financing, leadership, and governance of 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.

One approach would be to utilize a combination of transportable education savings accounts and loans, perhaps indexed to future earnings much like Social Security by mandatory earmarking of a portion of an individual's earnings over their careers as a source of funds for their education. Here, in contrast to Social Security, which amounts to saving over a career for one's relatively unproductive golden years, instead one would be borrowing and investing on the front-end to enhance one's personal productivity and hence lifelong prosperity through future education. By making such lifelong learning ("LiLa's") savings accounts mandatory, again like Social Security, one would create a sense of ownership on the part of all citizens, thereby making it more likely that they would seek to take advantage of the educational opportunities provided by their account. A variation on this theme would be to access the capital markets by using the government (either federal or state) to borrow money at low interest rates to be loaned to students, and then provide strong tax incentives to employers to assist students in paying off these loans during employment. Note employer participation would bring another very important consumer to the table, since clearly employers (private or public) would want to demand high-quality learning experiences in disciplines of importance to their enterprise if they are going to pay off the student loans of their employees.

The Globalization of Education

Globalization and the attendant emergence of the

global knowledge economy are exerting tremendous pressures on learning institutions around the world and reshaping some of their basic assumptions and activities. The international movement of students and scholars in higher education was the earliest expression of these conditions, and it continues to be the most visible expression of the global nature of the higher education enterprise. Today students in the millions are internationally mobile in search of a university degree and a cross-cultural experience. Universities and their faculties build international linkages, attracting students from far and wide for their academic programs, and augmenting these with exchange programs, sabbaticals, and conferences to support the free exchange of knowledge and ideas.

The global knowledge economy has stimulated an explosion in the demand for higher education, with the number of university students estimated to increase from 50 million in 2000 to over 150 million by 2025 (Daniels, 2001). While the leading American universities continue to dominate world rankings, their high-cost instructional programs and multiple missions such as socializing young adults and running academic medical centers are unlikely to be adopted by most of the rest of the world. Rather most nations are developing national strategies that link higher education directly to economic development in such a way as to stimulate strong public and private investments in expanding educational opportunities and developing world-class capabilities in advanced education and research. Although Europe continues to depend primarily upon public universities, in much of the rest of the world and particular in Asia, private higher education, including for-profit institutions, is expanding rapidly (Johnson, 2010).

The higher-education needs of large populations and rapidly expanding economies based on highly skilled workforces has stimulated massive investments in higher education in Asia, particularly in Singapore, Korea, China, and India. Europe is also successfully implementing important regional strategies such as the Bologna Process aimed at stimulating greater commonality and cooperation among national higher education systems while elevating the importance of university research through the European Research Area (Adelman, 2009).

The implications of the globalization of higher education are immense for American colleges and universities, both for opening up new markets for students but perhaps more importantly, for increasing competitive pressures as more world-class universities emerge as a consequence of national and regional strategies addressing the imperatives of the global economy (Weber, 2007). For example, American universities are heavily dependent on immigration, with over 50% of graduate students and 25% of faculty members in science and engineering being foreign born. As research universities around the world rapidly increase in value, there will be increased competition for this academic talent that could stem the flow to U.S. universities. The brain gain provided by the contribution of international students and faculty to American higher education may become a brain drain as the global emergence of high-quality universities attract these ex-patriots back to their home countries. Yet it is also clear that current U.S. policy at the state and federal level has yet to address the challenges and opportunities presented by globalization.

Broadening Educational Opportunity

As *The Economist* notes, the rise of the knowledge economy has driven the democratization of education, as an increasing fraction of the workforce will need to have access to postsecondary education. As knowledge has replaced physical resources as the driver of economic growth, schools, colleges, and universities have become the most important engines of the knowledge economy. This is happening throughout the world, not only in developed nations in North America, Europe, and Asia, but in all regions—developed, developing, and underdeveloped— aspiring to prosperity and security in an intensely competitive global, knowledge-driven economy. And here, market competition extends far beyond traditional business and trade to include knowledge resources such as human capital, R&D, and innovation, all both key products and assets of learning institutions (*The Economist*, 2005).

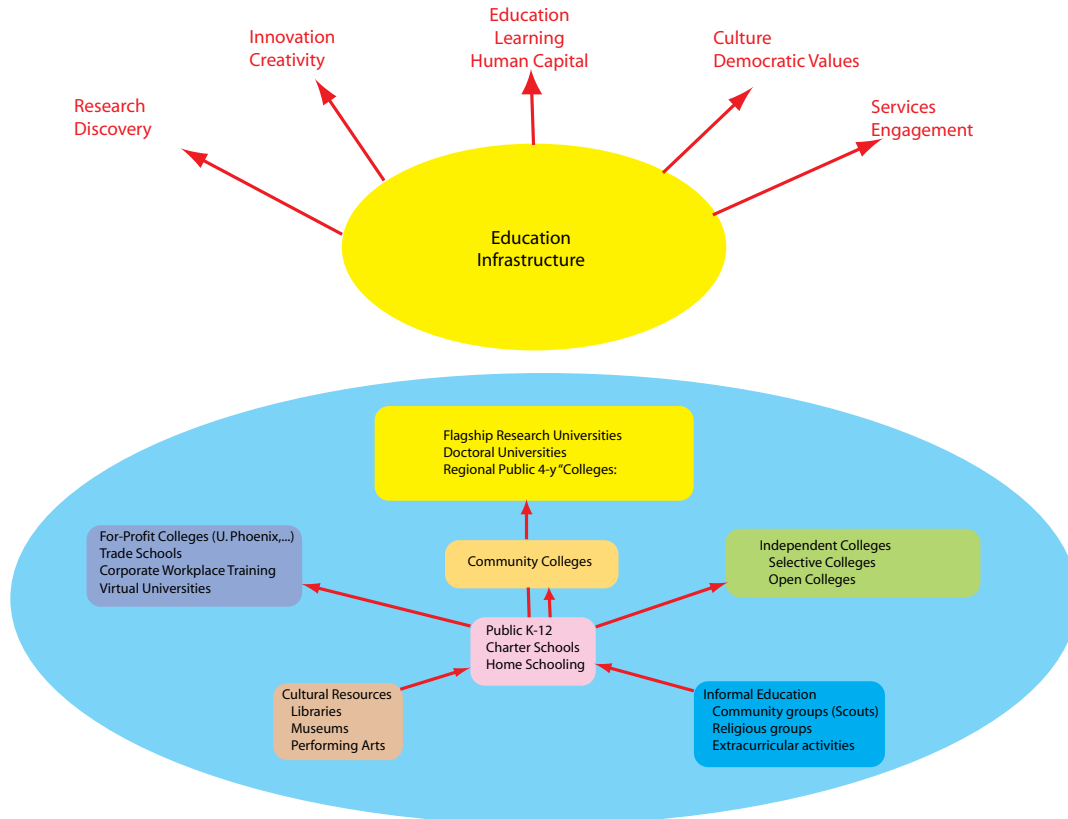
But this raises an important challenge to balance the twin demands of mass access, necessary for a competitive workforce, and world-class quality, necessary to provide the new knowledge and innovation essential for a knowledge economy. As *The Economist* notes, “We



Today’s students are far more diverse in age, ethnicity, nationality, and interests.

already possess a successful model of how to organize higher education: America’s. That country not only has almost a monopoly on the world’s best universities, but also provides access to higher education for the bulk of those who deserve it.” State and federal governments play a more limited role in American higher education since almost two-thirds of the support for our colleges and universities comes from the private sector, e.g., tuition and philanthropy, rather than federal or state government. This creates a highly market-driven and diverse array of colleges and universities, evolving and adapting to serve the ever-changing and diverse needs of American society. To conclude, *The Economist* stresses: “There is no shortage of things to marvel at in America’s higher education system, from its robustness in the face of external shocks to its overall excellence. However what particularly stands out is the system’s flexibility and its sheer diversity.”

Key in the achievements of both excellence and access in American higher education has been the public university, which today educates 80% of all college students in this country while conducting 70% of its research. With an expanding population, a prosperous economy, and compelling needs such as national security and industrial competitiveness, the public was willing to make massive investments in higher education during the 20th century. While elite private universities have been important in setting the standards and character of higher education in America, it has been the public university that provided the capacity and di-



A “learning ecology” for the Midwest

versity to meet our nation’s vast needs for postsecondary education.

Today, however, in the face of limited resources and more pressing social priorities, this expansion of public support of higher education has slowed. While the needs of our society for advanced education will only intensify as we evolve into a knowledge-driven world culture, it is not evident that these needs will be met by further expansion of our existing system of public universities. The terms of the social contract that led to these institutions are changing rapidly. The principle of general tax support for public higher education as a public good and the partnership between the federal government and the universities for the conduct of basic research are both at risk, a consequence of the increasingly limited tax resources and the declining priority given higher education in the face of other social needs. (Zemsky, 2005; Newman, 2004)

Today, even as the need of our society for postsecondary education intensifies, we also find erosion in the perception of education as a public good deserving of strong societal support. States have joined the federal

government by shifting priorities away from investment in the higher-education enterprise (appropriations to institutions) to investment in the marketplace for higher-education services (loans or tax benefits to students and parents). Whether a deliberate or involuntary response to the tightening constraints and changing priorities for public funds, the new message is that education has become a private good paid for by the individuals benefiting most directly—the students. This shift from the perception of higher education as a public good to an individual benefit has another implication. To the degree that higher education was a public good, benefiting all (through sustaining democratic values, providing public services), one could justify its support through taxation of the entire population. But viewed as an individual benefit, public higher education can become a highly regressive social enterprise since, in essence, the poor subsidize the education of the rich, largely at the expense of their own opportunities.

Even more fundamentally, as we enter the new millennium, there is an increasing sense that the social contract between educators and American society may

need to be reconsidered and perhaps even renegotiated once again. *In an age of knowledge, it has become the responsibility of democratic societies to provide their citizens with the education and training they need, throughout their lives, whenever, wherever, and however they desire it, at high quality and at an affordable cost.*

Of course, this has been one of the great themes of education in America. Each evolutionary wave innovation in education has aimed at educating a broader segment of society, at creating new educational forms to do that—primary and secondary schools, public universities, land-grant universities, the normal and technical colleges, community colleges, and today’s emerging generation of cyberspace universities. Our efforts to meet the educational needs of the 21st century are constrained, in part, by institutions, systems, policies, and politics which were determined by a 20th century industrial society.

But we now will need new types of educational institutions with new characteristics:

1. Like other social institutions, our schools, colleges, and universities must become more focused on those whom they serve. They must transform themselves from faculty-centered to learner-centered institutions, becoming more responsive to what their students need to learn rather than simply what their faculties wish to teach.

2. Society will also demand that educational institutions become far more affordable, providing learning opportunities within the resources of all citizens. Whether this occurs through greater public subsidy or dramatic restructuring of the costs of higher education, it seems increasingly clear that our society—not to mention the world—will no longer tolerate the high-cost, low-productivity paradigm that characterizes much of education in America today.

3. In an age of knowledge, the need for advanced education and skills will require both a personal willingness to continue to learn throughout life and a commitment on the part of educational institutions to provide opportunities for lifelong learning. The concepts of student and alumnus will merge.

4. America’s highly partitioned system of education will blend increasingly into a seamless web, in which primary and secondary education; undergraduate, graduate, and professional education; on-the-job training and continuing education; and lifelong enrichment become a continuum.

5. Already new forms of pedagogy are emerging: asynchronous (anytime, anyplace) learning that utilizes emerging information technology to break the constraints of time and space, making learning opportunities more compatible with lifestyles and career needs; and interactive and collaborative learning appropriate for the digital age, the plug-and-play generation. In a society of learning, people would be continually surrounded by, immersed in, and absorbed in learning experiences, i.e. ubiquitous learning, everywhere, every time, for everyone.

6. The great diversity characterizing higher education in America will continue, as it must to serve an increasingly diverse population with diverse needs and goals. But it has also become increasingly clear that our institutions must strive to achieve diversity within a new political context that will require new policies and practices.

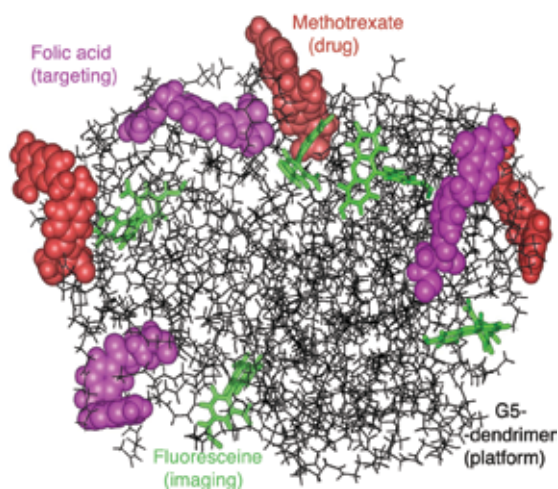
It is clear that the access to advanced learning opportunities is not only becoming a more pervasive need, but it could well become a defining domestic policy issue for a knowledge-driven society. Higher education must define its relationship with these emerging possibilities in order to create a compelling vision for its future as it enters the new millennium. (Duderstadt, 2000, 2005)

Innovation

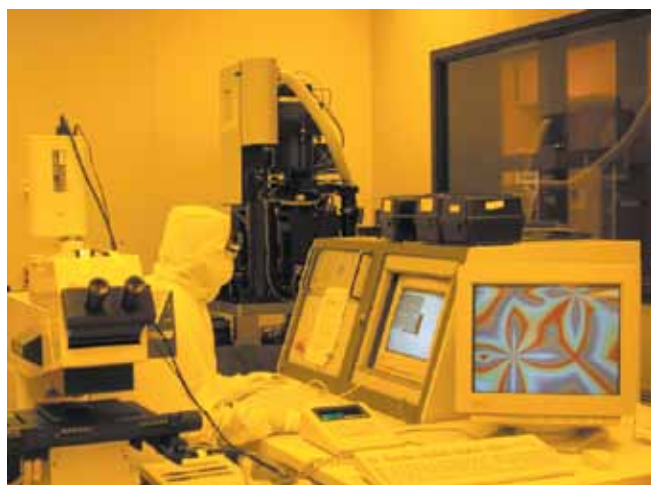
The creativity, ingenuity, and courage of innovators will be critical to our nation and our region in the twenty-first century. As a superpower with the largest and richest market in the world, the United States has consistently set the standard for technological advances, both creating innovations and absorbing innovations created elsewhere. From Neil Armstrong’s walk on the Moon to cellular camera phones, engineering and



Information technology
(U Illinois Blue Waters supercomputer)



Biotechnology
(UM designed macromolecule)



Nanotechnology
(UM nanotechnology laboratory)

scientific advances have captured people's imaginations and demonstrated the wonders of science. In fact, groundbreaking innovation was the driving force behind American success in the last century. An endless number of innovations—from plastics to carbon fibers, electricity generation and distribution to wireless communications, clean water and transportation networks to pacemakers and dialysis machines—has transformed the economy, the military, and society, making Americans more prosperous, healthier, and safer in the process (Duderstadt, 2005).

Future breakthroughs dependent on research and innovation will have equally powerful impacts. The innovations that flow from advanced education and research are not simply nice to have, like high-definition television; many are essential to the solutions of previously intractable challenges. Research in materials, electronics, optics, software, mechanics, and many other fields will provide technologies to slow, or even reverse, global warming, to maintain water supplies for growing populations, to ameliorate traffic congestion and other urban maladies, and to generate high-value products and services to maintain our standard of living in a world of intense competition. To meet these and other grand challenges, the Midwest must be an innovation-driven region that can capitalize on fundamental advances in life sciences, physical sciences, and engineering (Branscomb, 2008).

Here it should be kept in mind that Midwest is very much part of a global economy in which research and development are performed worldwide. Our multinational corporations manage their R&D activities to take advantage of the most capable, most creative, and most cost-efficient engineering and scientific talent, wherever they find it. Smaller firms without global resources are facing stiff competition from foreign companies with access to talented scientists and engineers—many of them trained in the United States—who are the equals of any in this country. Relentless competition is driving a faster pace of innovation, shorter product life cycles, lower prices, and higher quality than ever before.

To meet the demands of global competition, other states and nations are investing heavily in the foundations of modern innovation systems, including research facilities and infrastructure and strong technical workforces (Weber, 2009). Some of the innovations that

emerge from these investments will be driven by local market demands, but many will be developed for export markets. As other regions develop markets for technology-laden goods and international competition intensifies, it will become increasingly difficult to maintain a globally superior innovation system. Only by investing in research and advanced education can the Midwest retain its competitive advantage in high-value, technology-intensive products and services, thereby encouraging multinational companies to keep their R&D activities in this country.

Colleges and universities have a long history of contributing to U.S. preeminence in technological innovation. Research universities are particularly critical to generating new knowledge, building new infrastructure, and educating innovators and entrepreneurs. The Land-Grant Acts of the nineteenth century and the G.I. Bill and government-university research partnerships of the twentieth century showed how federal action can catalyze fundamental change. In the past, universities dealt primarily with issues and problems that could be solved either by a disciplinary approach or by a multidisciplinary approach among science and engineering disciplines. To meet future challenges, however, universities will need a new approach that includes schools of business, social sciences, law, and humanities, as well as schools of science, engineering, and medicine. Solving the complex systems challenges ahead will require the efforts of all of these disciplines.

But there is yet another challenge. While our colleges and universities are experienced in teaching the skills of analysis, we have far less understanding of the intellectual activities associated with creativity. In fact, the current disciplinary culture of our curricula sometimes discriminates against those who are truly creative, those who do not fit well into our stereotypes of students and faculty.

Our educational systems may need to reorganize themselves quite differently, stressing forms of pedagogy and extracurricular experiences to nurture and teach the art and skill of creation and innovation. This would probably imply a shift away from highly specialized disciplines to programs placing more emphasis on integrating knowledge. Perhaps it is time to rip education out of the classroom and place it instead in the discovery environment of the laboratory or studio or

the experiential environment of practice.

By combining research with education, universities not only tap into the creativity of young people, but also train them in critical thinking, research methodologies, and solid engineering skills. Because of the high quality of the people and tools provided by American universities, industries have chosen to locate their facilities in the United States, and emerging industries have tended to cluster around major engineering research universities (e.g., Silicon Valley, Route 128, Research Triangle, etc.) where they have access to a continuous supply of technical talent. An academic campus is one of the few places where precompetitive, use-inspired, long-term basic research can be conducted without the constraints of quarterly earnings. In partnership with industry and national laboratories, universities can bring together experts from many disciplines to investigate problems related to agency missions or meet specific product/service goals. At the same time, university students can learn systems thinking and gain an understanding of market forces through internships and participation in research projects. No other institutions have the same capabilities.

In spite of severe fiscal constraints, many areas of the United States have recognized that research and technology-development capacity are key elements in restoring their economic prosperity in an intensely competitive, global, technology-driven marketplace. Leadership in innovation will require commitments and investments of funds and energy by the private sector, federal and state governments, and colleges and universities. The Midwest can and must take control of its destiny and conduct the necessary research, capture the intellectual property, commercialize and manufacture the products, and create the high-skill, high-value jobs that define prosperity in a 21st century knowledge economy. Fortunately it has the unique resources of the world's leading concentration of research universities (e.g., the CIC group) and the headquarters of many of the world's leading technology-based companies to build upon. Yet it is also clear that many of the most promising technologies—sustainable energy generation and transportation, biotechnology, nanotechnology, information services, water resources—make sense only if pursued aggressively on a regional basis.

Of course there are many approaches to building

globally competitive economies built upon innovation. Some focus on restoring lagging support for basic research and the need to reform science and engineering education. Others stress the importance of market forces in bridging the “valley of death” between basic research and commercial innovations. Yet throughout the world it has become clear that BOTH strong public investment and powerful market incentives are necessary ingredients for successful innovation-driven economies.

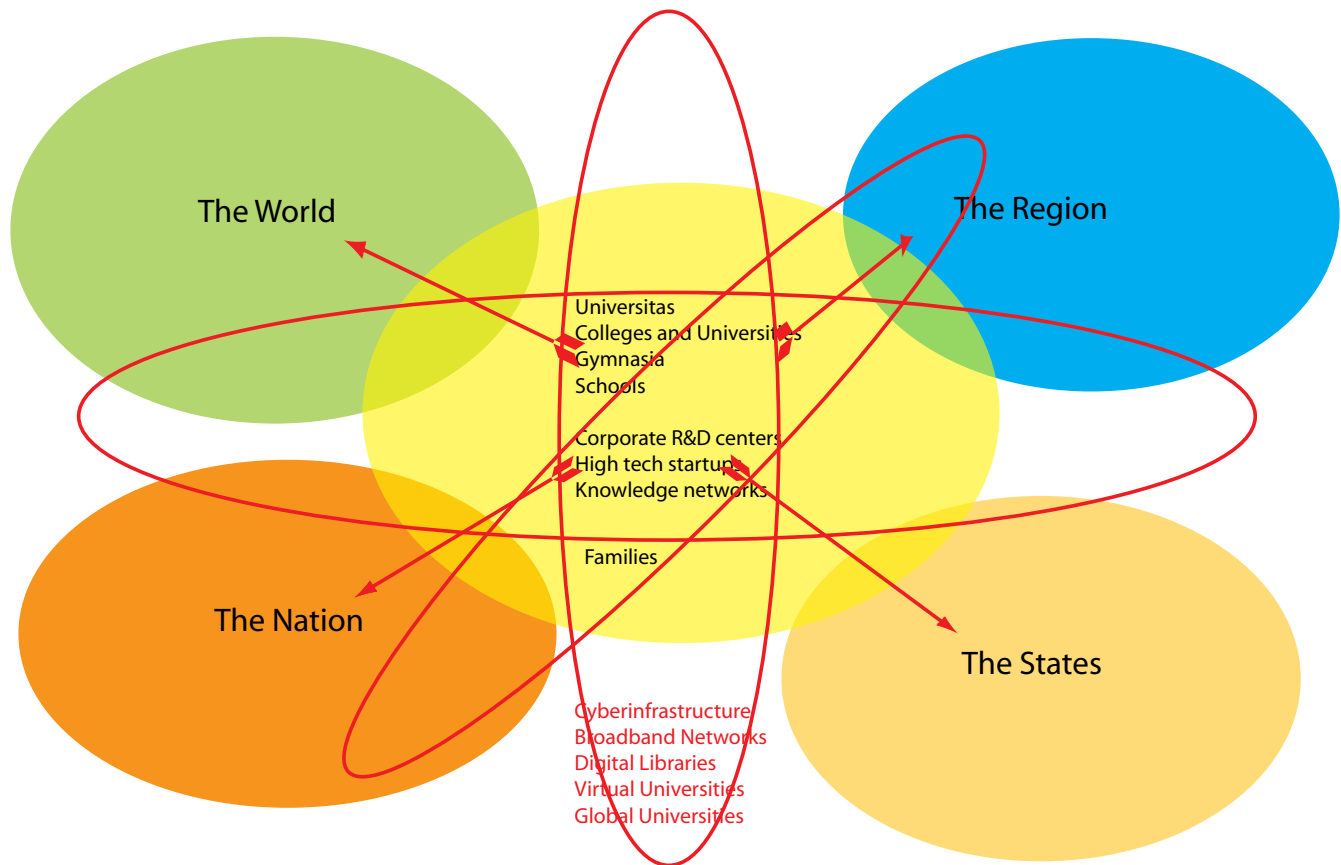
The Atlantic Century study suggested the following imperatives for innovation-driven economies (Atkinson, 2009):

1. Put in place incentives for firms to innovate within their borders. These should include robust R&D tax incentives; incentives, such as accelerated depreciation,

to invest in new equipment, particularly IT; and other policies that spur investment in the building blocks of growth, such as workforce development tax credits.

2. Be open to high-skill immigration. High-skill immigrants are the source of many new ideas and innovations. Countries that are open to high-skill immigration will be able to better succeed.

3. Foster a digital economy. Nations should not only expand public investments in IT in areas such as health care, energy systems, transportation, government, and education, but also put in place the right regulatory frameworks to spur, not limit, digital investment. Nations need to also consider how existing regulatory and public procurement policies can be redesigned to intentionally spur digital transformation.



One vision of the future of the Midwest as a learning and innovation-driven society.

4. Support the kinds of institutions that are critical to innovation. Nations need to expand funding not just for university research, but for the kinds of mechanisms and institutions that help foster commercialization of research. In addition, they need to boost support for a host of efforts such as local economic development, entrepreneurship development, and workforce training.

5. Ensure that regulations and other related government policies support, not retard, innovation. Too often, powerful interest groups (business, civic, and labor) fight against change and innovation, often under the guise of the public interest, but all too often the result is that progressive and positive innovation is slowed. Nations should ensure that their regulations, procurement, and other related policies tilt toward innovation.

The Midwest region must recognize that a broad range of government policies directly affect the nation's power to innovate: new technology investments, economic policy, trade strategy, government procurement, intellectual property, and standards policy. A major recalibration of private-sector thinking and government policies and priorities is in order. The way we think about networks of talent, the tools we have for building institutional skills and trust, the approach we take to competition in a world of process networks—all must be addressed. The temptation to revert to protectionism must be resisted. The growing importance of technically sophisticated, middle-sized firms that know how to cooperate and compete in a new world of peer-networked enterprises must be recognized and encouraged.

A Society of Learning and Innovation

The themes that will govern the future of the Midwest are simple to state if challenging to address: the imperatives of the global, knowledge-driven economy, universal learning opportunities, the capacity and drive to continually innovate, and risk-taking rather than entitlement—and all sought on a regional basis. In particular, lifelong and life-wide access to advanced educational opportunities will become the defining domestic policy issue for a knowledge-driven society. This will clearly require the development of new paradigms

for delivering education to even broader segments of our society, perhaps to all of our society, in convenient, high-quality forms, at a cost all can afford. Fortunately, today's technology is rapidly breaking the constraints of space and time. It has become clear that most people, in most areas, can learn and learn well using asynchronous learning, that is, "anytime, anyplace, anyone" education. Lifetime education is rapidly becoming a reality, making learning available for anyone who wants to learn, at the time and place of their choice, without great personal effort or cost. With advances in modern information technology, the barriers in the educational system are no longer cost or technological capacity but rather perception and habit.

It is becoming increasingly clear that the dominant priority of a knowledge-driven society has become intellectual capital: the education of our citizens, the support of their ideas, their creativity, and their innovation and entrepreneurial efforts. This will require new concepts, institutions, policies, and investments, articulated by the vision of society of learning and innovation. Hence the challenge is to set aside the usual constraints imposed by existing educational structures (e.g., schools and colleges, policies and politics) and instead begin with a clean slate to determine the lifelong educational needs of citizens in a global knowledge-driven society and how one might meet these needs (Duderstadt, 2005; Brown, 2009).

Chapter 5

How Far Do We Have To Go? A Gap Analysis

*It was the best of times, it was the worst of times,
It was the age of wisdom, it was the age of foolishness,
It was the epoch of belief, it was the epoch of incredulity,
It was the season of Light, it was the season of Darkness,
It was the spring of hope, it was the winter of despair.*

—Charles Dickens, *A Tale of Two Cities*

The familiar opening lines from Charles Dickens' novel characterizing eighteenth century France also portray the situation of Midwest region today. Revolution is in the air!

So what is the Midwest facing? A season of light or a season of darkness? A spring of hope or a winter of despair? Is our future one of the despair characterizing the dying farming and factory economy of the Midwest? Or can we achieve the vision proposed in the preceding chapter of a culture of learning and innovation that provides all of our citizens with prosperity and social well being?

More to the point, and again in a Dickensian spirit, are learning and knowledge institutions such as our schools, colleges, and universities facing yet another period of evolution? Or will the dramatic nature and compressed time scales characterizing the changes of our time trigger a process more akin to revolution?

In this chapter we consider the road ahead, how far the Midwest must travel in order to build a society capable of facing the imperatives of the 21st century global economy. In this effort we will continue following the roadmapping process by utilizing a *gap analysis* to compare where the Midwest is today with what it must become tomorrow. Here we must continue to bear in mind that in the flat world of a global, knowledge-driven economy, the key to prosperity lies not with low taxes, cool cities, and great weather. Rather it requires educated people, new knowledge, innovation, and an entrepreneurial spirit. This, in turn, requires visionary public policies and public and private investments

that look toward the future rather than clinging to the past. The challenge to the Midwest, its public leaders, its business, industry, and labor, its educational and cultural institutions, and its citizens is to invest in the production of the human capital, infrastructure, new knowledge, and innovation necessary to achieve prosperity and social well-being in a 21st world.

By any measure, the assessment of the current state of the Midwest provided in Chapter 3 is very disturbing. The region is having great difficulty in making the transition from a low-skill agricultural and manufacturing economy to one based on knowledge and innovation. In recent years our auto-industry states have led the nation in unemployment; the out-migration of young people in search of better jobs is among the most severe in the nation; our educational systems are underachieving with one-quarter of our adults without a high school diploma and only one-third of high school graduates college-ready. Although the Midwest's system of higher education was once regarded as one of the nation's best, the erosion of public support over the past three decades has not only driven up tuition, but also put the quality and capacity of our public colleges and universities at great risk.

To be sure, the Midwest was once the economic engine of the world, the arsenal of democracy, largely due to the investments made by our ancestors in public assets such as schools and colleges, social benefits, and civic infrastructure. Ironically, at a time when the rest of the world has recognized that investing in education, research, and innovation is the key to not only pros-



As economic activity and jobs are off-shored to low-cost, high skill centers such as Bangalore and Shanghai, it is clear that Midwest states are no longer just competing with one another.

perity but, indeed, survival, too many of our citizens and leaders, in both the public and private sector, have come to view such investments as a low priority, expendable during hard times.

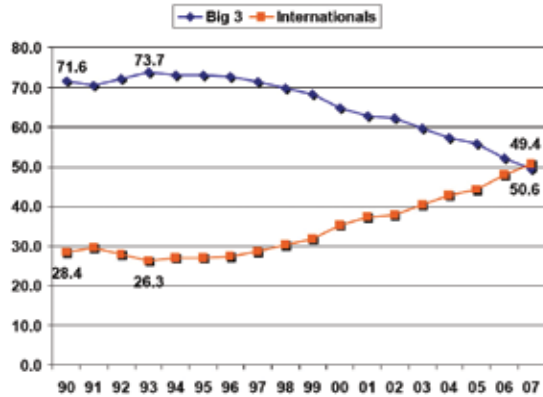
From this perspective, the vision we have proposed for the Midwest tomorrow as a society of learning and innovation seems very distant indeed. The road ahead looks long, perilous, and uncertain.

The Midwest's Challenge: Economic Transformation

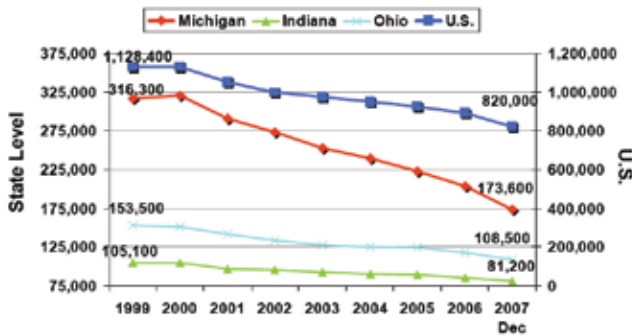
Today the Midwest is experiencing a transition to a postindustrial society as fundamental as the transformation from a farming society to an industrial society a century ago, driven by the emergence of an economy based on knowledge—educated people and their ideas—and powered by breathtakingly rapid development of new technologies; the globalization of the world's economy and culture enabled by technologies of communication and travel; and the demographic changes in the American population bringing hitherto under-represented groups into a majority of the workforce. Yet many of our people and our institutional leaders are reeling from the transformation, on the defensive, desperately clinging to the past, to the habits and expectations of an earlier era when we were a leading agricultural and industrial power not just of America but of the entire world. Many among us look for scapegoats—foreign workers and industries, immigrants,

business, labor, politicians, even schools and colleges. Some take a “this too shall pass” attitude, almost as if we closed our eyes we could make change stop. Others demand entitlements, no longer secure in a rapidly changing world.

Perhaps the recent bankruptcies of General Motors and Chrysler should be viewed as harbingers of what is to come if the region continues to back into the future. In fact, the decline of the American automobile industry has been underway for decades, as management continued to resist change and ignore innovation while relying on a workforce with increasingly obsolete skills, protected by powerful unions demanding benefits inconsistent with the emerging global economy and by political leaders determined to isolate the industry from the new imperatives such as emissions control and fuel efficiency (Longworth, 2008). While other nations developed industries for the 21st century that have now moved onto our shores, the leaders of the American automobile industry sought instead short-term profits based on products that were soon to become dinosaurs in the new world order. The Big Three were in many ways the poster children of the Midwest's failure to cope with global challenges—an aging industry with high costs, obsolete, factories, resistance to change, an absence of innovation and imagination, crippled by myopic management and dependent upon a workforce with education and skills no longer competitive in the global marketplace. As a consequence, the auto industry has now lost more than half a million Midwest jobs



The decline of market share of the domestic automobile companies (Rothwell, 2009)



The decline of automobile manufacturing employment (Rothwell, 2009)

Fact: Not Only State with Manufacturing Job Losses



Decline of American manufacturing jobs (Rothwell, 2009)

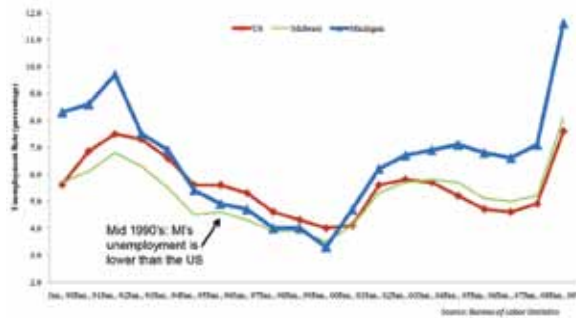
over the past decade, with Michigan and Ohio losing respectively 75% and 60% of their automobile jobs.

Today we find the Midwest midway through a several-decade-long transition from a region dominated by big companies, big unions, and big government to a new economy dependent upon thousands of small, dynamic companies competing in a broad spectrum of world markets. We are experiencing a transition from low-skill, high-pay jobs to high-skill, high-pay jobs; from a transportation industry to an information services industry; from the Industrial Age to the Age of Knowledge. We're learning the hard way that if we want to fully prosper in this new world, we must take the long view, invest in people and learning institutions—in making available life-long education and training, and similarly invest in research and the technological innovation it produces. The Midwest's major sectors—government, business, and labor—must be dramatically restructured to serve us better in the new century. The Midwest today faces fiscal collapse if we continue to fund our current needs and desires by shifting the cost to future generations.

The Midwest first has to recognize that its old low-skill, factory-based economy is dying, never to return. Yet today many of our towns, cities, and states continue to be plagued by an entitlement culture and increasingly demoralized and hopeless as the low-skill jobs that once provided security and prosperity are swept aside by the global economy. To be sure, economic and social upheaval of the magnitude facing the Midwest is unprecedented. It challenges our basic assumptions about how we live our lives, it changes the rules in mid-game. It displaces and hurts far too many. But the almost certain consequence of this continuing widespread denial of and resistance to change would be to condemn the Midwest to a future of decline that would soon be irreversible. Why? Because such denial violates a fundamental law of nature that all living systems must continually adapt to their changing environment or risk extinction. To survive let alone prosper, the Midwest has to summon the courage and strength to face up to reality, to see change not as a threat but to seize the opportunities it offered to make a better world for ourselves and our children.

So how is the Midwest responding? Michigan provides a typical example. Of course the state's public

Fact: Rising Unemployment



Once again Michigan serves as the bellwether for the challenges of the knowledge economy. (Rothwell, 2009)

leaders are doing the usual misguided things favored by many politicians, e.g., providing lucrative tax abatements to dying industries, encouraging the building of more casinos and sports stadiums, and heavily subsidizing frill industries such as Hollywood movie production. Every city wants to be a creative city. Indeed, Michigan's governor even created a "Cool Cities" program in a rather desperate attempt to make some of the state's tired towns "creative" by funding art galleries and pedestrian zones.

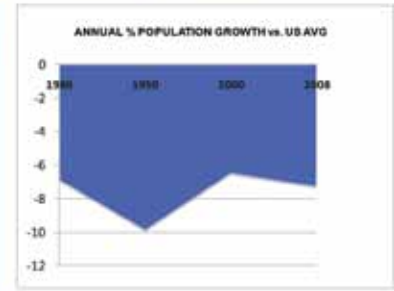
Of course there are also some well-intentioned efforts such as the creation of green technology jobs. But even these initiatives are all too frequently misdirected and poorly understood, as if taking out-of-work auto workers and putting them into abandoned assembly plants to make wind turbines can rebuild the old factory-based manufacturing economy based on low-skill but highly compensated labor. Honestly, if Michigan cannot be globally competitive in manufacturing products invented in Detroit such as Thunderbirds, how can it ever expect to be competitive in manufacturing products like wind turbines and solar technology developed by the aerospace industry and the electronics industries and now being rapidly exploited by China and Germany? In fact, while manufacturing will remain an important component of the Midwest's industrial plants, our future factory jobs are likely to consist primarily of engineers programming robots rather than low-skill assembly line work.

Today and in the future, it is our people, their character, their knowledge, skill, and ability to innovate that, when allied with developing technologies, give us

Result: Relatively Smaller

Michigan Is Getting Smaller Relative to US

Michigan has been growing at a slower rate than the average US state for nearly 40 years. This has resulted in Michigan becoming less desirable for business investment as its share of the consumer market declines.



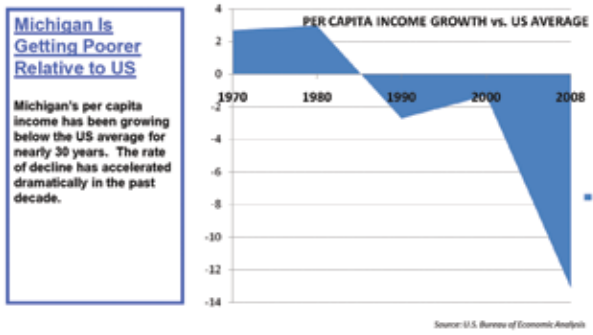
Michigan is growing more slowly—in both population and economic activity—and the U.S. (Rothwell, 2009)

the competitive edge in the world economy. The keys to economic growth are education and innovation, not economic development programs. Glazer and Grimes state it well: "Quite simply, in a flattening world, the places with the greatest concentrations of talent win! States and regions without concentrations of talent will have great difficulty retaining or attracting knowledge-based enterprises, and they are not likely to be the places where new knowledge-based enterprises are created" (Glazer, 2010). And such is also the important lesson for the Midwestern United States.

The vulnerability of low-skill jobs in an increasingly knowledge-driven economy was made apparent in the recent "Great Recession", in which 7.9 million jobs disappeared in fields with low educational requirements, compared to 400,000 in fields that required more education. Today the states with the highest per capita income (e.g., Connecticut, New Jersey, Massachusetts, New York) have the highest percentage of college-educated workers (30% or greater), while those Midwest states experiencing declining prosperity are characterized by lower levels of college attainment (25% or less). (Glazer, 2010).

The Midwest faces a particularly serious challenge in producing the human capital—the educated population, the knowledge workers, the scientists, engineers, and other professionals—that will enable it to compete. Not only is our population aging rapidly, but the out-migration of our 25- to 44- year old population creates a brain drain with very serious implications. Certainly our educational institutions have demonstrated the capacity to compensate to some degree by utilizing their

Result: Relatively Poorer

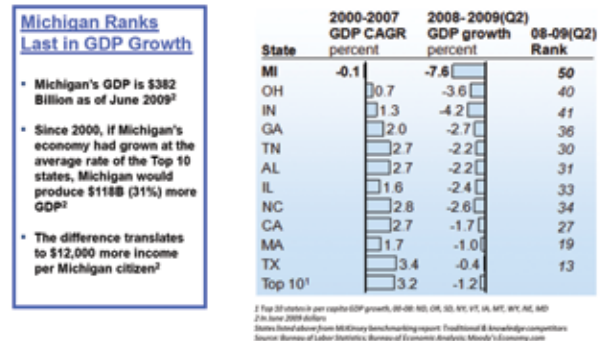


Michigan's per capita income has now dropped below the national average. (Rothwell, 2009)

quality and reputation to attract and retain both their graduates and those they attract from throughout the nation and around the world. Yet all too often, state politicians object to our public universities enrolling students from other states or nations, apparently oblivious to the fact that over the longer term, the capacity of our academic institutions to attract talented students, knowledge workers, and companies from around the world is of extraordinary importance to our region. As the resource map of Midwest's educational capacity makes painfully apparent (Chapter 3), the region's educational achievement at this level is seriously inadequate and must be improved dramatically if it is to build a workforce of world-class caliber. In the global economy cities prosper by attracting and producing well-educated, highly skilled, and creative citizens. Nearly half the people in Seattle and San Francisco have college degrees. This plunges to 11% in Detroit and Cleveland!

The Midwest also must make additional investments to create the new jobs to employ better-educated graduates. Thus far, too few jobs of this kind—dependent upon skill and knowledge—exist in our region. The old economy is gone, never to return. Furthermore, even if our traditional industries manage to survive the recent recession, albeit with government bailouts, they can never dominate our economy again. The productivity gains made through efforts such as total quality management, lean manufacturing, and right-sizing costs in the old industries unfortunately come at the expense of jobs—and perhaps also at the expense of the R&D necessary to achieve technological innovation and

Result: Relatively Poorer



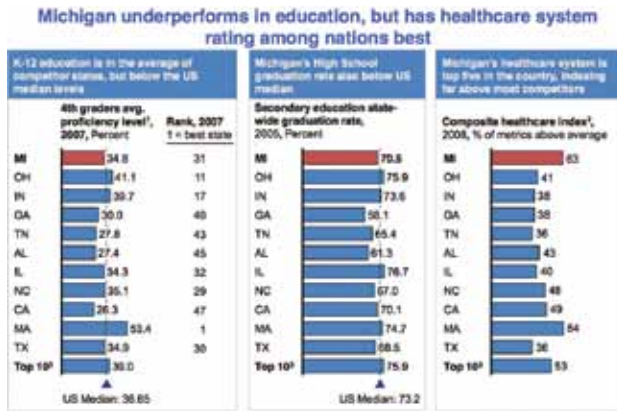
The growth of its economy now is 50th among the states. (Rothwell, 2009)

sustain market share.

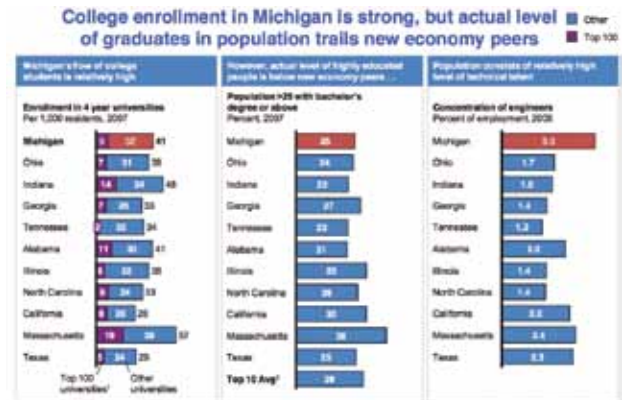
It seems increasingly clear that new jobs in the Midwest are not going to be spawned by its existing industry but instead will be created by entirely new activities dependent upon technological innovation, both in high-tech areas such as biotechnology, information technology, and nanotechnology, and in knowledge-intensive services. They will require skilled knowledge workers, technological innovation, and energetic, risk-taking entrepreneurs. And it is from this perspective that the most significant players in building the new economy of the Midwest are likely to be its schools, colleges, and universities, since these institutions are the primary source of all three essential elements of the knowledge economy: educated people, new knowledge, and innovation.

K-12 Education: The Crippling Gap

Clearly the quality and performance of K-12 education is a very critical issue for the region. For example today almost half of all Michigan adults are currently hindered by a literacy level too low to function adequately in today's knowledge-driven society. One-fifth of Midwest citizens do not have a high school diploma, while only one-third of high school students graduate with college-ready transcripts. The fact that only one Midwest state, Ohio, has been successful thus far in the federal \$4.35 billion "Race to the Top" grant competition suggests that most of the region is still unable to break the stranglehold of local school boards, unions, and state politics to reform K-12 education (Duncan,



Michigan provides clear evidence of the priorities of an aging population. (Rothwell, 2009)



Michigan's performance in higher education also reflects the priorities of a factory economy. (Rothwell, 2009)

2010).

There have been a few bright spots in several of the region's systems of public education, including the adoption by several states of some of the most rigorous requirements for K-12 education in the nation. However the achievement of these goals will be a challenge for many of the region's school systems, particularly those in economically disadvantaged areas where poverty and job losses have taken a serious toll on schools and families.

Furthermore, while state initiatives such as charter schools and federal accountability measures ("No Child Left Behind") are having some impact, this are also largely at the margin because of far more significant socioeconomic issues such as the deterioration of the family and community environment for learning and the student (and family) motivation for academic achievement. Too many parents and citizens are still willing to accept less than the best for our children. Michigan's students now may be able to compete with children from Ohio, but they are far behind children in Asia and Europe—e.g., with the U.S. ranking 25th out of 30 developed nations in high school completion and achievement (OECD, 2010; Lingenfelter, 2009). Here part of the difficulty is the vast difference in standards and assessment measures used among the states.

Inadequate school preparation is compounded by poor alignment between high schools and colleges, which often creates an "expectations gap" between what colleges require and what high schools produce. Compared to the rest of the world, primary and secondary education in the United State is too thin, too brief,

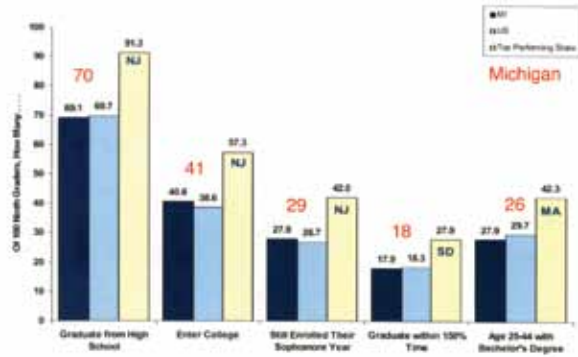
and not rigorous enough. The result is a high level of remediation by colleges (and by employers), a practice that is both costly and inefficient.

The fact remains that throughout the Midwest too few citizens prepare for, participate in, and complete the educational programs capable of preparing them for the knowledge economy, especially those underserved and nontraditional groups who make up an ever-greater proportion of our population. More generally, the leakage from our current education pipeline from primary education through secondary school and college into knowledge-intensive employment is clearly unacceptable.

Of comparable importance is the teaching profession itself. It is here that higher education (and our society) simply must do a better job of attracting the best and brightest into teaching careers and providing them with the quality education, attractive pay, and support necessary for these important roles. In Singapore teaching is regarded as the most important profession in contrast with the United States where law and business rule the roost.

Higher Education in the Midwest: A Critical Asset at Great Risk

There is growing evidence that a skilled-worker shortage—created by low birthrates, out-migration of young adults, and poor performance of our educational systems—poses a serious threat. Beyond these current challenges, it is also the reality that a global, knowledge-driven economy is continuing to raise the bar for



Particularly alarming are the attrition of college-bound students. (SHEEO, 2009)

educational achievement. Some recent reports that suggest that “a vast majority of the emerging high-wage, high-skilled jobs available require a level of skill that can be obtained at the community college or technical school level and do not require a bachelor’s degree” (MEDC, 2002). Yet the reality is that a bachelor’s degree is already almost a mandatory credential for a job in the new economy, and soon advanced degrees—or at least lifelong learning—will become a necessity. We must take great care not to repeat the mistakes of the 20th century, when we doomed generations to poverty by restricting their educational opportunities to only the level they needed for the low-skilled jobs of that time. The educational demands of a changing world are moving ever higher.

Yet here the challenges are immense. Today the United States ranks in bottom third of developed nation’s in the percentage of its population with college degrees. In fact, to achieve President Obama’s goal of once again leading the world in college attainment of our population by raising the percentage of adults age 25-64 with college degrees from 37% to the world-class standard of 55% would require an additional 16 million adults with college degrees (Lingenfelter, 2009).

Hence it is at the level of higher education that the Midwest region may be at the greatest risk, since for too long it has taken its colleges and universities—perhaps the most critical assets of the knowledge economy—for granted. Many studies have highlighted the importance of higher education to the ability of regions to compete for prosperity in the global economy. Most agree that the single most important investment that regions—cit-

State	FY2004	FY2008	FY2009
Illinois	\$7,450	\$7,393	\$7,777
Wisconsin	\$6,637	\$6,443	\$6,534
Minnesota	\$6,064	\$6,445	\$6,161
Missouri	\$6,421	\$5,923	\$6,084
Iowa	\$5,464	\$5,847	\$5,905
Michigan	\$6,167	\$5,521	\$5,365
Ohio	\$5,068	\$4,708	\$4,858
Indiana	\$5,129	\$4,814	\$4,752
US	\$6,881	\$7,220	\$6,931

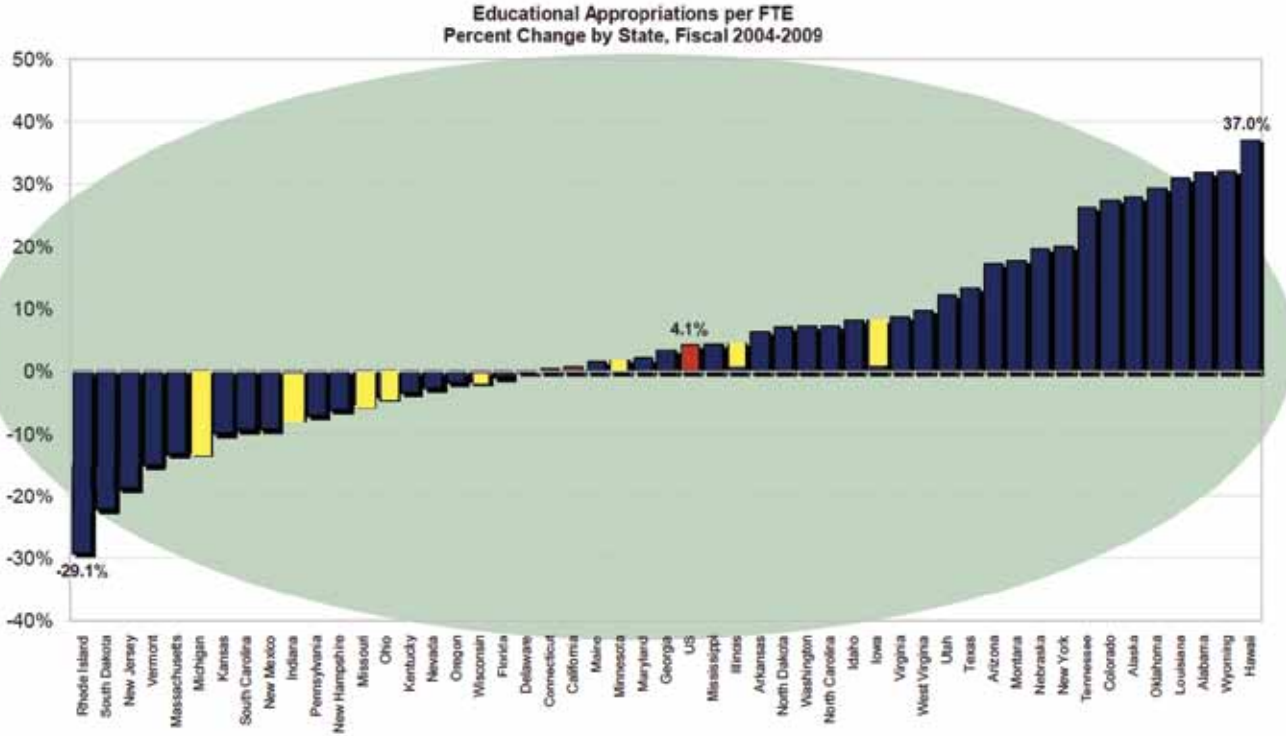
State support of higher education (per student) in the Midwest has now dropped below the US average.

ies, states, nation-states— can make in their future is to invest in colleges and universities, since these will be the key source of an educated workforce, research and innovation, and entrepreneurial activity.

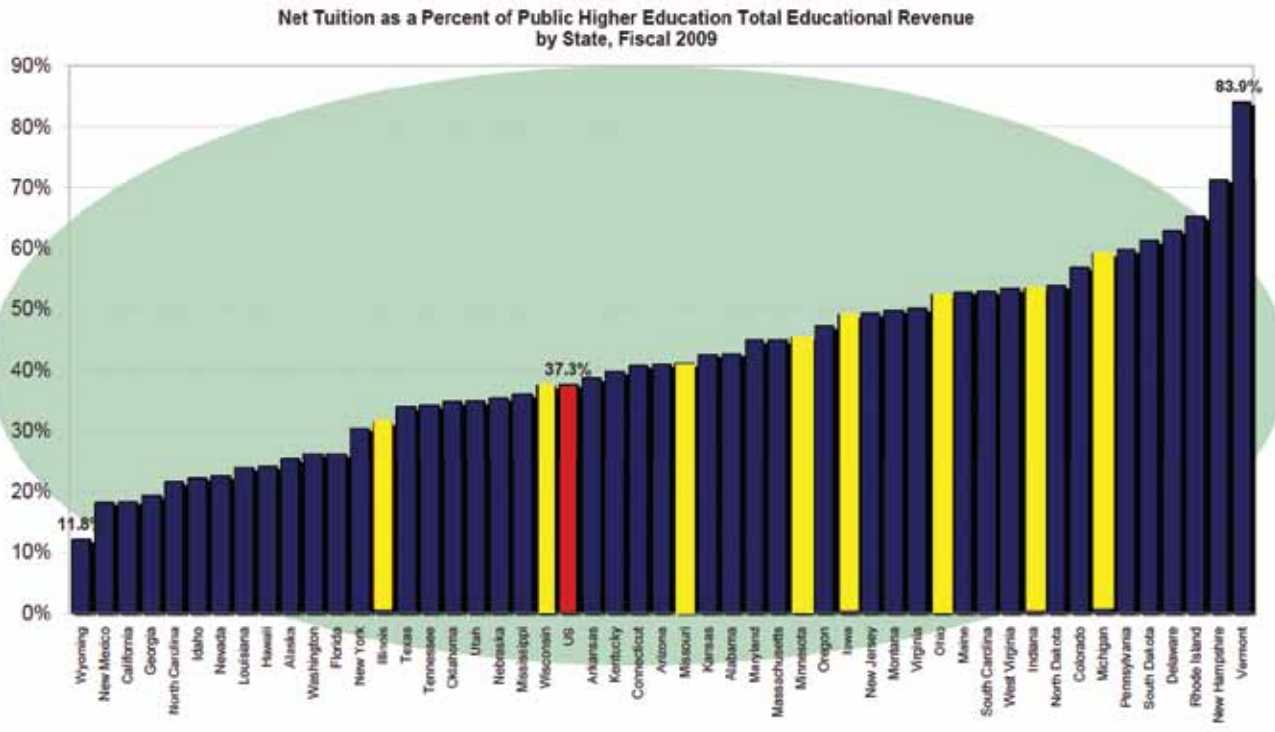
In a recent study, Glazer has determined that the single most critical factor in driving the growth of private income (i.e., both private sector employment earnings growth and investment earnings) in a state is college degree attainment. States with high college degree attainment (such as Connecticut, Massachusetts, New York, and Minnesota) are leaders in private income growth while those with low degree attainment (Ohio, Michigan, Indiana) rank low in this measure of prosperity. It should also be noted that states with low taxes tend rank low in private income growth, apparently because they fail to invest adequately in higher education. (Glazer, 2010) Hence it is reasonable to conclude that higher education trumps tax policy in driving prosperity in the knowledge economy.

The Midwest region’s system of higher education has long been regarded as one of the nation’s best. Yet today cracks in the region’s higher education capacity are beginning to appear. Although the Midwest’s flagship universities and independent colleges have high graduation rates (80% and above), the rest of region’s higher education enterprise—community colleges, regional universities, for profit colleges— graduate fewer than 50% of their students, corresponding to roughly one million students who will enter college each year only to fail to graduate.

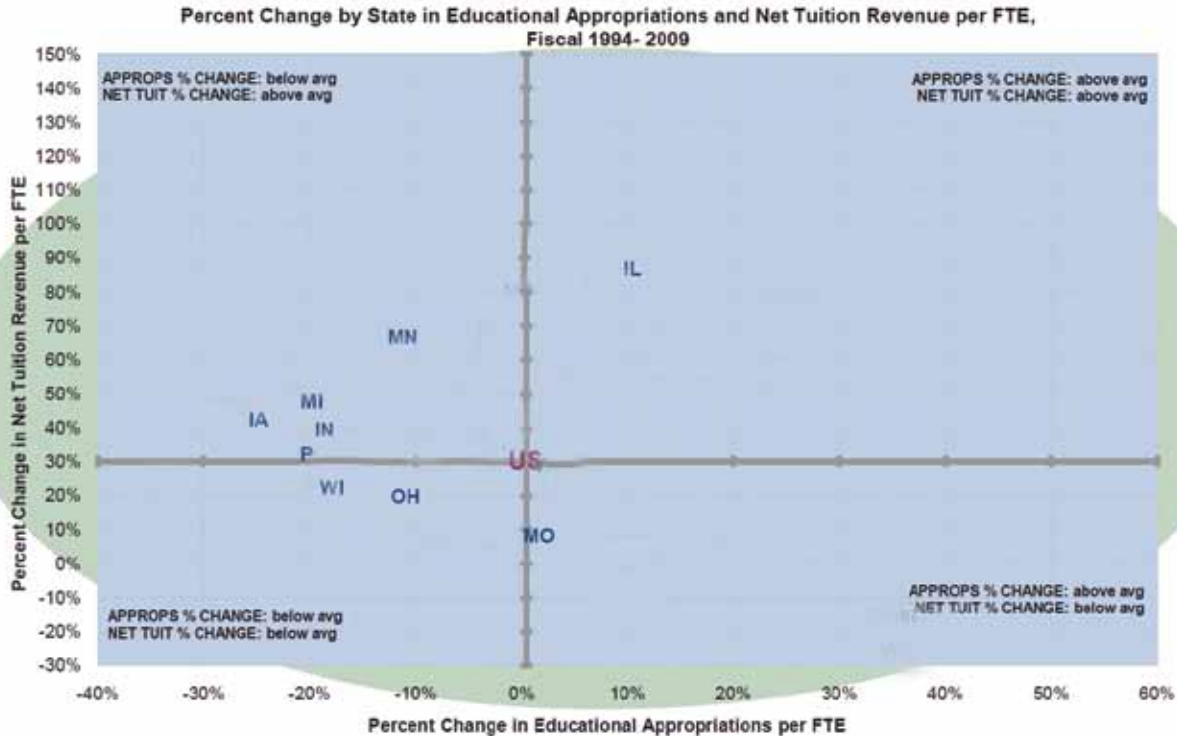
Furthermore, there are increasing signs that leaders



The Midwest states provide strong evidence that as state appropriations go down... (SHEEO, 2009)



Tuition goes up... (thereby eroding higher education's capacity to serve low income students). (SHEEO, 2009)



Most Midwest states are moving into the low state support/high tuition regions of the scatter chart. (SHEEO, 2009)

of state governments still do not recognize the importance of their public colleges and universities as a strategic investment, either in the magnitude or the nature of the deployment of public funding relative to other states. The Midwest states today spend an average of \$5,700 a year on a public university student, significantly below the national average of \$6,900 and a statewide average of \$7,300 for each K-12 student (SHEEO, 2009). But even more disturbing is that after a massive prison building boom in the 1980s, today the Midwest spends almost 30% more on locking people up (corresponding to \$40,000 per inmate) than it does on educating them in our public colleges and universities, a truly tragic statement of the region's priorities. As yet another example of short-sighted thinking by state governments, although the federal government provided \$53.6 billion in FY2010 to stabilize state and local funding of critical public services such as education during the recent "Great Recession", most Midwestern states (including Illinois, Michigan, Wisconsin, Indiana, and Missouri) chose to spend less than 10% of these Educational Stabilization Funds on higher education. (Lingenfelter, 2009)

State support of higher education on a per student basis has been declining in Midwest states for over two

decades. Despite this erosion of state support, public universities have strained to hold tuition increases in check. In fact, when financial aid and inflation are included, the net tuition levels for public higher education in the region have actually declined over the past decade (McPherson, 2010). But with the recent massive cuts to public higher education in the wake of the damage to state budgets by the recession, public universities have had no choice but to begin to raise tuition levels at double-digit rates. Perhaps indicative of the region's myopia concerning education, governors and state legislators continue to blast these tuition increases, pandering to the fears of students and parents, even as state government plans to cut higher education still further. Since state support is the key to enabling leading public research universities to enroll students from impoverished backgrounds, the erosion of state support and consequent increase in tuition has seriously degraded the capacity of these institutions to serve low income students (e.g., as measured by the declining percentage of Pell Grant students they enroll). (Haycock, 2010)

Today there are increasing signs that both the quality and capacity of Midwest's public universities are beginning to suffer, at just that moment when the chal-

State	Preparation	Participation	Affordability	Completion	Benefits	Learning
Illinois	B	C	F	B+	B	I
Indiana	C	C	F	B-	D+	I
Iowa	B	A	F	A	C+	I
Michigan	C	C	F	C+	B+	I
Minnesota	B	B	F	A	B	I
Missouri	C+	C	F	B	C+	I
Ohio	B-	C-	F	B-	C+	I
Wisconsin	B	C+	F	A-	C	I

Eroding state support, rising tuition, and low college degree attainment leads to poor grades for Midwest states in the national *Measuring Up* assessment (NCPPE, 2009).

Challenges of a global, knowledge-driven economy have positioned our universities as among our most important assets. Student-to-faculty ratios and workloads have been increasing, eroding not only the quality of classroom instruction but also constraining research university faculty from conducting the research critical to economic development in a knowledge economy increasingly dependent upon technological innovation. Faculty salaries at public universities have fallen 20% behind those at private universities (compared to 1980 when they were roughly even), leading to a migration of some of the best professors from public to private institutions. Further erosion has occurred in the value of pension plans, medical benefits, life insurance, housing, and other benefits key to faculty recruiting and retention.

Many four-year colleges and universities will face serious challenges from the anticipated decline in college-age students characterizing the Midwest region over the next two decades. While the increased higher education needs of adults in the workplace may balance the demand for higher education, much of this is likely to benefit more community colleges and for-profit institutions that are more experienced and efficient in adult education. The flagship public research universities are likely to compensate for the regional decline in college-age students by using their brand names to aggressively recruit more out-of-state and international students—likely charging them tuition at private lev-

els to compensate for eroding state support. However, independent colleges and regional public universities could well find themselves with declining enrollments that threaten their very existence.

Despite the growing importance of the research and advanced degrees (science, engineering, medicine, etc.) provided by the region's flagship public research universities, these too have experienced serious erosion in state support over the past two decades, now comprising less than 20% of their total operating budget. In fact the University of Michigan's state appropriation in 2010 has declined to less than 11% of its academic budget and 6% of its total budget, relegating the state to the position of the smallest minority stakeholder in the institution. Today most of the major public research universities in the Midwest are being forced by declining state support into following Michigan's evolution into "privately-funded but publicly-committed" universities.

To compound these challenges, several state governments continue to threaten the autonomy of their public universities by attempting to micromanage admission policies, curriculum, facilities funding, and personnel policies. Particularly insidious has been the impact of recent statewide referenda that now prohibit policies such as affirmative action critical to the ability of the region's universities to serve its increasingly diverse population.

Little wonder that after the cavalier treatment high-

Institution	Carnegie	Net Tuition (a)	State and Local Appropriations (b)	Private Gifts, Investment Returns, and Endowment Income (c)	Federal Appropriations and Federal, State, and Local Grants and Contracts (d)	Auxiliary Enterprises, Hospitals, Independent Operations and Other Sources (e)	Total Revenue (f)=(a+b+c+d+e)
Indiana University-Bloomington	Public Research	\$11,576	\$6,427	\$1,802	\$3,326	\$6,503	\$29,634
Iowa State University	Public Research	\$6,749	\$11,471	\$1,210	\$7,617	\$9,442	\$36,689
Michigan State University	Public Research	\$11,164	\$9,056	\$2,663	\$7,991	\$6,773	\$37,667
Ohio State University*	Public Research	\$10,451	\$8,461	(\$1,134)	\$11,680	\$37,560	\$67,016
Pennsylvania State University*	Public Research	\$14,826	\$4,411	\$3,622	\$7,161	\$18,207	\$48,426
University of Illinois*	Public Research	\$11,880	\$10,237	\$2,069	\$12,464	\$20,736	\$57,386
University of Iowa	Public Research	\$8,433	\$13,229	\$3,453	\$13,452	\$43,420	\$81,987
University of Michigan-Ann Arbor	Public Research	\$15,963	\$9,007	\$18,995	\$21,223	\$59,506	\$124,693
University of Minnesota-Twin Cities	Public Research	\$10,522	\$15,773	\$3,780	\$19,255	\$10,264	\$59,593
University of Missouri*	Public Research	\$8,146	\$8,670	\$1,801	\$6,609	\$20,714	\$46,139
The University of Texas*	Public Research	\$6,243	\$11,066	\$2,356	\$13,534	\$15,266	\$48,470
University of California-Berkeley	Public Research	\$8,900	\$15,515	\$4,447	\$16,044	\$8,715	\$53,620
University of California-Los Angeles	Public Research	\$8,776	\$18,302	\$4,661	\$23,500	\$67,880	\$113,119
University of California-San Diego	Public Research	\$6,586	\$12,049	\$2,249	\$26,924	\$44,562	\$96,372
University of North Carolina at Chapel Hill	Public Research	\$9,001	\$21,654	\$10,609	\$26,596	\$23,106	\$92,966
Selected Comparison Group	Median	\$8,776	\$15,515	\$4,447	\$23,500	\$23,106	\$92,966
Selected Comparison Group	Mean	\$8,302	\$15,717	\$4,864	\$22,120	\$29,906	\$80,909

Total 2008 Revenues for selected public research universities. Note how the state support of the Midwest flagship public universities is roughly half that of leading high-tech states. Note also the impact of medical centers income on total revenues (although none of this can be used to subsidize academic programs). (TCS, 2010)

er education has received from state leaders over the past two decades, university governing boards with fiduciary responsibility for the welfare of the Midwest's public universities have begun to lose confidence in state government as a reliable partner in providing adequate support for this critical state asset. Term-limited legislators and governors, political parties controlled by narrow special-interest groups, and a body-politic addicted to an entitlement economy simply cannot be trusted. Instead, governing boards are seeking more institutional autonomy to give them control over decisions such as admissions, tuition and fees, faculty and staff compensation, procurement, and other areas sometimes micromanaged by state government.

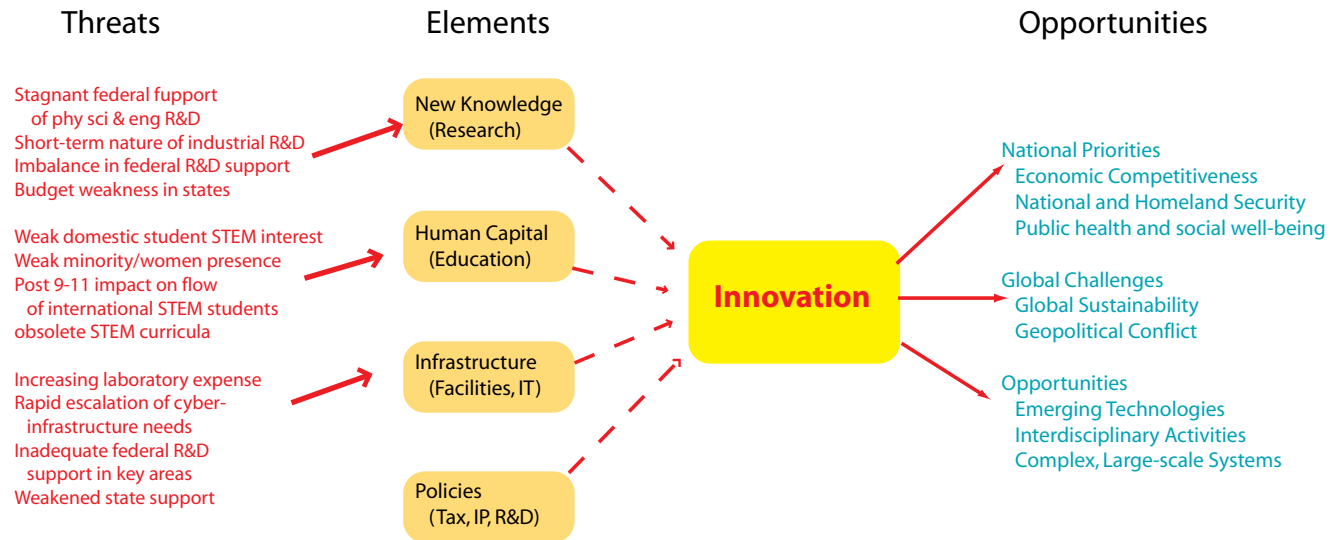
The logical although disappointing conclusion we can draw from these statistics is that the Midwest region needs and deserves a higher education system that is much better than state government is apparently willing to pay for! So, what to do? Should the region simply allow the myopia and partisan politics of state government to drive down—and perhaps permanently damage—the quality of its public colleges and universities, a legacy established earlier through the commitments of past generations of the region's citizens? Or should it instead challenge the governing boards of our colleges and universities to accept their fiduciary

responsibilities, constitutional autonomy, and accountability for tomorrow by taking those actions necessary to preserve these critical institutions for future generations? That may be the choice before us, but we must make it before it is too late.

The Production of New Knowledge: Research and Innovation

New jobs in the Midwest are not going to be spawned by existing industry but instead will be created by entirely new activities, e.g., biotechnology, information technology and computer networking, lasers and ultra-high-speed technology, and an array of knowledge-intensive services such as systems integration and software development. These new jobs will be created by innovation based on research and development. They will require post-graduate education at the master's and doctorate level. They will be created by the new companies spawned by the entrepreneurial efforts of graduates of the region's universities.

A recent study by the National Governors Association finds a growing awareness of these imperatives: "Governors realize that investments in research and development can spur not only new ideas, new products and new technologies, but can increase a state's talent



The threats to innovation

pool, economic bottom line and its success in national and global markets. Innovation can't be left to chance—every state needs a clear strategy for success that applies lessons learned from their peers and from abroad” (NGA, 2007). The study found that the most successful state strategies rely heavily on their core assets: their research universities and their proximity to industries.

From this perspective, it is clear that the most powerful economic engines in the Midwest are likely to be its world-class research universities. Research universities produce all three of the key ingredients in technology-based economic development: technological innovation, technical manpower, and entrepreneurs. Through their on-campus research, they generate the creativity and ideas necessary for innovation. Through their faculty efforts, they attract the necessary “risk capital” through massive federal R&D support (currently in excess of \$8 billion/year for the Midwest’s research universities). Through their education programs they produce the scientists, engineers, and entrepreneurs to implement new knowledge. They are also the key agent of knowledge transfer, both through traditional mechanisms, such as graduates and publications, and through more direct contributions such as faculty/staff entrepreneurs, the formation of start-up companies, strategic partnerships, and so on.

There is ample evidence to support the impact of world-class research universities. One need only look at MIT’s impact on the Boston area, Stanford and UC-

Berkeley’s impact on Northern California, Caltech, UCLA, and USC’s impact on Southern California, and the University of Texas’s impact on Austin. These successful examples offer an important lesson. Only world-class research universities are capable of major impact through technology-driven economic development. A university must be able to play in the big leagues, to compete head-to-head with institutions such as MIT, Stanford, and Berkeley—as well as Beijing’s Tsinghua University, France’s Ecole Polytechnic, Germany’s Max Planck Institutes, and India’s Institutes of Technology—if it is to attract the outstanding faculty and students and massive resources necessary for technological leadership.

Fortunately, today the Midwest has one of the most formidable concentrations of research universities in the world, with considerable activity in research and graduate education, that could serve as the source of new knowledge, innovation, and entrepreneurs necessary to act as powerful job creation machines. Unlike many other economic regions that must create world-class research universities, the Midwest region needs only to support its existing concentration of such institutions adequately.

Yet there are several particular caveats. The first concerns the imbalance in R&D investments in the region. In decades past, largely because of the great prosperity of region’s manufacturing industry, the Congressional delegations from Midwestern states had relatively little



The promise of the Midwest's research universities

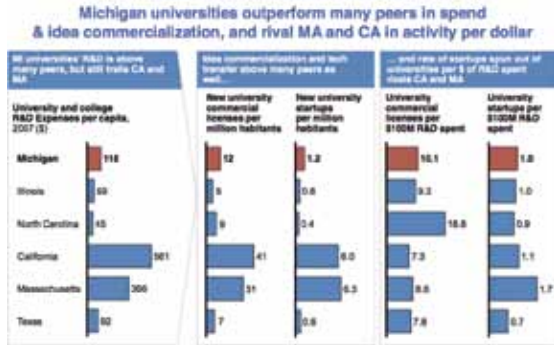
incentive to go after large federal investments in R&D sought by other regions such as the southeast and west coast, preferring instead to give priority to protecting the region's traditional manufacturing industries from intrusive federal regulation. Hence the massive federal investments in R&D facilities stimulated by the Cold War flowed to other states such as California and Texas, leaving the Great Lakes states ranked at the bottom of the nation both in return of federal tax dollars and in federal R&D. In fact, although the Midwest contains 17% of the nation's population and conducts 24% of its industrial R&D, it current receives only 7% of federal R&D funding. To some degree the Midwest has been able to compensate for this lack of federal support and support its technology-dependent industrial base through the development of world-class research universities in the world. Yet, as we have noted, today this critical resource of publicly funded research universities is at some risk as Midwestern states struggle to fund legacy costs such as corrections and unfunded federal mandates such as Medicaid with the declining tax revenues generated by weakening industrial and agricultural economies.

Second, it is important to recognize that while research and scholarship are appropriate activities for

all universities, in truth states can afford only a limited number of world-class research universities capable of competing for the very best students, faculty, and public and private support. David Ward, former chancellor of the University of Wisconsin and a distinguished geographer by discipline, estimates that it takes the tax base provided by a population of 5 million to support a single public research university of world-class quality, perhaps best measured by membership in the Association of American Universities (AAU). This rule of thumb appears to work in most states—and most nations—e.g., Wisconsin with its one AAU-class university in Madison; Michigan, with its two AAU campuses in Ann Arbor and East Lansing; and California with the six AAU campuses of the University of California. There is ample evidence that political attempts to feed ambitious institutional aspirations fueling mission creep of community colleges to four-year universities, baccalaureate institutions to add graduate programs, and regional universities to become national research universities not only are doomed to failure, but this effort also tend to create a leveling effect in which all institutions are pushed toward a least common denominator of quality.

Third, it is important to deploy public resources in both a visionary and effective manner. For example, during the 1990s the state of Michigan proposed to use a portion of its tobacco-settlement funds to establish a Life Sciences Corridor, which was promoted as “a billion-dollar investment” in life sciences research. In reality, however, the \$30 million/year allocated annually for this purpose was modest in scope compared with both federally funded research in Michigan universities in biomedical research (currently over \$1 billion/year annually). Further, it fell considerably short of the investments that other states were making in R&D activities at their research universities, e.g., California's commitment of \$300/year million to build several major research centers on its university campuses or the successful referendum to commit \$3 billion over the next ten years for stem cell research.

In sharp contrast, the University Research Corridor subsequently established not by state government but rather through the collaboration of Michigan State University, Wayne State University, and the University of Michigan is estimated to have created over 68,000



Midwestern research universities are highly competitive in technology transfer. (Rothwell, 2009)

jobs in 2008 while contributing \$12.8 billion/year to the state's economy (Sallee, 2008). Indeed, from this perspective, state government's effort to balance the state budget by cutting higher education is foolish in the extreme, since it is threatening the research capacity of these institutions and hence the geese that lay the golden eggs!

Entrepreneurs, Startups, and High-Tech Economic Development

Although the Midwest is fortunate to have more than a two dozen world-class research universities, it has not benefited from high-tech economic development to the degree of other regions such as Austin, San Diego, or Seattle. This failure has not been for lack of trying. Faculty members with strong entrepreneurial experience have been recruited from high-tech communities. Management talent has been lured to the state to lead startup efforts. Universities have invested their own resources in areas such as the life sciences and information technology with regional economic development as an objective. Yet still technology-driven economic development has not taken off. Why?

In part it is due to climate. No, not the weather in the "good, gray Midwest," but rather the economic culture—the availability of venture capital funds, a risk-taking philosophy on the part of financial institutions, a network of entrepreneurs, and capable management resources. The region does not benefit from the level of available investment capital characterizing other regions such as California or Texas. Furthermore its industrial and political culture continues to be driven very much by the manufacturing industry and domi-



Limited availability of venture capital in the Midwest impedes high-tech economic development. (Rothwell, 2009)

nated by companies that are not knowledge-driven but instead dependent on mature technologies.

It is interesting to compare the experience of Midwestern states with that of other more successful regions such as Boston's Route 128, North Carolina's Research Triangle, San Diego, and Austin. Just as "all politics is local," one could claim that "all high-tech economic development is regional." In each of these success stories, the trigger event was the spinoff startup company from faculty research at a world-class university that was wildly successful, creating the wealth (and the wealthy entrepreneurs) that could be plowed back as venture capital into the next round of startups, e.g., DEC (Ken Olsen) in Boston, SAS (Jim Goodnight) in North Carolina, Qualcomm (Irwin Jacobs) in San Diego, and Dell Computers (Michael Dell) in Austin. There were notable differences, of course. The Austin miracle involved a partnership between the University of Texas and state government, along with public funding, to attract key research organizations (the Microelectronics and Computer Corporation and Semitech); San Diego relied primarily on private capital; Stanford and Austin both made a strategic asset of their substantial land holdings.

At the core of all of these efforts, however, were world-class research universities that served as magnets to attract top talent, along with the high quality of life in surrounding communities, which kept talent in the region. These universities were characterized by both focused excellence and intellectual breadth that allowed them to span many fields, engaging in both basic and applied research of the highest quality. In each case, university, industry, and government leadership were well aligned and capable of working together at

the highest level. Each situation began with a “big hit” that then provided both the role model and the venture capital stream for subsequent startups.

There is one more key feature of these success stories that may explain much of the frustration occurring today in university-industry relations. In each case, ownership of key intellectual property was critical to attracting the necessary private capital for successful startups. Both universities and faculty entrepreneurs were aggressive in capturing and retaining intellectual property rights. An interesting counter example is provided by Johns Hopkins University, which in an altruistic fashion declined to assert ownership of a cancer drug it developed arguing that it was too important to restrict the drug through patents. It was instead released it into the public domain, thereby undercutting further economic development in the Baltimore area.

The research universities in these high-tech hot spots have embraced a sophisticated, nonlinear model of knowledge transfer, where they increasingly view their primary missions—and their greatest rewards—as creating new industries rather than supporting old companies. Clearly, these universities see one of their most important value to society and their greatest institutional payoff as “creative destruction,” building the new industries that will eventually devour the old.

Ironically the decisions of many established companies to dismantle their own internal capacity for R&D and instead outsource R&D through cooperative relationships with research universities will intensify these negotiations. Rather than welcoming them with open arms, many American universities are negotiating with industry just as other companies would, insisting on beneficial intellectual property rights and adequate support of research costs. Cooperative arrangements with universities will have to have sufficient benefits to compete with spinoffs, either through direct financial support of the university by industry or through indirect support through industry’s ability to influence government policies for investing in R&D and higher education. This brave, new world of peer-to-peer university-industry relationships has been a shock to many companies that have long viewed support of higher education as philanthropy rather than a quid pro quo strategic technology alliance!

Little wonder then that established companies seek-

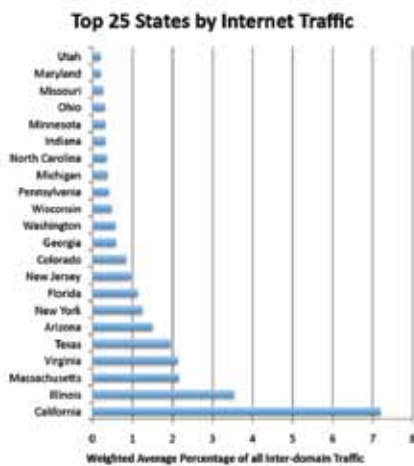
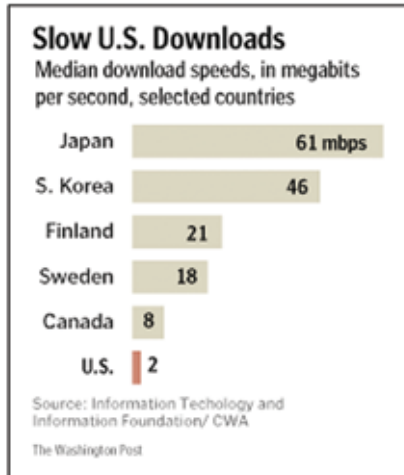
ing cooperative relationships are increasingly frustrated by the priorities such universities give to spinoffs and startups by aggressively negotiating to retain the intellectual property rights necessary to attract private investment. Although some companies have adopted a near-term strategy of off-shoring their R&D activities to nations with less aggressive intellectual property demands, over the longer term this will deprive them of access to the world-class research universities of the United States.

Knowledge Infrastructure

In the last half of the 20th century, state and federal efforts to build the transportation networks necessary for the shipment of goods and services were key to the economic prosperity of our region. The early waterways of rivers, lakes, and canal were succeeded by rail and interstate highway systems and then the expansion of major airports as key elements in connecting Midwestern cities and industries to other economic centers both in the United States and abroad. Chicago, Detroit and Kansas City became great economic centers in part because of their highway and rail linkages to other centers and air linkages to the world.

Today, digital technology has become the infrastructure necessary for the commerce of a knowledge economy. Our rapid evolution into a knowledge-based, global society has been driven in part by the emergence of powerful new information technologies such as digital computers and communications networks. Modern digital technologies have vastly increased our capacity to know and do things and to communicate and collaborate with others. They allow us to transmit information quickly and widely, linking distant places and diverse areas of endeavor in productive new ways. This technology allows us to form and sustain communities for work, play, and learning in ways unimaginable.

We live in a networked world, in which ubiquitous, high-bandwidth connectivity has become essential not only for economic prosperity but for full participation in a knowledge society. As Friedman has noted, the emergence of the Internet, coupled with the massive overinvestment of billions of dollars in fiber networks during the dot-com bubble, has driven down the cost of transmitting voice, data, and images to practically



The United States lags badly in Internet bandwidth; the Midwest states fall even further behind.
(*Washington Post*, 2007)

zero, bringing people-to-people and business-to-business connectivity to a whole new level. Today almost one billion people are connected through broadband, driving the emergence of the global, knowledge-driven economy (Friedman, 2005). The value of networks increases as the square of the number of its participants (Kahn's law), leading to the formation of new knowledge communities and innovative business, and unleashing global competition.

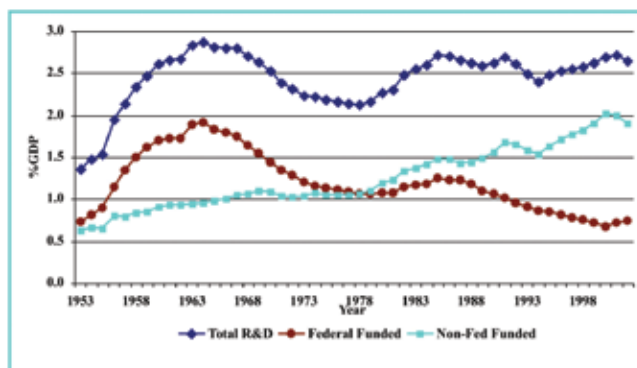
Yet both the nation and the region are falling further behind the rest of the world in providing this key infrastructure for the knowledge economy. Again to quote Friedman: "While a huge amount of fiber was laid to connect India and American, virtually none was laid to connect American households due to a failure of the 1996 telcom deregulation to permit real competition be-

tween the telcoms and the cable companies" (Friedman, 2005). Today the United States is the only industrialized nation without an explicit national policy for promoting broadband, and as a consequence, our nation has dropped from 4th to 13th place in the global ranking of broadband Internet use.

Midwestern states have fallen even further behind, ranking in the lower quartile among the states in the growth rate of deployed broadband lines and very last in per-line investments. For example, in Michigan alone it is estimated that the current lag in access penetration, if not addressed, represents a \$440 billion shortfall in GDP over the next decade. As a study concluded, "It is certainly not the lack of interest in the technology that is creating the gap between Michigan and the U.S. as a whole. Price and ability to pay may be a contributor. But lack of ubiquitous access to a broadband network may be a root cause, particularly in higher socioeconomic levels" (Gartner, 2001).

What is lacking is visionary public policy. In the case of the interstate highway system or air transportation, government recognized the public-good nature of providing the necessary infrastructure for transportation and therefore provided public support and regulation. In contrast many states and the federal government have largely left it to the private sector—primarily the telcoms and cable industry—to provide the "cyberinfrastructure" necessary for the knowledge economy. Unfortunately, the financial incentives and regulatory structure have not stimulated the necessary private investments, and as a result the Midwest has fallen far behind other regions and nations in building the infrastructure necessary for its future prosperity.

While the recent efforts by both local communities and the state to create wireless hubs are commendable, thus far these are being proposed on the cheap, without significant public financing. Furthermore, it is clear that politically constrained legislatures are particularly susceptible to lobbying by the telcoms and cable companies to block these efforts, even though it has been the reluctance of these companies to invest adequately in the region's broadband infrastructure that is putting our state at risk. (Here one need only compare the broadband resources of San Antonio, the corporate headquarters of AT&T (or SBC as it was once called), with those of Midwestern cities!)



The U.S. government has lost its leading position in the support of research and development. (AAAS)

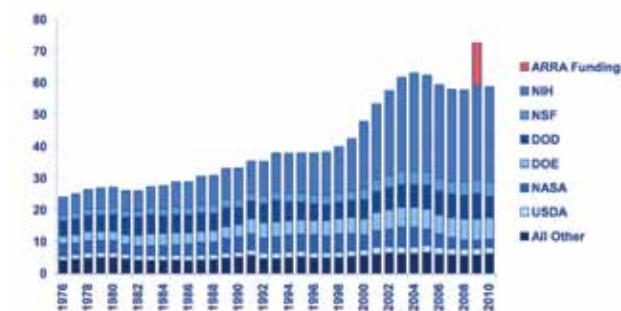
This is an extremely serious issue. It has become clear that without strong action by state governments, either through public investment in statewide network connectivity at a level similar to investment in the interstate highway system, or through regulatory pressures exerted through state public service commissions on the telcoms and cable companies to force them to install high-bandwidth for every Midwestern citizen and business, we will simply not be able to close the high-speed access gap for the citizens of the state. Imagine how the region's automotive industry would have evolved if our people had been forced to drive along one-lane dirt roads. That is precisely the situation we now face for the electronic commerce that is evolving throughout the world.

Challenges at the Federal Level

Most nations are taking action to address—or at least cope with—the ongoing challenges of meeting workforce needs while elevating their universities to world-class status, although local cultures, traditions, and 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 universi-

Trends in Research by Agency, FY 1976-2010

in billions of constant FY 2009 dollars



Source: AAAS Report: Research & Development series.
FY 2009 and FY 2010 figures are latest estimates.
Research includes basic research and applied research.
1976-1994 figures are NSF data on obligations in the Federal Funds survey.
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The past decade has seen even further erosion in federally sponsored R&D. (AAAS)

ties in particular (Weber, 2007). Of course our nation does have a well-organized national research system, based on competitive grants from federal agencies. 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.

This is one area where the rest of the world has a very decided advantage over the United States. For example, 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 universities, key both to the economic strength and integration of the European Community (Adelman, 2009). 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 envy. Similar national strategies have driven dramatic progress in higher education in Asia, particularly in Singapore, Korea, China, and India.

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 believe we need a new national strategy to sustain and enhance the quality of the nation's higher education enterprise.

The United States is part of a global economy, and research and development (R&D) are performed worldwide. Multinational corporations manage their R&D activities to take advantage of the most capable, most creative, and most cost-efficient engineering and scientific talent, wherever they find it. Smaller U.S. firms without global resources are facing stiff competition from foreign companies with access to talented scientists and engineers—many of them trained in the United States—who are the equals of any in this country. Relentless competition is driving a faster pace of innovation, shorter product life cycles, lower prices, and higher quality than ever before. To meet the demands of global competition, other countries are investing heavily in the foundations of modern innovation systems, including research facilities and infrastructure and strong technical workforces. Some of the innovations that emerge from these investments will be driven by local market demands, but many will be developed for export markets. As these and other countries develop markets for technology-laden goods and international competition intensifies, it will become increasingly difficult for the United States to maintain a globally superior innovation system.

Even though current measures of technological leadership—percentage of gross domestic product invested in R&D, absolute numbers of researchers, labor productivity, high-technology production and exports—still favor the United States, a closer look at the engineering research and education enterprise and the age and makeup of the technical workforce reveals several interrelated trends indicating that the United States may have difficulty maintaining its global leadership in technological innovation over the long term. The large, growing imbalance in federal funding for research between engineering and physical sciences on one hand and biomedical and life sciences on the other, combined with a shift in funding by industry and federal mission

agencies from long-term basic research to short-term applied research, raises concerns about the level of support for long-term, fundamental engineering research. The market conditions that once supported industrial investment in basic research at AT&T, IBM, RCA, General Electric, and other giants of corporate America no longer hold. Because of competitive pressures, U.S. industry has downsized its large, corporate R&D laboratories in physical sciences and engineering and reduced its already small share of funding for long-term, fundamental research. Although industry currently accounts for almost three-quarters of the nation's R&D expenditures, its focus is primarily on short-term applied research and product development. In some industries, such as consumer electronics, even product development is increasingly being outsourced to foreign contractors.

Consequently, federal investment in long-term research in universities and national laboratories has become increasingly important to sustaining the nation's technological strength. But just as industry has greatly reduced its investment in long-term engineering research, mission agencies that have traditionally been engineering-intensive have also shifted their focus to short-term research. For example, U.S. Department of Defense (DOD) funding for both basic and applied research has fallen substantially from peak levels in the 1990s, and cuts of more than 20 percent in 6.1, 6.2, and 6.3 budget categories are projected for FY2009 (AAAS, 2008). Given the importance of DOD funding to engineering research in key disciplines—the DOD funds about 40 percent of engineering research at universities and more than 50 percent of research in electrical and mechanical engineering—these reductions have had a significant impact on the level of fundamental research conducted in a number of engineering fields (NRC, 2005).

The stagnating federal investment in research and research infrastructure has weakened the human-capital foundation of the American research enterprise. An innovation-driven nation will require a large cadre of scientists, engineers, and innovators with the depth of knowledge and creativity to create breakthrough technologies and systems. In addition to solid grounding in fundamental engineering concepts, these knowledge professionals must have the ability to address complex

systems in multidisciplinary research environments.

These concerns raised both by industry and the National Academies finally stimulated the federal government to launch a very major effort represented by the American COMPETES Act, aimed at sustaining U.S. capacity for innovation and entrepreneurial activities. The elements of this initiative will span the next decade and 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 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. The Obama administration has proposed to begin restoring adequate federal investment in basic research funding and STEM education. Yet with growing federal deficits resulting from federal expenditure commitments of the past decade (for health care, the wars in Iraq and Afghanistan, and bailing out institutions caught in the recent collapse of financial markets, and tax cuts), it will be very challenging to reach the goals of the America COMPETES Act.

However, whether the federal government decides to act or not, it is also clear that regions such as the Midwest cannot afford to wait. It is essential that the region move rapidly to develop and implement its own goals, plan, and process—that is, roadmap—to achieve a regional vision of an educational infrastructure capable of meeting its human capital, knowledge, and innovation needs.

The challenges and opportunities confronting the Midwest must be faced with resolve by its cities and states without hope of a bailout by the federal government. Yet is also important to view the region's future as very much an issue of national consequence, since the Midwest's role as critical bellwether for the nation's future remains undiminished. As a nation it is clear that we continue to have a vested interest in what happens in the Midwest. Its fate will determine the future of America.

Public Policy Issues at the State Level

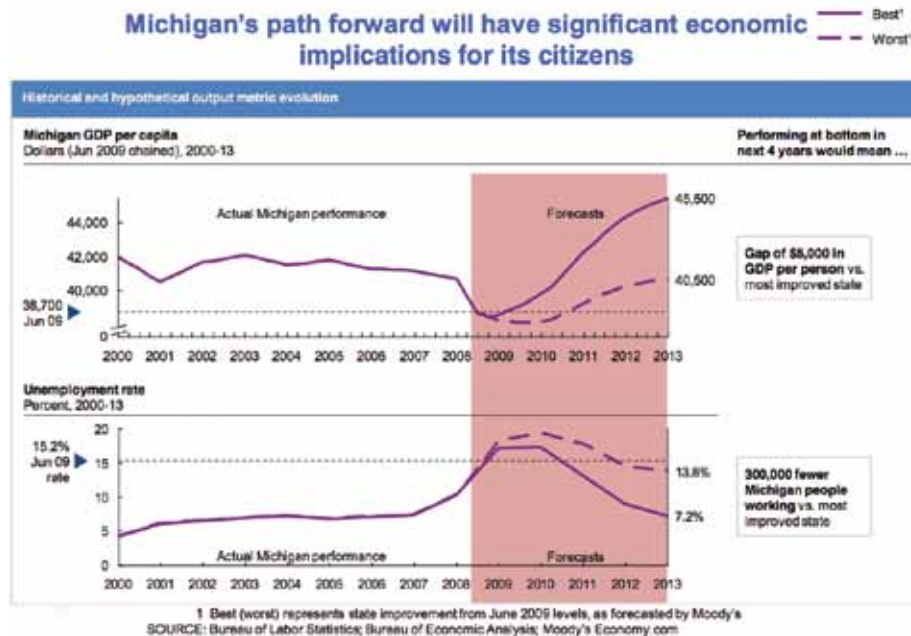
A key objective of any policy discussion at the state level is to shift the public conversation away from distracting issues such as Balkanized state politics, culture wars, and bitterly partisan battles to focus instead on the imperatives of a knowledge economy: lifelong learning, research and innovation, and knowledge-age infrastructure. Here our message is deceptively clear:

1. Knowledge and innovation are the drivers of the global economy today and tomorrow.
2. The key inputs to knowledge and innovation are lifelong learning (human capital), new knowledge creation (R&D, innovation), and the infrastructure that supports these two (schools, colleges, research centers, cyberinfrastructure).
3. Public policy and public investment at the regional level are critical in developing and sustaining each of these three capacities. The states and regions that understand this imperative and do it best will be best positioned to succeed in the future. Those that fail will become economic backwaters.

Since public commitments and government action are the longer-term key, it is important to lay out a possible agenda for state leaders, the more specific the better. It is important that state policy makers begin to consider new financing and governance issues within the context of future state needs and priorities rather than past political party ideologies.

Most important, state governments have to begin by getting its fundamental responsibilities aligned with the needs of a knowledge economy:

1. Empowering families, students, and workers with the responsibility and the resources to access lifelong learning opportunities that they determine will be best for themselves, including early childhood, K-12, post-secondary, and continuing education.
2. Providing the infrastructure and the investments necessary to attract federal and private research funding and stimulate innovation and entrepreneurial ac-



Once again Michigan provides a frightening vision of where inadequate state policies can lead. (Rothwell, 2009)

tivities.

3. Developing a tax structure that provides “equitable, predictable, and durable funding of education, research, and innovation” critical to a knowledge economy.

To be sure, many of the challenges driving the tsunami now engulfing the Midwest—globalization, demographic change, a knowledge-driven economy, and ruthlessly competitive markets—are simply the imperatives of a new age. Yet perhaps the greatest and most threatening gap between the trauma and tragedy of the Midwest today and the promise of what it might become tomorrow is unique to our states: the absolute vacuum of leadership we are currently experiencing.

Clearly many of the policy issues reflected in our analysis are closely related to important challenges in state capitals across the Midwest. These include an unwillingness to provide adequate leadership in addressing the issues (e.g., tax and expenditure restructuring) necessary to allow sufficient investment in the future, overly constraining the ability of educational institutions to take actions necessary to cope with an increasingly competitive marketplace (e.g., eliminating affirmative action and bans on stem cell research),

and apparently an almost total lack of understanding of the realities and role of education and innovation in a knowledge society. Meanwhile, most of the region’s private sector leadership and media have been sitting on the sidelines, largely silent if not oblivious to the key challenges facing the Midwest region.

Related to these issues is the increasing irrelevance of the region’s political parties to the realities of our present and the challenges for the future. Both are largely trapped in the past, driven by the desire to protect old sacred cows (e.g., big business, big labor, big government, and wealthy campaign contributors) or by “value-morality” ideologies (abortion, gay rights, stem cell research, creationism) that are distracting public leaders and public attention from what really matters in a 21st-century global economy. As Midwestern economies crash to the bottom among the states, our elected public leaders continue to back into the future, clinging to the practices and expectations of an obsolete past, instead of facing up to the actions, commitments, and sacrifices that will be necessary to rebuild the Midwest’s strength and prosperity in a radically different future.

Particularly serious is the need to restructure obsolete tax systems, designed for a 1950s factory-based manufacturing economy rather than a 21st-century knowledge economy, and restore both integrity and re-



The tax burdens of Midwest states have been relatively modest and well below those of high-tech states such as California and Massachusetts.

sponsibility to the state budget process. To be sure, a weak economy coupled with the burden of unfunded federal mandates has destabilized the budget process in many states. Of particular concern is the rapidly growing burden of Medicaid, a consequence largely of the federal government's inability to come to grips with a growing uninsured population and the urgent need for universal health care in our nation. As recent studies have suggested, the economic burdens of the unfunded Medicaid mandates passed onto the states by the federal government have now surpassed the entire public education budget (both K-12 and higher education) in the majority of the states (Kane, 2003).

Yet the Midwestern states' budget problems are largely self-inflicted: the result of tax cuts without corresponding spending cuts, failure to confront overdue government and structural reforms, a pattern of using one-time funds to handle real structural deficits, and the extreme stress placed on the state's manufacturing industry—particularly the automobile industry. Study after study has addressed the misconception that Midwestern states are high-tax states, demonstrating instead that our tax burden both for citizens and business has now declined below the national average, although some would prefer that it crash to the bottom along with states such as Mississippi and Alabama (notably those planning to retire in Florida, leaving behind their children to endure the consequences of the resulting

erosion of the state's intellectual, social, and civic infrastructure) (Rothwell, 2010).

Strategic actions by state governments have largely been thwarted by lobbyists and political ideologies moored to the past, resulting in spending cuts of critical services, the use of one-time resources used as Band-Aids to cover the fundamental imbalance between tax revenues and growing expenditures such as corrections and public employee benefits. During the 1980s, Midwestern states launched massive prison construction programs, in response both to ill-considered mandatory sentencing laws and pandering to public concern about crime. As a result, state spending on prisons in the region surpassed that for higher education in the early 1990s and today has

become one of the largest uncontrolled mandates for state tax dollars. Moreover, strong political pressure from unions has dissuaded state leaders from taking strong action to restructure public employee benefits (both state employees and teachers) to levels more comparable to those of the nation. In several Midwestern states school finance reform effort of the 1990s created K-12 education as yet another funding mandate, which along with Medicaid and prisons, leaves little for higher education, which is still treated as a discretionary budget item. (Kane, 2003) As a consequence, over the last several years, no state activity has been cut as much as the funding for public higher education—a glaring sign of the lack of strategic vision on the part of state leaders.

The structural deficiencies in state budgets were compounded during the 1990s. During a period of relative prosperity that should have provided state government with the opportunity to restructure antiquated tax systems and begin to invest in the future by restoring funding for key priorities such as higher education and infrastructure, many states decided instead to cut their tax rates. This created permanent budget deficits that become worse each year as the Midwest's foundering economy continues to weaken, while an aging population and a growing population of uninsured, coupled with the rapid increases in health care costs, drive Medicaid burdens into the stratosphere.

Today many Midwestern states find themselves sim-



Midwest state governments have been slow to respond to the knowledge economy.

ply unable to meet both their obligations for the present (e.g., Medicaid, corrections, K-12 education, public employee benefits) while investing adequately in their future (e.g., higher education, research and innovation, knowledge infrastructure). State governments, increasingly manipulated by special interests and subject to the narrow agendas of political parties, have been unable to restructure an obsolete tax system, designed for a factory-based industrial economy that is no longer dominant in our state. Even today most of the region's economic activity involves knowledge-intensive services—e.g., financial services, health services, and professional services such as law and management, generating revenue that is not included in the tax base. All too frequently both state and local governments tend to use tax abatements to bail out or attract traditional industries rather than investing in the new knowledge-driven businesses capable of competing in tomorrow's global economy.

From a more cynical viewpoint, there is absolutely no evidence whatsoever that cutting state taxes has a positive economic impact—although to be sure in the current anti-tax climate, it may generate votes. What is certain, however, is that cutting investments in education, innovation, and knowledge infrastructure is crippling in a knowledge economy. As Bill Gates stresses, “The IT and biotech industries are far more sensitive to quality of talent than incentives. California is No. 1 not because they have the most friendly tax policies there. If you're coming up with a breakthrough in medicine,

it doesn't matter if you're paying a little more in taxes” (Gates, 2005).

While any discussion of the “t” word is usually banned in state capitals, it has become increasingly clear that without a major restructuring of state tax policy and public expenditures, the Midwest will simply be unable to balance the obligations created by mandates for state funding with the necessary investments in its future. Future generations will bear the burden of our indecision and myopia.

Public Attitudes: Half Right (Essentially) and Half Wrong (Terribly!)

Despite the actions of state governments, special-interest-driven referenda, and political ideologies, public surveys reveal a far more enlightened perspective on the part of the electorate with respect to investing in the state's future. In recent surveys over 80% of citizens express a serious loss of confidence in the leaders of state government. Midwest voters believe that the region's public universities are critical to its economy, providing job training, economic development, and research that will determine the state's future prosperity.

While families value higher education for the educational opportunities the Midwest's colleges and universities provide to their sons and daughters, in today's highly competitive global economy, the public values our universities even more because of their capacity to create new jobs and stimulate the economy. Recent polling suggests that members of the public may be far ahead of our political leaders in sensing that the primary role of higher education in our state has become job creation rather than simply providing a place to send the kids. They understand, like most economists, that the real cure to globalization, outsourcing, off-shoring, and technological change is the availability of advanced educational opportunities. Despite the rhetoric of state leaders, higher tuition levels are not really a major concern of the public, who understand that as state support erodes, higher tuition levels are inevitable if quality is to be sustained. And they accept that quality and access are the highest priorities at this point in the state's history—not bargain-basement prices for bargain-basement quality.

That's the good news. But there is also some bad

news. Polls conducted in 2005 and repeated in 2007 found that just 27% of parents consider a good education essential for success, and nearly half believe that their children can still get a good job with only a high school diploma. More recently, additional polling revealed that with the economy worsening, fewer Michigan residents see education as the way out. "Instead, they want their public schools to prepare students for the low-skill jobs of the past." As Nolan Finley, a *Detroit News* editor, summarized the implications of these depressing statistics: "Michigan is doomed to be the new Mississippi. A backward state locked to a last-century industry, awash in ignorance and unprepared to seize the opportunities presented by new technologies and scientific advances" (Finley, *Detroit News*, December 9, 2007).

A Final Warning from History

The widest gap of all between the challenges of today and the visions for tomorrow are likely to arise from the history of the American Midwest, perhaps best stated by in Bruce Catton's bicentennial history of the state of Michigan (Catton, 1976):

"Michigan as a state grew up in the belief that abundance is forever. Michigan's abundance of furs brought the early trappers and traders. An abundance of forests drew lumberjacks who reduced the pines to stumps and sawdust. The state held an abundance of iron ore and copper and developed new means to move men and goods at an ever-faster pace, until it too ran out, and the mines closed. Then cheap labor and mass production led to the birth of a new industry, automobiles, that dominated the state for over a century, until it also encountered other parts of the world that were just as inventive, and had even cheaper (and higher quality) labor.

"The idea that abundance was "inexhaustible"—that fatal Michigan word—dominated thinking about the state from its earliest days. Unrestrained exploitation of natural resources, from beavers to pine trees to iron and copper ore, led eventually to unrestrained exploitation of human beings. A belief in unlimited resources simply creates a set of unlimited desires. This is the incalculable, explosive fact that lies just below the

surface in American life.

"In Michigan, perhaps more clearly than in other states, can be seen the enormous increase in the speed of society's movement, the pressures that come when a society adjusted to one era is suddenly compelled to shape itself to an entirely new one, the torment of modern man torn by the astounding discovery that the things he makes have taken charge of his life. Without intending anything of the kind, man discovers that he is involved in an enormous revolution, simply because the power in his hands is so vast that its mere existence turns the world upside down.

"Fully characteristic of a society whose desires became ever more insistent as the possibility of satisfying them increased was a demand for more speed and flexibility of movement. Michigan was above all other things a prodigal society; inevitably so, in view of the base on which it was built. The bounty was going to last forever, and if you threw something away, you could always replace it with something better.

"Nothing was planned; people just took a chance. Here was the state that gave away great forests and iron ranges, with the carefree liberality of a sailor on shore leave, in order to get railroads built, with the abiding that everything would be justified in a great tomorrow. The problem is characteristic. The whole organization of society is keyed to a means of transportation that must, some day, run out of gas.

"A society whose lusty tradition of individualism and firm belief in the equality of all men were both based on that frontier ability is likely to flounder when conditions change. A society that is based on a firm conviction that there is a blessed abundance of good things and that the supply will never fail is under the most profound pressure to justify its faith by good works. If it fails to do this, it will explode. For the modern world is one in which all stakes are raised to infinity; win it all or lose it all, in this or the next generation." (Catton, 1976)

The Writing on the Wall

Clearly any candid appraisal of the Midwest's current situation does not inspire confidence that the region is headed in the right direction. Our under investment in advanced education, research, and innovation,

coupled with short-sighted public policies and corporate strategies that further constrain efforts to build a high-skill workforce and generate the research, innovation, and entrepreneurial zeal necessary to achieve a knowledge economy, should be a matter of great concern to state leaders. The keys to economic growth in a global, knowledge-driven economy are a world-class workforce and a knowledge infrastructure capable of stimulating innovation. These are the assets that will save the Midwest region from becoming a backwater economy, providing a point of liftoff from which we can create new markets, processes, and skills.

Learning and knowledge generation are becoming powerful political forces throughout our nation and around the world, as competitiveness in a global, knowledge-driven economy depends increasingly on a highly educated workforce, new knowledge, and innovative products and services. Just as the space race of the 1960s stimulated major investments in research and education, there are early signs that the skills and innovation race of the 21st Century may soon be recognized as the dominant policy of our times. But there is an important difference here. The space race galvanized public concern and concentrated national attention on educating “the best and brightest,” the elite of our society. The skills race of the 21st Century will value instead the skills and knowledge, the innovation, and the capacity for adapting to change of our entire workforce as a key to economic prosperity, security, and social well being.

The Midwest must restore an adequate balance between addressing the priorities of an aging population and investing in the future through education. The challenge to leaders is to develop visionary policies, outstanding institutions, and world-class infrastructure that will produce the knowledge workers, the educated professionals, the new knowledge, and the innovation necessary to build and attract new knowledge-based industries capable of driving future economic growth.

Chapter 6

A Roadmap to the Midwest's Future

The art of progress is to preserve order amid change and to preserve change amid order.

—Alfred North Whitehead

We now turn to the final phase of the roadmapping process by constructing a roadmap for the Midwest region. As stressed throughout this report, in a knowledge-intensive society, regional advantage is achieved through creating a highly educated and skilled workforce that is competitive on a global level. It requires an environment that stimulates creativity, innovation, and entrepreneurial motivation. It also requires world-class infrastructure—schools and colleges, research laboratories and cyberinfrastructure, tax and intellectual property policies. And it requires vision, commitment, and leadership in both the public and private sectors. In a sense, it requires building a culture of learning and innovation capable of prospering and thriving in a rapidly changing 21st century world. In this chapter we will focus on the goals and strategies, essentially suggesting the roads one must build, while in the next chapter the focus will be on tactics, plans, and processes—that is, how one can travel along these roads.

Since building a 21st century learning and innovation infrastructure for a region will clearly involve multiple players—institutions, states, and the nation more broadly, this roadmap will be developed in a layered fashion, setting out the goals, strategies, plans, and processes for each constituency. Of course, the roadmaps for each layer are strongly coupled to one another. National goals and strategies provide the foundation for regional, state, and institutional efforts. For example, if the federal government continues to inadequately fund graduate education and university research in key areas such as renewable energy and information technology, it is unlikely that the states and regions will be able to compensate sufficiently; consequently, their efforts to build innovation-driven economies will be crippled. As a more positive example, if college and university priorities can be shifted toward embracing more unique

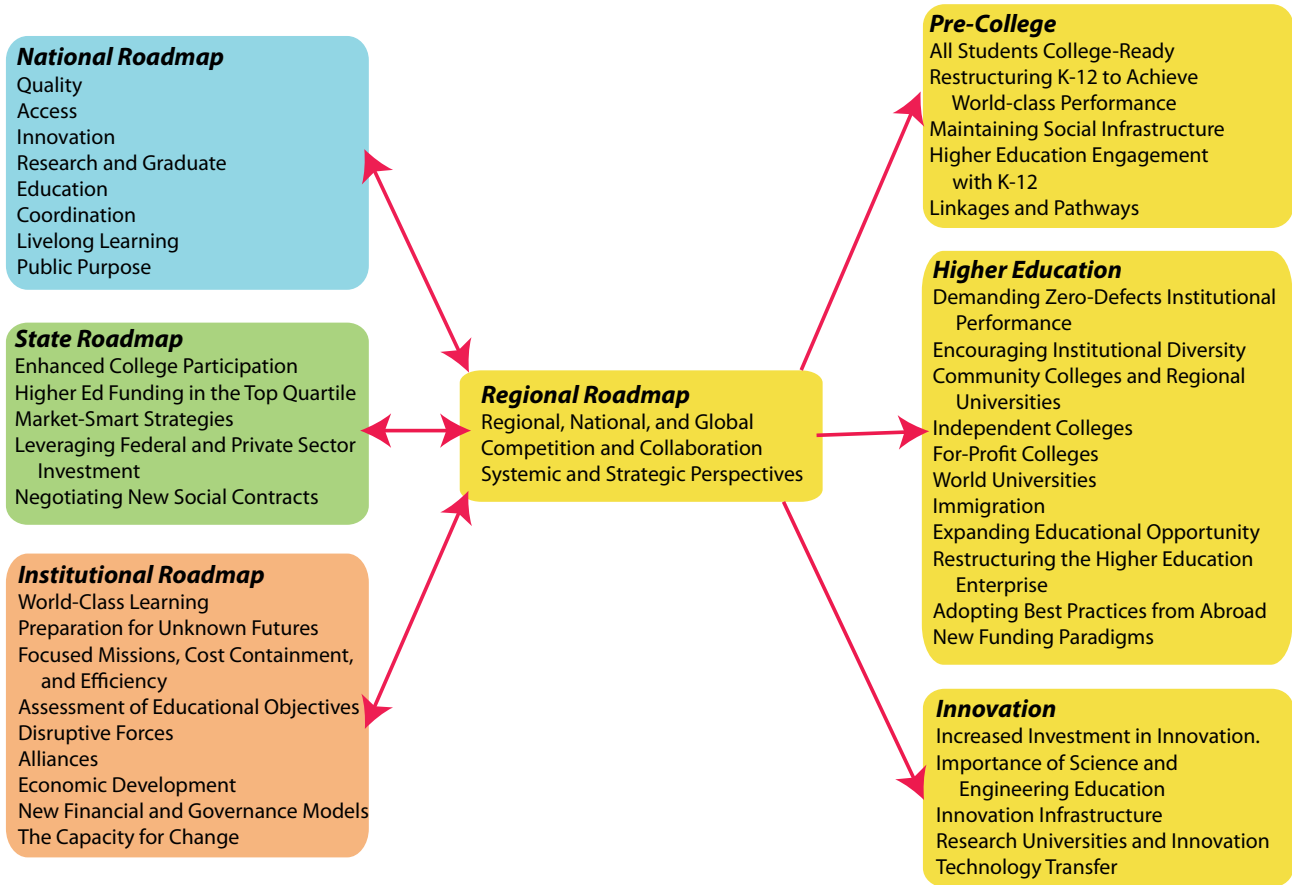
roles rather than imitating one another, then this might avoid the mission creep that frequently drives inefficiency, duplication, and costs. Finally, it is also clear that some roadmapping elements will be similar across all levels, such as the demands for high quality and public accountability.

We begin with a framework for the roadmaps by providing a summary of the key findings detailed in earlier chapters and using these to develop a set of premises for the roadmap development. Although the focus of this report is on the development of education roadmap at the regional, state, and institutional levels, they will evolve within the national context. Hence as the last element of this layered set of roadmaps, we also suggest goals that might characterize a broader planning effort at the national level by drawing upon the work of the National Commission for the Future of Higher Education in America (the Spellings Commission). We also suggest possible timeframes for the implementation of each recommendation, i.e., *now*, *soon* (within a few years), and *eventually* (within a decade).

Although the roadmapping effort will be focused on post-secondary education because of its multiple missions of developing human capital, knowledge, and innovation, the linkages with and dependency upon K-12 education and the importance of lifelong learning will also be considered. We begin by summarizing the principal findings of the earlier chapters and stating the premises for the roadmapping exercise.

A Framework of Findings and Premises

1. We have entered an era in which educated people, the knowledge they produce, and the innovation and entrepreneurial skills they possess have become the keys to economic prosperity, public health, national se-



Various Levels of a Midwest Roadmap

curity, and social well-being. Hence the strength, prosperity, and leadership of a nation in a global knowledge economy will demand a highly educated workforce and hence depend upon a world-class system of education. An increasingly technology-dependent nation will also require world-class research universities, capable of discovering new knowledge, developing innovative applications of these discoveries through entrepreneurial activities, and educating those capable of working at the frontiers of knowledge and the professions.

2. Education has become a key determinant of one's personal standard of living and quality of life. Today the breakpoint between those who succeed in college and those who fail is perhaps the most critical decision point in one's life! As a consequence, in today's knowledge economy, it has become the responsibility of democratic societies to provide all of their citizens

with the educational and learning opportunities they need, throughout their lives, whenever, wherever, and however they need them, at high quality and at affordable costs.

3. Yet access to educational opportunities has become increasingly stratified according to student financial circumstances, thereby undercutting the fundamental principles of equity in providing educational opportunities for a democratic nation. In particular, the provision of broad access to quality higher education should be viewed as a shared responsibility among colleges and universities that seek both quality and efficiency; students and other clients of higher education who act as informed consumers; the availability of private capital; and the commitment of federal, state, and local governments to provide adequate and equitable financial support.

4. The core competency of the American economy is its capacity to innovate. While the characteristics of the American culture—a diverse population, democratic values, free-market practices, a predictable legal system—provide a fertile environment for innovation, history has shown that significant public and private investment is necessary to produce the key ingredients of innovation: new knowledge (research), world-class human capital (education), infrastructure (institutions, facilities, networks), and policies (tax, investment, intellectual property).

5. There are growing concerns about the nation's supply of scientists, engineers, physicians and nurses, teachers and other knowledge-intensive professionals both because of declining student interest (due in part to the weakness of K-12 education, the obsolete nature of university science curricula, and inadequate support of graduate education), anticipated retirements, and declining immigration (due to visa restrictions) at a time when other nations are rapidly increasing commitments in these areas.

6. While some elements of American education are clearly world-class such as its research universities, international comparisons raise issues about the relative quality and performance of our education enterprise more broadly. There are numerous valid concerns about student access, affordability, quality, performance, and responsiveness of various elements of the American education system that could threaten its capacity to serve the needs of the nation. Furthermore, even the best of America's academic institutions are characterized by complacency engendered by past reputation that could erode future innovation and excellence.

7. American education is a mature industry that has become risk-averse, complacent, and increasingly expensive. It is an enterprise that has yet to address the fundamental issues of how academic institutions must be transformed to enable them to adapt to changes driven by forces such as the emerging knowledge 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 universities), and new paradigms (e.g., distance learning, open educational resources).

8. Public policy alone is unlikely to be effective in stimulating the educational enterprise to become more responsive to a rapidly changing world. Public funds at both the state and federal level will be limited for at least a generation by the priority given to the needs of an aging population, national security, and tax relief, and will likely be insufficient to meet the growing need for lifelong access to postsecondary education for the majority of our population.

9. American higher education is supported by a balance of public and private resources, roughly 45% public and 55% private. While public funds are likely to be constrained, the resources available in the private sector through capital markets and intergenerational wealth transfer will be very substantial, likely intensifying even further the market forces on colleges, universities, and other elements of the postsecondary education sector.

10. While it is only prudent to enhance the ability of the American education enterprise to face the challenge and opportunity presented by strong market forces, it is important to resist the tendency to portray higher education primarily as a private benefit rather than a public good. Restoring public trust and confidence in our schools, colleges, and universities is essential to enable critical roles such as producing the leaders of our governments, commerce, and professions; defending and propagating our cultural and intellectual heritage; challenging our norms and beliefs; creating and applying new knowledge to serve our society; and 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.

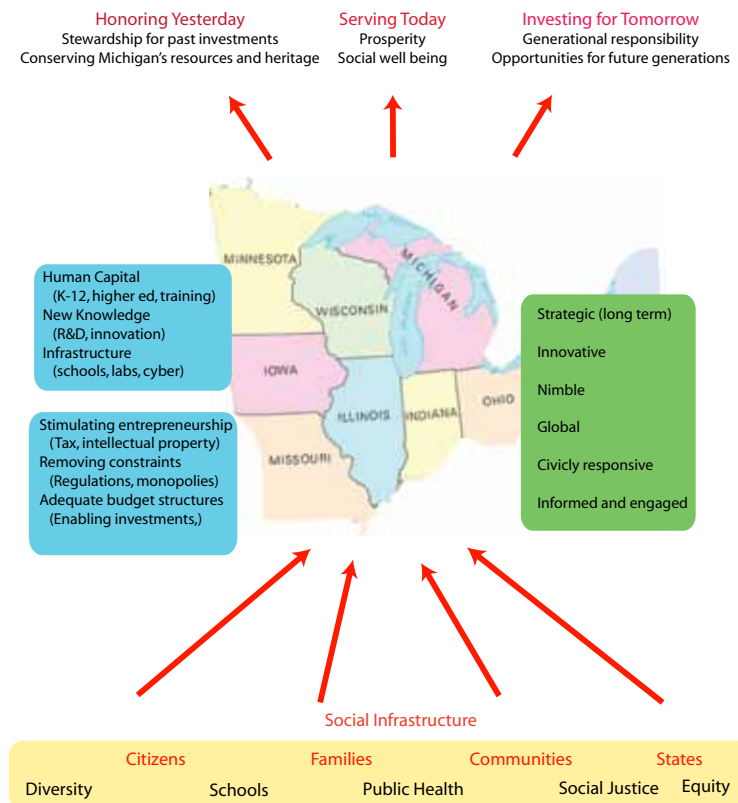
A Roadmap for the Midwest Region

We turn first to the roadmapping process for the Midwest region. This is designed as an organic and evolving plan to suggest paths the region might take to transform itself from the deteriorating industrial and agricultural economy of today to a vibrant, knowledge-driven economy of tomorrow, capable of competing in a global economy and providing our citizens with prosperity, social well-being, and security. The key themes that augment the national agenda include the importance of regional integration (through coordination, mobility, and technology), the globalization of higher education, the educational paradigm shifts required by a knowledge economy, and the role that its flagship research universities can play in both envisioning and creating the future of the region.

We begin with a simple premise: *the key to the Midwest's future lies with its people, with their skills, character, creativity, innovation, and entrepreneurial spirit.* The quality and diversity of our workforce must become our greatest asset. In the past the Midwest has exploited its vast natural wealth—its forests, minerals, lakes, and

location—to achieve economic strength and global leadership. But this was possible largely because of the pioneering spirit, gritty courage, and self-reliance of the people who have been attracted to the state by these assets. It was our people who made our farms and factories the best in the world. Over generations we have learned that if we believe and invest in our citizens and those who come to the Midwest—in their education, health, and social well-being—it is our people who will keep us at the forefront of innovation, productivity, and trade.

Hence in the regional roadmap we have stressed setting and achieving higher goals in K-12 education and higher education, restoring adequate public investments in the region's schools, colleges, and universities, and facilitating the technology transfer and high-tech business startups aimed at creating the new industries that will eventually replace the Midwest's declining factory-based manufacturing industries. However even in the near term bold steps to begin to build the necessary knowledge-based workforce are both imperative and appropriate, although it will take time to achieve the necessary progress. Investing in building the nec-



A strategic roadmap to the Midwest's future

essary infrastructure will also be essential to support and sustain both innovation and workforce development. The challenge will be to provide world-class opportunities for lifelong education, training, and cultural enrichment to all of the region's citizens while demanding, achieving, and sustaining the region's educational institutions at the very highest level of excellence, efficiency, and accountability.

For the longer term, there can be no more compelling priority with a higher rate of return than an investment in our people through both public and private support of educational opportunities at all levels and throughout their lives. The Midwest must build and sustain a culture of learning and innovation. This must span the full range of educational opportunities, from pre-school to K-12 to higher education, to graduate and professional education, to lifelong learning. It must augment this with further public and private investments in institutions capable of generating new knowledge through R&D and then transferring this into innovative products, processes, and services in the global marketplace.

To be sure, this will be challenging, since it will demand substantial new investments, both in individuals (e.g., financial aid, vouchers) and institutions (appropriations, tuition, and philanthropy), that will almost certainly require new tax revenues. It will also require both the public and private sector to address those legacy costs (e.g., corrections, health care, retirement) that have become excessive and clearly out of line with the best practices of leading economies elsewhere. It will demand new standards for excellence and accountability for institutions, students, and families. It must both encourage and demand that our educational institutions embrace the new paradigms for learning, knowledge creation, innovation, and entrepreneurship that are characterized by the world-class quality, ability, and accountability necessary to compete in the global economy. And it will require a restoration of the Midwest's historic commitment to rebuilding the social safety net for those caught in the inevitable maelstrom associated with the creative destruction of the global economy as new industries appear to replace the old.

Our first recommendations concern three important perspectives: *acting regionally while thinking globally; demanding regional collaboration instead of pointless competi-*

tion; and thinking far more strategically.

Regional to National to Global: While it is natural to confine policy to state boundaries, in reality such geopolitical boundaries are of no more relevance to public policy than they are to corporate strategies in an ever more integrated and interdependent global society. Hence the Midwest's strategies must broaden to include regional, national, and global elements.

Competition to Collaboration: Midwestern states, governments, and institutions must shift from Balkanized competition to collaboration to achieve common interests, creating regional partnerships capable of responding to global imperatives.

Systemic and Strategic Perspectives: The Midwest needs to develop a more systemic and strategic perspective of its educational, research, and cultural institutions—public and private, formal and informal—that views these knowledge resources as comprising a knowledge ecology that must be adequately supported and allowed to adapt and evolve rapidly to serve the needs of the state in a change-driven world, free from micromanagement by state government or intrusion by partisan politics.

Education policy at the state and local levels is usually far too fragmented, with widely differing perspectives and philosophies depending on its knowledge and learning infrastructure, e.g., K-12 responsible to local communities and state boards of education, public higher education largely the responsibility of politically determined governing boards, independent colleges usually quite autonomous, and an array of cultural organizations (museums, libraries), industrial resources (workplace training programs, corporate R&D), and informal learning opportunities largely out of sight, out of mind. In a similar sense, state funding of education tends to run on automatic pilot, determined more by the increasingly inadequate resources provided by obsolete tax codes and burdensome legacy cost structures of most Midwestern states (e.g., based on a 1950s manufacturing and agricultural economy rather than a 21st-century knowledge-services economy) and driven more by political ideology and patronage than carefully designed as a strategic investment in the region's fu-

ture. By elevating the dialog to the regional level, leaders of state, local, and metropolitan governments, higher education, business, industry, labor, and the public at large (through the media) can be challenged to view education and innovation from a far more systemic and strategic perspective and key to the Midwest's future.

Here we certainly do not intend to suggest that yet another layer of bureaucracy needs to be added upon those already imposed by state and local governments. Rather we believe that more policy attention needs to be given to the strategic evolution of education, research, and innovation resources in the region, freed from the tyranny of legislative committees and political election cycles and more responsive to the long-term needs of the Midwest region.

Pre-College

We begin by addressing the primary concerns about pre-college education in the Midwest: the complex interplay of inadequate preparation, lack of information about educational opportunities, and persistent financial barriers that impede the ability of students to pursue their education to the advanced level required by the knowledge economy—particularly for low-income and under-represented minority students. Inadequate primary and secondary education not only deprives too many children of the knowledge and skills necessary to compete in the global, knowledge economy but it fails to prepare them adequately for further study at the postsecondary level necessary to provide the knowledge and skills essential both for a globally competitive workforce and personal quality of life.

While a detailed analysis of the necessary reforms in primary and secondary education is beyond the scope of this study, it is appropriate to mention several of the themes suggested by numerous other studies:

1. Universal access to quality early childhood programming for all four-year-old children and universal high quality (full-day) kindergarten
2. Development and acceptance of national standards for elementary and secondary education
3. Equitable and durable support for K-12 education, albeit accompanied by accountability for teaching quality and student performance



Here come the Millennials!

4. Strong support for teacher preparation and professional development

The pre-college recommendations that relate more directly to the goals of this regional education roadmap are as follows:

All Students College- or Workplace- Ready: The Midwest region should set high goals that ALL students will graduate with a high school degree that signifies they are not only either college- or workplace-ready but furthermore prepared for a world that will require a lifelong commitment to learning. State governments and local communities should provide both the mandate and the resources to achieve these goals. (Now!)

President Obama has proposed as a national goal that every student in the nation should have the opportunity to pursue postsecondary education and furthermore. Furthermore he challenged “every American to commit to at least one year or more of higher education or career training”, thereby enabling “America to once again have by 2020 the highest proportion of college graduates in the world”. This bold goal will require an unprecedented effort to expand higher education access and success by improving student preparation and persistence at the national, state, and local level, addressing non-academic barriers, and providing significant increases in aid to low-income students (Lin-



Our K-12 schools are challenged to catch up with the skills required by a changing world.

genfelter, 2009).

A high school degree should signify that a student is college and/or work ready. The effort is underway in a number of states including the Midwest to better align K-12 graduation standards with college and employers (e.g., the Race to the Top challenge program), but we are suggesting that the bar should be set even higher: All students enrolling in our K-12 schools should be prepared for further—indeed, *lifelong*—learning at the postsecondary level as an absolute requirement for the knowledge economy. No child—or school—should be left behind and forced to settle for anything less than a rigorous college preparatory education!

Restructuring K-12 to Achieve World-class Performance: To achieve a quantum leap in student learning, Midwestern schools systems will have to restructure themselves to achieve world-class performance, including setting high standards for student and teacher performance, lengthening the school year, investing in modern learning resources, implementing rigorous methods for assessing student learning, preparing and rewarding outstanding teachers, and managing and governing school systems in an accountable fashion. (Soon)

The Achilles heel of American education is at the level of primary and secondary education, as evidenced by the latest international rankings that place U.S. students at an abysmal 25th in math and 21st in science

out of 30 developed nations. Although there is general awareness of these challenges, and numerous major efforts have been launched to address deficiencies (e.g., No Child Left Behind, Race to the Top, etc.), progress remains elusive. Nevertheless, this issue must remain at the top of American priorities at all levels—national, state, regional, and local. Without significant improvement in K-12 education, the United States faces a bleak future in a global, knowledge-intensive society.

Key in this effort will be the adoption of rigorous nationwide—standards that set out the skills students should learn from kindergarten through high school, along with effective assessment methodology to monitor progress. Here recent efforts by the National Governors Association and Council of Chief State School Officers to promote clear, ambitious goals for what children should learn from year to year are an important step in the right direction (NGA, 2010).

Social Infrastructure: Beyond the necessary investments in K-12 education and the standards set for their quality and performance, raising the level of skills, knowledge, and achievement of the Midwest's workforce will require a strong social infrastructure of families and local communities, particularly during times of economic stress. To this end, state and local governments must take action both to re-establish the adequacy of the Midwest's social safety net while engaging in a broad effort of civic education to convince the public of the importance of providing world-class educational opportunities to all of its citizens. (Soon)

As we have noted earlier, the Midwest's social priorities have become seriously distorted in recent years, placing more emphasis on locking people up or providing tax benefits to the affluent than investing in the educational opportunities and welfare of its citizens. A striking example is provided by those states and institutions giving priority to merit scholarship programs, which primarily channel state resources to economically advantaged students attending well-supported schools in affluent areas at the expense of the financial aid necessary to provide educational opportunities to the less fortunate. It is imperative that these merit-based programs be restructured with a strong need requirement if the state is to target public resources where they are likely to have the most impact on the

Midwest's future workforce.

Furthermore, since the educational standards demanded by the global economy require strong families and communities in addition to schools, the Midwest must recommit itself to adequately supporting the necessary social programs and policies to enable all of its citizens—including those disadvantaged by economic dislocation or discrimination—to access educational opportunities. Although particularly challenging, such social safety nets are even more important during today's economic times.

Here part of the challenge is public awareness. Many students and parents do not understand the steps needed to prepare for college, and the current system fails to address this information gap. State and local governments need to partner with schools and colleges to provide resources for early and ongoing college awareness activities, academic support, and college planning and financial aid application assistance. Such efforts should include developing students' and parents' knowledge of the economic and social benefits of college through better information, the use of role models and extensive career exploration. ,

Beyond the disturbing fact that many parents still do not understand the imperatives of postsecondary education for the children's future, it is also clear that an aging population has yet to realize its generational responsibility to invest adequately in the Midwest's future. Higher education should partner with business to raise public awareness of the educational and social imperatives of the global economy and the necessary commitments that parents, citizens, and governments must make to secure their future.

Finally, it is essential to provide both students and parents with the confidence that they will have the ability to afford a college education if they make the effort to prepare themselves academically at the K-12 level. While some states such as California have accepted the responsibility to provide a college education for all citizens through a robust system of public community colleges, regional universities, and the University of California, others have looked to the private sector. Here the Kalamazoo Promise stands out as an example of a visionary philanthropic effort to guarantee the funding of a college education for all students graduating from the local high schools. A more ambitious federally-



Linking higher education with K-12 students is essential, particularly in areas of technology.

funded initiative of a similar spirit is the *Learn Grant* program, suggested by the Spellings Commission and described in more detail in Chapter 8 of this report.

Higher Education Engagement with K-12: *Higher education must become significantly more engaged with K-12 education, accepting the challenge of improving the quality of our primary and secondary schools as one of its highest priorities with the corresponding commitment of faculty, staff, and financial resources. Each Midwest college and university should be challenged to develop a strategic plan for such engagement, along with measurable performance goals and should be encouraged to join in consortia to address the challenges of K-12 education. (Now!)*

Although the quality of American higher education is heavily dependent upon the quality of K-12 education, most colleges and universities have limited their engagement with K-12 education to teacher training. A few have gone further to create and manage charter schools, much in the spirit of the clinical "university schools" characterizing schools of education in the past century. But most of higher education has largely viewed the challenges faced by K-12 education in America as somebody else's problem and tended more to criticize the quality of our schools and the preparation they provide to college-bound students than to work with them to correct their deficiencies.

In particular, higher education needs to become far

more tightly coupled to primary and secondary education. Recent studies have revealed the inadequate preparation of high school graduates for college work, along with the limited success of higher education in addressing student deficiencies in written and quantitative literacy. Colleges and universities need to work closely with K-12 education, aligning high school curricula with college standards and providing feedback to prospective students about their readiness for college work. In particular, the senior year of high school (12th grade) should be used by colleges and secondary schools both to introduce advanced students to college-level work while providing the remedial education necessary to repair deficiencies in student preparation for further study. A commitment to lifelong learning could provide yet additional opportunities for addressing the current diversity in K-12 learning experiences and student learning readiness that today leads to all too frequent failure at the college level.

Since our schools hold the key to the quality of students entering postsecondary education, our workforce, and higher education itself, the Midwest's colleges and universities have a very strong and vested interest in becoming deeply engaged with K-12 education in the region. They also have a major responsibility, since the low priority many of our institutions have given teacher education, the misalignment of K-12 and college curricula and entrance standards, and the confusing signals they have conveyed to schools, students, and parents about the preparation necessary for success in college have at times made our universities more a part of the problem than the solution to quality in primary and secondary education. Among the possible elements are efforts to give a much higher priority to teacher education, elevating the status of schools of education to enable them to attract top college students; assisting both state agencies and secondary schools in aligning curricula with university admission and program requirements; developing methods to assess the progress of college-readiness for secondary school students; and launching major public awareness programs for secondary school students and parents so that they understand both the academic requirements and financial opportunities to attend college.

However more is needed. For example, there are many secondary school students who are ready for col-

lege-level work. Hence colleges and universities could consider actually offering college courses—for credit and taught by university faculty—in secondary schools to accelerate the educational opportunities for students, to create more awareness among students and secondary school teachers of the nature of contemporary college curricula, and to create a more seamless transition from school to college. The rapid evolution of online education and resources such as the Open CourseWare initiation, iTunes U, and other open education resources provide powerful tools to this end. In fact, some institutions such as MIT are already providing sophisticated web portals to assist K-12 teachers and students in utilizing their online materials.

It is particularly important to develop programs that bring together secondary school and college faculties in peer-to-peer relationships. The federal government used to sponsor summer workshops on college campuses for K-12 teachers that helped in such efforts, particularly in key areas such as STEM education (science, technology, engineering, and mathematics). In the absence of such federal programs, state governments should consider assuming this role, perhaps in partnership with business and the philanthropic community.

Each of the Midwest's colleges and universities should be challenged to develop a high-priority strategic plan for engagement with K-12 education that is both university-wide (perhaps reporting directly to the president or provost of the institution) and characterized by measurable performance objectives. This is simply too important an activity to relegate to schools of education. It must involve the commitment of the entire institution.

Linkages and Pathways: The Midwest must create clear pathways among educational levels and institutions, remove barriers to student mobility, and promote new learning paradigms (e.g., distance education, lifelong learning, workplace programs) to accommodate a far more diverse student cohort. (Soon)

The Midwest must greatly expand college participation and success by developing ways in which postsecondary institutions, K-12 school systems, and key policy makers can work together to create a seamless pathway between high school and college. Both stu-

dents and the region could be well served by a higher degree of coordination, particularly in facilitating the transition among various sectors (e.g., K-12, community college, undergraduate, graduate, professional, lifelong learning) and elements (public, private, for-profit, corporate training) of education. The absence of coordination agreements can be a serious hurdle to students attempting the transition from one education level or institution to another. While competition among institutions is important, particularly in a marketplace increasingly funded from private sources, so too is sufficient coordination to allow a smooth, transparent transitions from one stage or institution to the next in a future increasingly dependent upon lifelong learning.

Standards for transfer of credit among higher education institutions should be reviewed and revised, subject to rigorous standards designed to ensure educational quality, to improve access and reduce time-to-completion. Of importance here is the development of a regionwide (or national) student record system, capable of statistically tracking the flow and progress of students throughout postsecondary education, as well as the development of incentives at the state and local level for institutional coordination and cooperation among all elements of the education sector.

Higher Education

Demanding Zero-Defects Institutional Performance: *All Midwestern colleges and universities should be challenged to achieve a zero-defects, total quality performance goal in which all enrolled students are expected to graduate in the prescribed period. This will require not only adequate financial, instructional, and counseling support but also strong incentives and disincentives at the individual and institutional level (e.g., basing public support on graduation rates rather than enrollments, demanding that faculty give highest priority to adequate staffing of required curricula, and setting tuition levels to encourage early graduation).* (Soon)

Although there are many reasons for the low graduation rates characterizing American higher education (currently below 50% for 6-year baccalaureate graduation), it nevertheless represents a very serious challenge both in terms of human and economic cost. The region

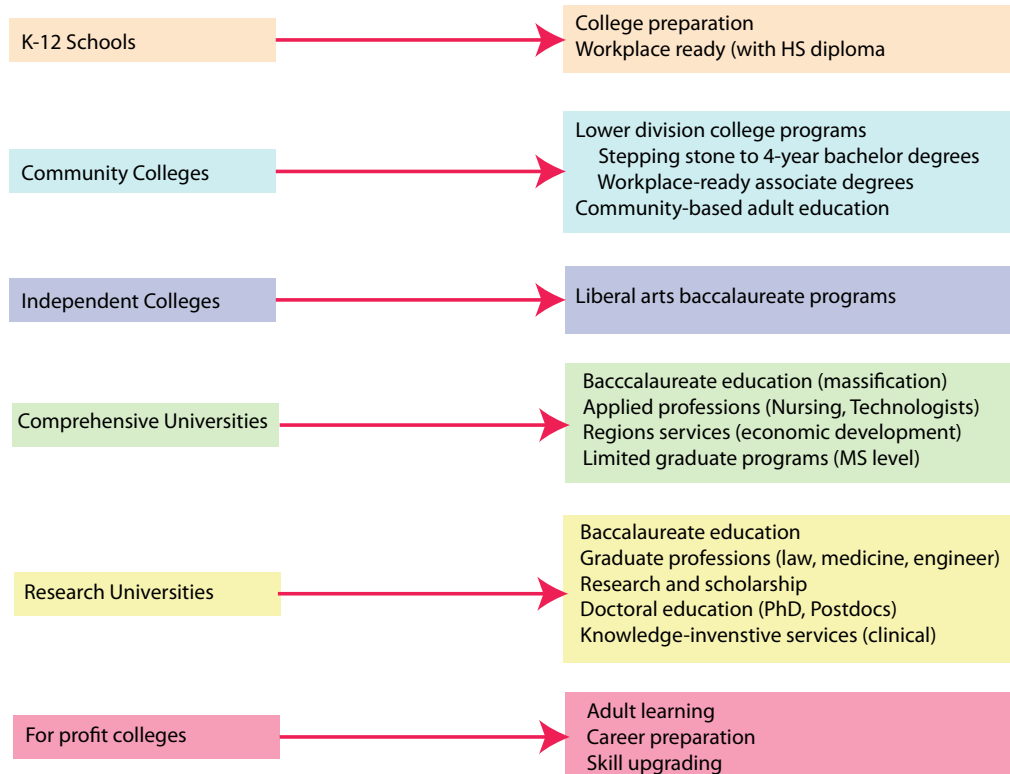


It is imperative that the Midwest dramatically increase student degree attainment in higher education.

should simply refuse to tolerate such low performance on the part of students, faculties, and institutions. A region-wide effort should be launched to elevate graduation rates to world-class standards (e.g., that of Korea, now above 80%). This effort should involve state governments, the business community, and foundations (e.g., the Lumina Foundation's efforts to adopt the Bologna "tuning" process in the US). (Adelman, 2009) Institutions should be held accountable for graduation rates both through performance-based funding and public region-wide comparisons of both performance and mitigation efforts.

Institutional Diversity: *The Midwest should strive to encourage and sustain a more diverse system of higher education, since institutions with diverse missions, core competencies, and funding mechanisms are necessary to serve the diverse needs of its citizens, while creating a knowledge infrastructure more resilient to the challenges presented by unpredictable futures. Using a combination of technology and funding policies, efforts should be made to link elements of the Midwest's learning, research, and knowledge resources into a market-responsive seamless web, centered on the needs and welfare of its citizens and the prosperity and quality of life in the region rather than the ambitions of institutional and political leaders.* (Soon)

It is increasingly apparent that the great diversity of higher education needs, both on the part of diverse constituencies (young students, professionals, adult learn-



The current core missions and competencies of the Midwest education enterprise

ers) and society more broadly (teaching, research, economic development, cultural richness) demands a diverse higher education ecosystem of institutional types. Mission differentiation is key, since the availability of limited resources will allow only a small fraction of institutions to become globally competitive as comprehensive research institutions. A differentiated system of higher education helps to accomplish the goals of both enhancing educational opportunity and conducting research of world-class quality, but it assigns different roles in such efforts for various institutions. Enabled both by a multiple state character and its decentralized nature, the Midwest region has achieved such a highly diverse system, enabling it to focus significant public and private resources to create a small set (roughly two dozen) 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 400 in number), albeit with an inevitable tendency toward “mission creep”.

Traditionally, the higher education enterprise has been pictured as a learning pyramid, with the community colleges at the base, the accredited public and

private four-year colleges at the next level, the institutions offering graduate degrees next in the pyramid, and the research universities at the pinnacle. In some states these roles are dictated by a master plan. In others, the role and mission of educational institutions are not constrained by public policy but rather determined by available resources or political influence. In reality, however, institutional roles are far more mixed. It is true that community colleges serve primarily local communities, but they provide quite a broad range of educational services, ranging from two-year associate degrees to highly specialized training. They also provide an increasing amount of postgraduate education to individuals currently holding baccalaureate degrees who wish to return to a college in their own community for specialized education in areas such as business processes, information technology, foreign languages, or enrichment learning.

Many small liberal arts colleges strongly encourage—in some case, even pressure—their faculty to be active scholars, seeking research grants and publishing research papers in addition to teaching. Certainly too, many four-year colleges have added graduate pro-

grams and adopted the title “university” in an effort both to serve regional interests and to acquire visibility and prestige. At the other end of the spectrum, many research universities have been forced to take on significant responsibilities in remedial education at the entry level, particularly in areas such as language skills and mathematics, as a result of deteriorating K–12 education. Many have even moved directly into the K–12 education arena, creating and managing charter schools or even entire school systems. These trends will only increase an already significant blurring of roles among various types of institutions.

Yet it is critical that institutions remain committed to their core missions and competencies and resist the temptation of mission creep that could distort their public purpose. More precisely, one might define these roles as shown in the figure above. Within this context, we make the following recommendations for particular elements of the Midwest higher education enterprise:

Community Colleges and Regional Universities: Key will be enhanced support of the efforts of community colleges and regional universities to integrate the new knowledge developed by research universities into academic programs capable of providing lifelong learning opportunities of world-class quality while supporting their surrounding communities in the transition to knowledge economies by developing additional professional programs more suited to the needs and interests of adult students. (Now!)

The region should recognize and support the efforts of community colleges and regional universities to adapt and evolve to serve the rapidly changing education needs of their communities. For example, it is clear that many community colleges are evolving into “polytechnics” capable of providing adult learners with advanced education in key professional disciplines at the baccalaureate level. Similarly regional universities may need to develop professional degree programs at the doctoral level to meet regional needs. Such an expansion of educational mission should be encouraged and supported as a natural consequence of an evolving learning and innovation society, although it should also be expected to provide high quality programs to address substantial demand rather than simply responding to an institutional desire for mission creep.

Independent Colleges: The region should encourage affiliations among independent colleges stressing high quality undergraduate education based on the liberal arts and research universities capable of providing the vast resources for state-of-the-art education in advanced subjects such as science and engineering.

There is some evidence that the highly supportive, learning-intensive residential experiences offered by independent colleges may be the optimum learning environment for most young students. Liberal arts colleges seem to have the best success at this stage, providing both a nurturing and learning-intensive environment. Yet it is also the case that such colleges simply do not have the resources to provide the advanced learning opportunities of a major research university. The region should encourage affiliations between comprehensive research universities and liberal arts colleges. This could allow the students enrolling at large research universities to enjoy the intense, highly personal experience of a liberal arts education at independent colleges while allowing both students and faculty members at small colleges to benefit from the intellectual resources and research experiences occurring only on a large research campus.

For-Profit and Proprietary Providers: To meet the expanding needs of a knowledge-driven economy requiring lifelong learning opportunities, the Midwest should recognize the strategic importance of for-profit and proprietary higher education providers who not only have the capacity to access capital markets, but have developed successful paradigms for educating adult learners. Yet it is also important that the for-profit sector be held accountable for student success and employability. (Now!)

The for-profit higher education sector is evolving very rapidly to provide cost-effective programs for working adults in key disciplines such as business, health services, and information technology. For-profit universities now educate about 7% of the nation’s roughly 18 million students (with the University of Phoenix enrolling over 455,000). They are poised to capture students that public institutions are unable to accommodate. They should be viewed as an important



The for-profit higher education sector is evolving quite rapidly.

resource for the region and encouraged as a key component of a public-private education marketplace, albeit with more quality control to maintain both academic standards and the financial burdens on students.

World Universities: As a component of the Midwest's higher education strategies, serious consideration should be given to encouraging the region's internationally prominent research universities to explore the possibility of evolving into truly world universities, capable of accessing global economic and human capital markets. Key in this effort will be a far more strategic approach to immigration, viewing the region's research universities as portals to attract talent from around the world.

The emergence of a global, knowledge driven economy has intensified the need for broad access to advanced education and training. The economic value of the knowledge produced by research universities continues to escalate. The rapid emergence of low-cost yet highly sophisticated technical services in large developing markets (e.g., India, China, Russia) has triggered a serious concern about the nature of university education necessary to sustain the high standard of living of wealthy economies. Yet even in the face of such trends, the aging populations of many developed nations are depending increasingly on market forces and private funding rather than public policy and tax support to determine the future of their higher education systems.

Of particular interest is the way that such forces have stimulated a number of universities—and uni-



Globalizing Midwestern universities

versity organizations—to consider seriously expanding beyond the bounds of their regions to compete in the marketplace of the global community. Key in such strategies is the rapid evolution in information, communication, and transportation technologies, which are enabling entirely new global learning and knowledge structures. (Weber, 2007; Johnson, 2010)

To quote *The Economist* again, “the most significant development in higher education is the emergence of a super-league of global universities. This is revolutionary in the sense that these institutions regard the whole world as their stage, but also evolutionary in that they are still wedded to the ideal of a community of scholars who combine teaching with research. The great universities of the 20th century were shaped by nationalism; the great universities of today are being shaped by globalization. These top universities are citizens of an international academic marketplace, with one global academic currency, one global labor force, and increasingly, one global language, English. The emerging global university is set to be one of the transformative institutions of the current era. All it needs is to be allowed to flourish” (*The Economist*, 2005).

The Midwest has several universities clearly positioned to become truly global universities. They should be encouraged to evolve in this direction, since this would provide the region with important access to both global economic markets and talented immigrant populations.



Higher education must respond to the great diversity of Millennial students.

Immigration: Immigration is vital to transforming the Midwest economy, as a source of both talent and energy and contributing to its innovation and entrepreneurship. The only immigration policy that will help the Midwest is one that opens the door as widely as possible.

Immigration is vital to growing a regional economy. Today immigrants are needed not only to help perform the work that must be done to keep the Midwest functioning, but to provide it with the knowledge workers and entrepreneurs so essential to its future. Historically, immigrants and multinational populations have been the greatest contributors to urban population and growth, including growth in major U.S. cities over the past 20 years. They are the source of new enterprises and stimulate the entrepreneurial culture that creates diverse, multi-ethnic, urban communities that are attractive to talented, education, and young residents. (Longworth, 2008; Lingenfelter, 2009)

Hence the Midwest region should view immigration not only as an important asset but indeed as a vital one. To this end, it should seek to have its key metropolitan areas viewed as a test-bed for new immigration policies aimed at attracting highly skilled talent to the region. For example, it might seek to be able to provide

green-card opportunities to all international students receiving advanced degrees in science, engineering, medicine, or other critically needed disciplines from the region's universities.

Expanding Educational Opportunities: The Midwest must recommit itself to the fundamental principles of equal opportunity and social inclusion through the actions of its leaders, the education of its citizens, and the modification of restrictive policies, if it is to enable an increasingly diverse population to compete for prosperity and security in a intensely competitive, diverse, and knowledge-driven global economy. (Now!)

The increasing diversity of the American population with respect to race, ethnicity, and national origin has long been perceived as one of my nation's greatest strengths. A diverse population gives us great vitality. A diversity of perspectives and experiences is also vital to sustaining an innovation-driven economy, perhaps the United States' most significant core competency in a global, knowledge-driven economy. And of course such diversity helps us to related to a highly diverse world. However, today it is also one of our most serious challenges as a nation since the challenge of increasing

diversity is complicated by social and economic factors. Far from evolving toward one America, our society continues to be hindered by the segregation and non-assimilation of minority cultures, as well as a backlash against long-accepted programs designed to achieve social equity (e.g., affirmative action in college admissions).

Our schools, colleges, and universities have played a major role in serving immigrants and minority populations. In fact, a distinguishing characteristic and great strength of American higher education is its growing commitment over time to serve all segments of our pluralistic society. Higher education's broadening inclusion of talented students and faculty of diverse ethnic, racial, economic, social, political, national, or religious background, has allowed our academic institutions to draw on a broader and deeper pool of talent, experience, and ideas than more exclusive counterparts in other places and times. This diversity invigorates and renews teaching and scholarship in American universities, helping to challenge long-held assumptions, asking new questions, creating new areas and methods of inquiry, and generating new ideas for testing in scholarly discourse.

The Midwest simply must recommit itself to achieving new levels of understanding, tolerance, and mutual fulfillment for peoples of diverse racial and cultural backgrounds both on our campuses and beyond. We need to shift our attention from simply ensuring access to educational opportunity to enabling success in achieving educational objectives.

Restructuring the Higher Education Enterprise: Serious consideration should be given to reconfiguring the Midwest's educational enterprise by exploring new paradigms based on the best practices of other regions and nations. For example, the current segmentation of learning by age (e.g., primary, secondary, collegiate, graduate-professional, workplace) is increasingly irrelevant in a competitive world that requires lifelong learning to keep pace with the exponential growth in new knowledge. More experimentation in both academic programs and institutional types should be encouraged. Academic institutions should be provided with greater agility—albeit accompanied by greater accountability—to adapt and evolve to address new challenges and opportunities. (Eventually)

The environmental scan of Chapter 2 suggests the need for additional capabilities beyond those characterizing the current schools, colleges, and universities comprising the Midwest educational enterprise:

- A significant increase in baccalaureate degree attainment (50% or greater)
- Multiple pathways to advanced learning that adapt to diverse learning styles
- World-class training for the trades and technical professions
- Broader educational preparation for knowledge-intensive professions
- Lifelong learning for continual adult retraining and skill upgrading
- Lifelong learning for enrichment (particularly for seniors)
- More effective transfer of campus R&D to the marketplace
- Preparation for the unexpected and unimaginable

The Midwest should experiment with new paradigms of post-secondary general education. In particular, colleges and universities should be provided with greater flexibility and agility to adapt and evolve to respond to rapidly changing challenges and opportunities. Such evolution should be encouraged rather than constrained since it is a natural consequence of the increasing importance of knowledge and advanced education in the global economy. But institutions should be challenged to explore and embark upon such efforts only within a highly strategic and accountable process to avoid unnecessary mission creep. For example, while modification of existing institutions (e.g., allowing community colleges to offer baccalaureate degree programs in applied areas such as nursing or expanding online learning efforts of campus-based universities), these likely will yield only suboptimal solutions while possibly distracting current institutions from their more fundamental missions. Instead one should consider the introduction of new educational organizations with proven effectiveness from other parts of the world.

Adopting Best Practices from Abroad: Beyond strengthening and focusing the existing education infra-

structure of the region—its schools, colleges, and universities—it is clear that a changing world will demand these be augmented by new institutions addressing emerging needs. Here the experience and practice of other nations should be considered as possibilities for the Midwest, e.g., European models such as the Gymnasia and Sixth-form colleges used for advanced college preparation; the Fachhochschulen and polytechnic Institutes stressing rigorous education in the applied sciences; and the open universities used to provide broad educational opportunities for adults. (Soon)

The critical importance of increasing college degree attainment to levels required for a world-class workforce will require not only demanding dramatic improvements in the quality of our schools and colleges, but it will also require new institutions more capable of providing multiple paths to student access that adapt to diverse student learning styles and intellectual maturity. Here the Midwest might seriously consider adopting several of the highly successful models from Europe (in a spirit very similar to that recently suggested by Douglass as a successor to the California Master Plan (Douglass, 2010):

Gymnasium (Germany) and Sixth-form colleges (United Kingdom): Much of the concern about the quality of higher education in America arises from the transitional years of secondary education, grades 11-14, where much of the emotional and intellectual maturation of students is expected to occur within a general education curriculum. In Europe, students are provided with an additional one or two years of secondary education in rigorous college preparatory schools such as the German Gymnasium and the British Sixth-Form college. Not only does this provide the opportunity for students to gain additional intellectual and social maturity, but these programs cover most of the general education requirements characterizing the first two years of American undergraduate education, thereby allowing older and somewhat more mature European students to enter directly into the disciplinary-focused three-year baccalaureate programs now characterizing European (and increasingly most Asian) universities as a consequence of the Bologna process. This rigorous extension of secondary education not only reduces college attrition but it also eliminates the high costs of remedial

and general education at the university level, allowing these institutions to focus on advanced instruction in the disciplines.

Fachhochschulen and Polytechnic Institutes (Germany, Switzerland, United Kingdom): The rapidly increasing skill and educational requirements of technical crafts and professions suggest the need for colleges focused on applied science and technology such as the German Fachhochschule and European polytechnic institutes. These universities of applied science provide the more practical orientation and experience (frequently through internships in industry) in fields such as engineering technology, computer science, business and management, arts and design, and other professional fields characterized by applied knowledge. They have been successful in providing much of Europe (particularly Germany and Switzerland) with a world-class workforce in areas key to export-driven economies, e.g., heavy industry, advanced technology applications, and information services. While many of the Midwest's comprehensive universities offer such programs, the strong technical focus of the Fachhochschule-Polytechnic model is more typical of intensive programs such as those offered by Michigan Technological University and Missouri University of Science and Technology. It is a model worthy of further propagation throughout the Midwest.

Open Universities: Lifelong learning requirements for adult retraining, upgrading of skills, and adaptive to rapidly changing markets—not to mention lifelong enrichment—can probably best be achieved by launching a regional analog to the British Open University or the Western Governors University. In particular, the British Open University, first launched as a correspondence program with local facilitators, but now serving hundreds of thousands of students throughout the United Kingdom and the world through Internet technology, is a model that could serve well the needs of the Midwest for high-quality, accessible educational resources capable of meeting the lifelong learning needs of its population.

Innovation Hubs and Clusters: And finally, the critical role played by scientific research, technological in-

novation, creative design, and entrepreneurial skill can be met by lunching clusters of innovation hubs in key areas such as sustainable energy technologies, transportation, and IT services, capable of coupling campus- or laboratory-based scientific research to market-driven technological innovation and deployment.

Colleges and universities should be provided with greater flexibility and agility to adapt and evolve to respond to rapidly changing challenges and opportunities. Such evolution should be encouraged rather than constrained since it is a natural consequence of the increasing importance of knowledge and advanced education in the global economy. But institutions should be challenged to explore and embark upon such efforts only within a highly strategic and accountable process to avoid unnecessary mission creep.

New Funding Paradigms: Alternative mechanisms for funding higher education should be explored, such as adopting a "reverse social-security" approach in which students pay for their education from future earnings, institutions align the funding of their multiple missions with key patrons, and "learn grants" from public or private sources that provide strong incentives for early learning by providing all students entering K-12 with college investment accounts (see Chapter 8). (Soon)

Traditionally we have looked at a college education as a consumer good, requiring payment of the costs of tuition, room, board, and other expenses upon enrollment. Since these costs frequently exceed the resources that most students or families can generate during the actual period of enrollment, either savings or loan plans will play an increasingly important role in the future. Peter Drucker once suggested that we really should think about financing a college education in a much different way: "The basic problem of American higher education is that traditionally it has been priced no differently from the way food, soap, or shoes are priced. Customers pay in full when they take delivery of the merchandise. But a college education is not a consumer good that will be used up and gone within a short time. It is a long-term investment in the lifetime earning power of the graduate." (Drucker, 1994) To the degree that a college education is in reality a long-term invest-

ment in the future, perhaps we should look at it as we would other major investments we make in our life. For example, we borrow money to buy an automobile and a house, and we pay off these loans over long periods of time, even as we enjoy the purchase. A college education seems to fit this model, since not only does it improve one's quality of life, but it enhances one's earning capacity, thereby enabling the borrower to better pay off the loan.

Drucker proposed shifting the payment for a college education from the "front end," when most students have no money and next to no earning power, to a later period when their incomes are sizable and rapidly rising. In particular, those students choosing to pay later rather than at the time of enrollment would agree to have the installments paid through payroll deduction. They also would be required to take out twenty-year term life insurance policy for the amount of the outstanding liability; premiums for such insurance at the age of young college students are minimal. With these steps, the repayment claim for the investment made by the college in the future earning power of the student becomes a marketable security, bearing little risk and a fair rate of return. The former student, now a wage earner, could carry the annual payment. The graduate's family would have little or no financial burden at all. The college could be certain of being paid, and it could charge what it needs to build faculty and curriculum and still not price itself out of the market.

To carry this one step further, perhaps as a society we should look upon a college education as we do our Social Security system. Perhaps we should restructure federal student loan programs to facilitate payment through payroll deduction, just as we do payment for Social Security programs. An alternative would be to use tax assessment strategies, using the Internal Revenue Service as the collection agency. The basic idea is to shift the burden for the support of higher education from the previous generation to the generation of students that benefit most directly, but at a time in their lives when they can afford these costs. In a sense, the 2010 budget reconciliation act that emphasized direct federal lending programs did just this through income-dependent repayment mechanisms. This program allows students to receive their education load funds directly from the federal government via their colleges

and universities, thereby eliminating much of the cost and bureaucracy of the commercial loan industry. But equally significant is the fact that the direct lending program provided an opportunity to base repayment rates on future income and repayments collected through income tax withholding, thereby reducing much of the risk associated with financing a college education. Such income-contingent loan repayment is designed not only to ease the debt burden on college graduates, but also to encourage them to consider careers in fields of urgent national need such as teaching, public health, and community development.

Such income-contingent loan repayment is designed not only to ease the debt burden on college graduates, but also to encourage them to consider careers in fields of urgent national need such as teaching, public health, and community development. To alleviate the limitations of the American approach to income-contingent loan repayment, consideration might be given to the highly successful Australian loan repayment plans and the U.K. “degree tax” proposals, which are more dependent on income tax mechanisms (Chronicle, 2010).

Innovation

For the longer term, our vision for the future of the Midwest is shaped very much by the recognition that we have entered an age of knowledge in a global economy, in which educated people, the knowledge they produce, and the innovation and entrepreneurial skills they possess have become the keys to economic prosperity, social well-being, and national security. To this end, the regional roadmap pursues a vision of the future in which the Midwest builds a learning and innovation infrastructure capable of adapting and evolving to meet the imperatives of a global, knowledge-driven world. Such a vision is essential to create the new knowledge (research and innovation), skilled workforce, and infrastructure necessary for the Midwest to compete in the global economy while providing citizens with the lifelong learning opportunities and skills they need to live prosperous and meaningful lives in our state. As steps toward this vision, we recommend the following actions:

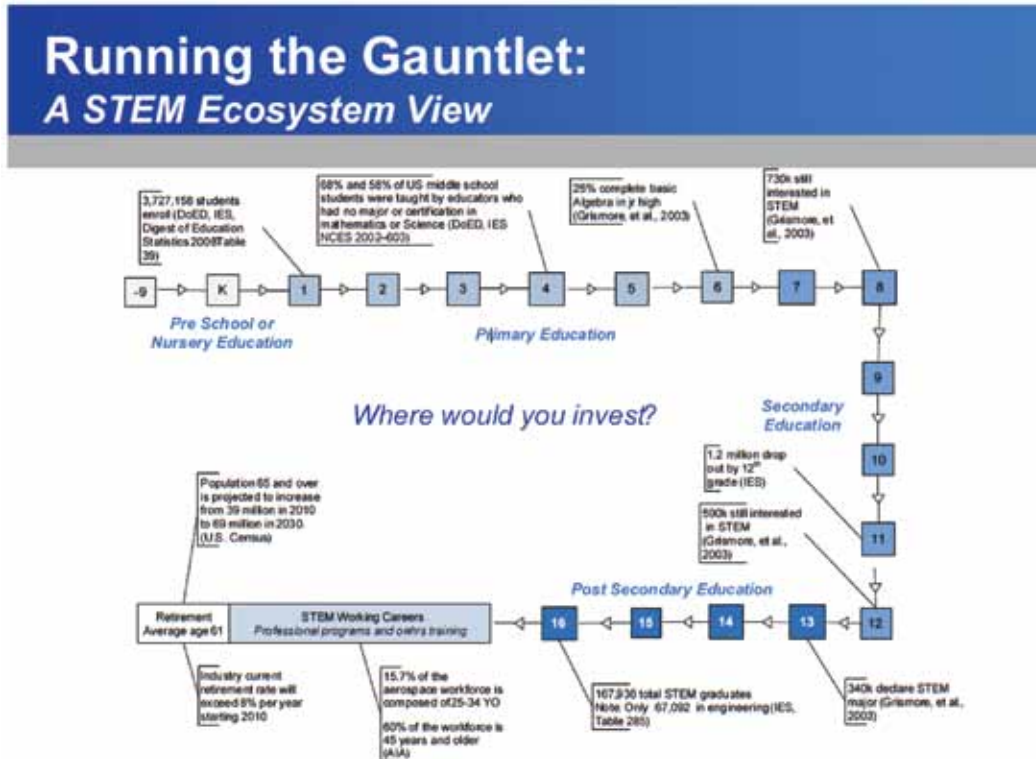
Increased Investment in Innovation: *The Midwest*

must invest additional public and private resources in initiatives designed to stimulate R&D, innovation, and entrepreneurial activities. Key elements would include reforming state tax policy to encourage new, high-tech business development, securing sufficient venture capital, state participation in cost-sharing for federal research projects, and a far more aggressive and effective effort by the Midwestern state’s Congressional delegations to attract major federal research funding to the region. (Now!)

While the development of human capital is the primary responsibility of the region’s educational institutions, the generation of new knowledge—R&D, innovation, entrepreneurial activities—and infrastructure will require a partnership among business, higher education, state and federal government. Just as state governments must begin to reinvest in the capacity of their public colleges and universities to produce knowledge workers and research, they must also provide strong incentives to re-establish longer-term R&D as a priority for Midwest industry. In particular the region should encourage and support private-sector investment in joint university-industry collaborative research (e.g., through tax credits) and assist in meeting the cost-sharing requirements for federally sponsored research grants and contracts (Council on Competitiveness, 2005; Duderstadt, 2008).

While the political influence of the Midwest on the federal government will be essential. Midwestern Congressional delegations should be encouraged to work together to support legislation that provides strong federal tax incentives and policy support to stimulate increased industry investment in R&D. They should also be directed to play a far more active role in attracting federal research dollars to Midwest universities and industry and encouraged to see this role as one of their most important responsibilities. The Midwest Congressional representatives should also seek committee leadership positions and influence necessary legislation to direct the establishment of major federal research centers in the Midwest.

State and local government must also play a stronger role in stimulating high-tech development. While the Midwest has the capacity to produce and attract the technologists and management necessary for startups, it is sadly lacking in adequate private capital—par-



The challenge of science, technology, engineering, and mathematics education (Stephens, 2010).

ticularly venture capital—necessary for these activities. Here, state incentives should be provided for the investment of both private capital and public assets (e.g., state pension fund, university endowment funds). States can also play a leadership role in encouraging the partnerships between large, established companies and new startups as well as coordinating university technology development programs and technology transfer activities.

Finally, there is a critical need to revise regional tax policies to be more supportive of small business startup activities. As in so many other areas such as education, the Midwest continues to be seriously constrained by obsolete tax systems, designed to favor 20th-century agricultural and factory-based manufacturing industries rather than a 21st-century knowledge economy. The region's tax codes must be modernized so that they do not penalize and stifle the growth of the emerging companies of the future to subsidize the dying industries of the past.

Importance of Science and Engineering Education:
The increasing dependence of the knowledge economy on science and technology, coupled with the Midwest's relatively

low ranking in percentage of graduates with science and engineering degrees, motivates a strong recommendation to place a much higher priority on providing targeted funding for program and facilities support in these areas in state universities. (Now!)

Industries and firms, even those that are based in a more traditional economy, are organizing their work around technology. For example, to compete in a global economy, all companies today must be competent in using advanced information technology. Where will the human capital for such advanced technology deployment come from? In the old economy, workers often followed companies, so public policies such as tax abatements to attract large firms made sense. However, as knowledge workers become more important factors in production, today's companies are instead choosing to locate where knowledge workers already are. The implications for the Midwest with its relative weakness in the production of scientists, engineers, and technology, are extremely serious. Advocates from nearly every industrial sector are calling on government to respond to the growing competitiveness challenge by increasing public investments in science and engineering edu-



Computer engineering students developing a fleet of flocking robotic blimps

cation and basic research and development. (Barrett, 2004; Duderstadt, 2008)

The Midwest ranks relatively low among the states in the fraction of science and engineering degrees among its college-educated workforce. Moreover, because of their intensive capital needs for laboratory facilities and equipment, science and engineering programs tend to suffer comparatively more damage than less technology-dependent programs during periods of inadequate state appropriations such as the past several years. This is aggravated by the Midwest's inability to provide tax dollars for badly needed campus academic facilities for over two decades. Other states are making major efforts to increase their science and engineering workforce by making major investments in science and engineering education, particularly at the college level.

Although the Midwest is more at risk in this area than many other states, this is a national problem as well. As Intel CEO Craig Barrett warns: "We are not graduating the volume of scientists and engineers, we do not have a lock on the infrastructure, we do not have a lock on the new ideas, and we are either flat lining, or in real dollars cutting back out investments in physical science" (Barrett, 2004). The Midwest should heed Friedman's warning: "It takes 15 years to create a scientist or engineer. We should be embarking on an all-hands-on-deck, no-budget-too-large crash program for S&E education immediately. The fact that we are not doing so is our quiet crisis. Scientists and engineers don't grow on trees. They have to be educated through



It is only a short leap between a robotic manufacturing cell and commercial application.

a long process because this really IS rocket science" (Friedman, 2005).

Innovation Infrastructure: Providing the educational opportunities and new knowledge necessary to compete in a global, knowledge-driven economy requires an advanced infrastructure: educational and research institutions, physical infrastructure such as laboratories and cyberinfrastructure such as broadband networks, and supportive policies in areas such as tax and intellectual property. The Midwest must invest heavily to transform the current infrastructure designed for a 20th-century industrial economy into that required for a 21st-century knowledge economy. (Soon)

The Midwest must invest heavily to transform the infrastructure for a 20th century manufacturing economy into that required for a 21st century knowledge economy. We have noted earlier the toll taken on higher education in the Midwest by the serious erosion in state support of its public colleges and universities. Of particular note here is the absence of any strategic plan for maintaining the capital facilities infrastructure of state universities, e.g., laboratories, libraries, and classroom facilities. When one considers that a rule of thumb for the renewal or replacement of university capital facilities is based on a 40 year amortization, the benign neglect of public university capital needs by state government puts at great risk the capacity of these institutions to meet the growing needs of the state for advanced education and research.

Of equal concern here is the inadequacy of the new types of infrastructure required for prosperity in an era increasingly dominated by the rapid evolution of computer and communications technology. In the 20th century, public investments in transportation infrastructure such as the Interstate Highway System and international airports were the key to building and sustaining the Midwest's manufacturing economy. In the 21st century, cyberinfrastructure—computer resources, broadband networks, and digital libraries—have become the key infrastructure necessary to build and sustain a knowledge-based economy. Other regions and nations are investing heavily in the infrastructure necessary to support a competitive learning and knowledge environment. Greater bandwidth is crucial because it allows faster transmission of knowledge—important for business and for individuals who can then engage in distance education, telecommuting, and e-commerce. The Midwest should achieve a better balance between its investments of public funds in institutions (colleges and universities) and in infrastructure (the connective tissue linking institutions and citizens). (Atkins, 2010)

Today it has become clear that public action is needed to compensate for the inadequate effort of the private sector (telecoms and cable companies) to provide the necessary connectivity for the Midwest citizens and businesses. To wait for the private sector to respond while other states and nations rush ahead with publicly funded network infrastructures puts at risk millions of jobs in the Midwest as well as the necessary educational infrastructure.

Research Universities and Innovation: The quality and capacity of the Midwest's learning and innovation infrastructure will be determined by the leadership of its research universities in discovering new knowledge, developing innovative applications of these discoveries that can be transferred to society, and educating those capable of working at the frontiers of knowledge and the professions. Because of the importance of research and graduate education to the region's future, these universities should be encouraged to strike an appropriate balance between these activities, while undergraduate education remains the primary mission of the Midwest's other colleges and universities. (Now!)

The Midwest is fortunate to have a high concentra-

tion of globally prominent research universities. While these institutions enroll large numbers of students in high quality undergraduate programs, their unique value to the region arises from their unusual capacity to conduct cutting-edge research and provide advanced education at the graduate and professional level, along with well-established programs of outreach and public service ranging from medical care to economic development. As the Midwest attempts to expand the number of college graduates, particularly during a period of limited resources, it is absolutely essential that the capability of its research universities for advanced training, research, and innovation be protected, since in the end, it will be the new knowledge produced on these campuses, along with the scientists, engineers, and other professionals trained at the advanced level, that will create the new jobs that the graduates from the Midwest's other colleges and universities will fill. (Weber, 2009)

It is important to recognize that beyond their research-intensive character, research universities have yet another distinguishing mission: they offer advanced graduate studies leading to the Ph.D. The doctorate degree is common in many professional disciplines (medicine, education, social work, law), and in fact we have recommended that such professional doctoral programs be expanded in comprehensive universities with less research intensity. However the PhD degree is unique in its capacity to produce scholars who are not only able to extend the knowledge base through original research, but also able to train new scholars for the academy so that this important capability can be propagated. Such PhD education requires the culture and community of scholars and students (or, in more ancient terms, a *universitas magisterium et scholarium*—a union of masters and scholars) that is a unique feature of world-class research universities. Such an institution is difficult to create, expensive to sustain, and of enormous importance to a society. This unique role must continue to be protected and viewed as one of the region's most important assets.

Engagement in Economic Development: The research universities of the Midwest, must become more strategically engaged in both regional and statewide economic development activities. Intellectual property policies should

be simplified and standardized; faculty and staff should be encouraged to participate in the startup and spinoff of high-tech business; and universities should be willing to invest some of their own assets (e.g., endowment funds) in state- and region-based venture capital activities. Furthermore, universities and state governments should work more closely together to go after major high-tech opportunities in both the private and federal sectors (attracting new knowledge-based companies and federally funded R&D centers). (Now!)

Clearly universities have an important responsibility to transfer the knowledge created on their campuses into broader society to address its needs and priorities. Transferring university-developed knowledge to the private sector fulfills a goal of publicly funded research by bringing the fruits of research to the benefit of society. With this important technology transfer come increasingly close relationships between industry and universities.

The traditional models for such technology transfer involve establishing ownership of intellectual property through copyright or patent and then using licensing or startups, coupled with a strong entrepreneurial spirit and adequate venture capital, to stimulate economic development. This linear approach to technology transfer has several compelling success stories: Silicon Valley, Route 128, and the North Carolina Research Triangle. The federal government has encouraged such activities with legislation such as the Bayh-Dole Act, which permits ownership and licensing of the intellectual property resulting from federally funded research. Yet today the more intimate, nonlinear relationships between fundamental scientific discovery, technology innovation, and market deployment demand new paradigms such as the discovery-innovation institutes and innovation hubs recently being implemented to address critical national priorities such as sustainable energy infrastructure (Duderstadt, 2010).

Furthermore, in the wake of Bayh-Dole, universities have mounted aggressive efforts to capture, patent, and license intellectual property resulting from their scholarly and instructional activities, relying on armies of lawyers to defend this ownership. Yet the primary intent of such government policies has been to promote utilization of new knowledge, not to maximize financial returns for institutions or individuals. There

remains considerable uncertainty concerning just how universities should approach the commercialization of the intellectual property associated with campus-based research and instruction.

While disclosure, patenting, and licensing intellectual property may be appropriate for some areas such as the product-orientation of biomedical research, it may not be an effective mechanism for very rapidly evolving areas such as information technology or instructional content. Today the increasing pace and changing character of knowledge generation (e.g., in digital forms), coupled with the hypercompetitive environment of a global, knowledge-driven economy, suggest that the Midwest should not rely entirely on catching up with other regions through conventional mechanisms, but should also explore entirely new models of technology transfer. (Weber, 2005, 2007, 2009)

As we noted earlier, there are numerous examples in which universities have not only encouraged faculty, student, and staff participation in high tech startups, but also provided or attracted substantial investment capital for such activities (e.g., CONNECT in San Diego). This creates a virtuous cycle of economic growth and reinvestment in the subsequent waves of high-tech development. Furthermore, close cooperation between state government, industry, and research universities has also led to major success in attracting both high-tech industry and major federal investments (e.g., the Research Triangle and Centennial Campus in North Carolina, MCC and STC in Austin, and Silicon Valley in California). Leaders of Midwest state and local governments, industry, and higher education should recommit themselves to building and sustaining such partnerships for the long term, seizing on current opportunities such as alternative energy sources for the transportation industry (e.g., biofuels, hydrogen and hybrid technologies), nanoscale biotechnology, and information systems.

So what other models might universities consider for technology transfer? One of the more interesting is provided by the "open source movement" in software development. In this model, a user community develops and shares publicly available intellectual property (e.g., software source code), cooperating in its development and improvement and benefiting jointly from its use. Perhaps the leading example is the development

of the Linux operating system, now evolving as a major competitor to proprietary systems such as Microsoft Windows and Unix. This “gift economy” represents an emergent phenomenon offered freely by a community working together with no immediate form of recompense except for social capital intertwined with intellectual capital.

Suppose the social contract between public universities and the states could be renegotiated such that in return for stronger public support, they would release intellectual property developed on the campus in the public domain. They could encourage their faculty to work closely with commercial interests to enable these knowledge resources to serve society, without direct control or financial benefit to the university, perhaps by setting up a “knowledge commons” environment adjacent to the campus (either geographically or virtually) where technology transfer was the primary objective. This might be just as effective a system for transferring technology as the current Bayh-Dole environment for many areas of research and instruction. Furthermore, such an unconstrained distribution of the knowledge produced on campuses into the public domain seems more closely aligned with the century-old spirit of the land-grant university movement. In fact, a recent issue of *The Economist* mused, “some zealots even argue that the open-source approach represents a new, post-capitalist model of production” (*The Economist*, 2005).

A Higher Education Roadmap for the Midwestern States

Although many of the key actions that need to be taken at the state level to achieve prosperity and social well being in a global knowledge economy both echo and depend upon similar actions at the national and regional level, the particular roles that states play in governing and funding public education merit specific roadmap goals and strategies.

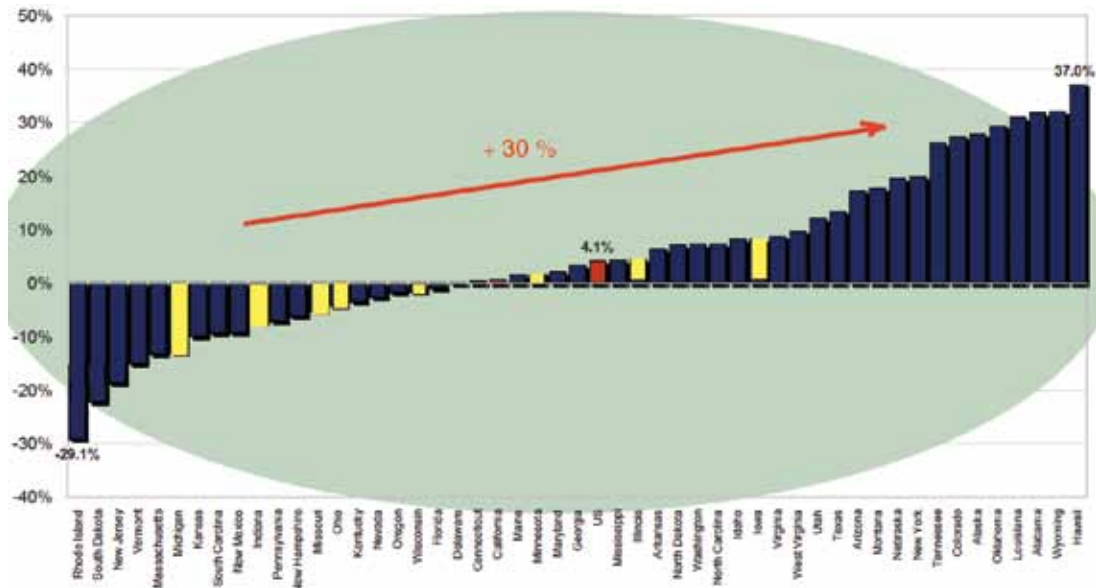
Enhanced College Participation: The Midwestern states must commit to increasing very substantially the participation of their citizens in higher education at all levels—community college, baccalaureate, and graduate and professional degree programs. This will require a substantial increase in the funding of higher education from both public

and private sources as well as significant changes in public policy. This, in turn, will require a major effort to build adequate public awareness of the importance of higher education to the future of the region and its citizens.

As we have stressed throughout this report, the most urgent near-term challenge facing the Midwest’s higher education systems is the need to develop more enlightened policies and strategies that enable the states to invest sufficient public funds in their higher education systems while providing their academic institutions with the incentives and agility to respond to market pressures. In order to ensure sufficient investment, we need to follow the guiding principles of quality, access, diversity, market agility, and accountability. It is only through an investment in knowledge resources and innovation—education, research, and the infrastructure to support them—that the Midwest will be able to compete in this global economy. Simplistic solutions that merely try to increase degree production without addressing quality or funding requirements are clearly both incomplete and inadequate.

However, it is important to acknowledge that the current tax bases of several Midwest states remain inadequate for this purpose. The tax revenues generated by economies based on dying industries, coupled with the reductions in tax rates implemented during the economic boom-times of the 1990s have created dysfunctional state budgets, no longer adequate to address current obligations such as K-12 education, corrections, and unfunded federal mandates such as Medicaid, while investing adequately in the Midwest’s future. This is particularly the case during weak economic times that, without new investments, are likely to become both more frequent and more severe for the Midwest region. Yet the current inability of state governments to develop and implement tax policies and cost structures sufficient to fund the necessary investments to build 21st century knowledge economies gives us pause.

While flexibility in state budget and tax policy is always desirable, particularly during periods of major social change, we are convinced that investments in education, innovation, and infrastructure are simply too critical to be subject to the year-to-year pressures of dysfunctional state budget processes and electorates still embracing an entitlement mentality from the Mid-



Global competition will demand significant increases in Midwest state appropriations.

west's industrial past. Hence we recommend seriously considering using dedicated tax revenue streams secure from tampering by partisan politics to fund public higher education and knowledge-generating activities such as research, innovation, and supporting infrastructure.

Higher Education Funding in the Top Quartile: To achieve and sustain the quality of and access to educational opportunities, the Midwest states should each set an objective to move into the top quartile in their higher education appropriations (on a per-student basis).

There is ample evidence that the Midwest's current investments in public higher education are simply inadequate, whether compared with other regions and other nations, or in light of the current and future challenges faced by the region. If the Midwest aspires to return to a position of national economic leadership, it follows that it must be prepared to invest adequately to create a workforce and stimulate the innovation required for such economic prosperity in a global knowledge economy. In higher education, just as in other economic sectors, quality and access require adequate investment.

It is important to set appropriate benchmarks for critical investments such as public higher education. Moving into the top quartile of the states would re-

quire a 30% increase, while moving to the level of support provided in states with strong knowledge-based economies such as California, North Carolina, Texas, and Massachusetts, would require an increase of 40%. We recommend an intermediate objective of moving to the top quartile of the states by increasing state appropriations per student by 30% (beyond inflation) over the next five years, with possible further increases after that to allow the Midwest to compete with the leading high-tech states.

Market-Smart Strategies: As powerful market forces increasingly dominate public policy, the Midwest's higher-education strategy should become market-smart, investing more public resources directly in the marketplace through programs such as vouchers, need-based financial aid, and competitive research grants, while enabling public colleges and universities to compete in this market through encouraging greater flexibility and differentiation in pricing, programs, and quality aspirations. (Soon)

As we enter a new century, there is an increasing sense that the marketplace is not only a more accurate measure of public priorities than the ballot box or public policy but also a more effective mechanism for allocating both public and private investments. For example, as the economic benefits of advanced education in a knowledge society soar, and higher educa-

tion is increasingly viewed by society (and its elected governments) as a private benefit rather than a public good, it is important to allow market forces, in addition to public policy, to shape the learning enterprise. Hence at both the state and federal level, government is shifting public investment away from base support of institutions and instead into the marketplace through voucher systems, student financial aid programs, and competitive research grants. (Breneman, 2005; Duderstadt, 2004)

Yet this must be done in a sophisticated manner, else the most fundamental responsibilities of government will be abandoned. For example, economists have long known that the most effective way to achieve access to public higher education is through state or federal need-based financial aid programs since this targets limited tax dollars to those who most need assistance to attend college. Merit-based scholarship programs and low tuition at public universities, while politically popular, deploy tax dollars primarily to benefit higher-income students who usually need little incentive or financial assistance in attending college. The same is true for those programs providing tax incentives for college expenditures, since these primarily benefit those with sufficient incomes to incur substantial tax liabilities. Since few citizens will pay sufficient state income taxes to cover the costs of educating their children in public universities (based upon the portion of state tax revenue going to support higher education), it becomes clear that merit-based scholarships, low tuition, and tax incentives represent an extremely regressive social policy—to put it bluntly, welfare for the rich at the expense of educational opportunity for the poor.

Leveraging Federal and Private-Sector Investment: *The Midwest should target its tax dollars more strategically to leverage both federal and private-sector investment in education and R&D. For example, a shift toward higher tuition/need-based financial aid policies in public universities not only leverages greater federal financial aid but also avoids unnecessary subsidy of high-income students. Furthermore, greater state investment in university research capacity would leverage greater federal and industrial support of campus-based R&D. (Now!)*

Although public universities are state institutions,

they are supported largely by resources other than state appropriations: private payments (e.g., tuition), federal support (e.g., student financial aid, research grants), gifts, and market-driven auxiliary activities (e.g., licensing income, executive education, intercollegiate athletics). Indeed, nationwide, 55 percent of the support for American higher education comes from private sources with another one-sixth from the federal government. Hence it is imperative that the Midwest strategically targets its tax dollars to leverage both federal and private-sector investment in advanced education and research, compatible of course with fundamental objectives such as broad access to and quality of educational opportunities.

Efforts to constrain tuition levels at the region's public universities have the perverse effect of failing to capture the full benefit of federal financial aid programs, which have actually been designed to support, in part, the far higher tuition levels at private universities. Furthermore, low tuition levels provide unnecessary subsidies for those affluent families who clearly have the capacity to afford the costs of a college education, as evidenced by the fact that they frequently send their children instead to private colleges and universities with costs several times that of public universities.

It is also important here to remind readers that while efforts to constrain tuition during a period of eroding state support are politically popular, they can seriously damage institutional quality. When state governments cut appropriations per student at public universities by 25% to 40%, as several Midwest states have done over the past several years, institutions that have already optimized cost structures over the past two decades to accommodate earlier erosion in state support have only two options: increase tuition or reduce quality. Reducing the level of university activity (e.g., enrollments or research) is not an option for most, both because of their increasing dependence upon tuition and research grants and their sense of public responsibility to serve the needs of the state.

Changing State Higher Education Policies: *Key to achieving the agility necessary to respond to market forces will be modernizing the policies that define the relationship between state governments and the Midwest's public colleges and universities to provide them with enhanced market agili-*

ty in return for greater (and more visible) public accountability with respect to quantifiable deliverables such as graduation rates, student socioeconomic diversity, and intellectual property generated through research and transferred into the marketplace. (Now!)

It is increasingly likely that market forces will dominate public policy and public investment in determining the future of most public universities, particularly as state support continues to become a smaller and smaller component of their revenue base. To micro-manage or constrain the options of public universities during what might be a several-decade period of weakened public support could not only seriously damage their quality but also hinder their capacity to serve the public during this era of a market-driven higher-education enterprise. Hence leaders of state government and higher education should seek an appropriate balance between accountability to public purposes and the autonomy necessary to enable the flexibility to adapt to market forces. For example, there should be agreed-upon and measurable objectives to ensure public accountability, e.g., student enrollments, degree success rate, socioeconomic distribution of students, technology-transfer activities, and sponsored research funding, in return for state government respecting the constitutional autonomy of the institutions and the authority of their governing boards.

While the Midwest's public universities are legally owned by the citizens of their states, they are enduring social institutions with a duty of stewardship to generations past and a moral obligation and fiduciary responsibility to take whatever actions are necessary to build and protect their capacity to serve future generations. Unlike governments that exist from election to election or companies facing quarterly earnings pressures, universities span generations, connecting the past with the future. Even though their actions might conflict from time to time with public opinion or the prevailing political winds of state government, most states provide their public universities with the capacity to set their own course to serve this public purpose. When it comes to objectives such as program quality or access to educational opportunity, university governing boards have always viewed these as long-term institutional decisions rather than succumbing to public or political

pressures of the moment.

Yet it is also fair to observe that the deep cuts in state appropriations for the Midwest public universities, at a time when enrollments are growing along with the region's need for advanced education, research, and innovation, have raised serious questions about whether state government is a reliable partner with public higher education in building a knowledge economy. Governing boards, faculty, alumni, students and parents, and the media are beginning to question whether term-limited elected state officials, responsive to the increasingly narrow agendas of the Midwest's political parties, can be trusted to act wisely or responsibly in the state's long-term best interests.

Similar concerns in other states have stimulated a reconsideration of the social contract between public higher education and state government, seeking to provide public universities with the agility they need not simply to respond to growing market forces, but to finance themselves increasingly from the marketplace as state support continues to decline as a proportion of their operating budgets. In return, state universities are willing to be held increasingly accountable for achieving measurable outcomes such as graduation rates, the socioeconomic character of their students, technology transfer, and other state priorities.

For most of our history, the growth of higher education in America has been sustained by tax dollars, either direct through state or federal appropriation, or indirectly through favorable tax policy. As a result, higher education has been strongly shaped by public policies and public agendas, from Jefferson's writings to the land-grant acts, from the GI Bill to Pell Grants, from the government-university research partnership to the Equal Opportunity Act. Public investment has both determined and protected the public purpose of higher education in America.

Today, however, there is an increasing sense that the growth of higher education in the twenty-first century will be fueled by private dollars. Public policy will be replaced increasingly by market pressures. Hence the key question: Will a privately funded, market-driven "global knowledge and learning industry" be able to

preserve the important traditions, values, and broader missions of the university?

A Roadmap for Colleges and Universities

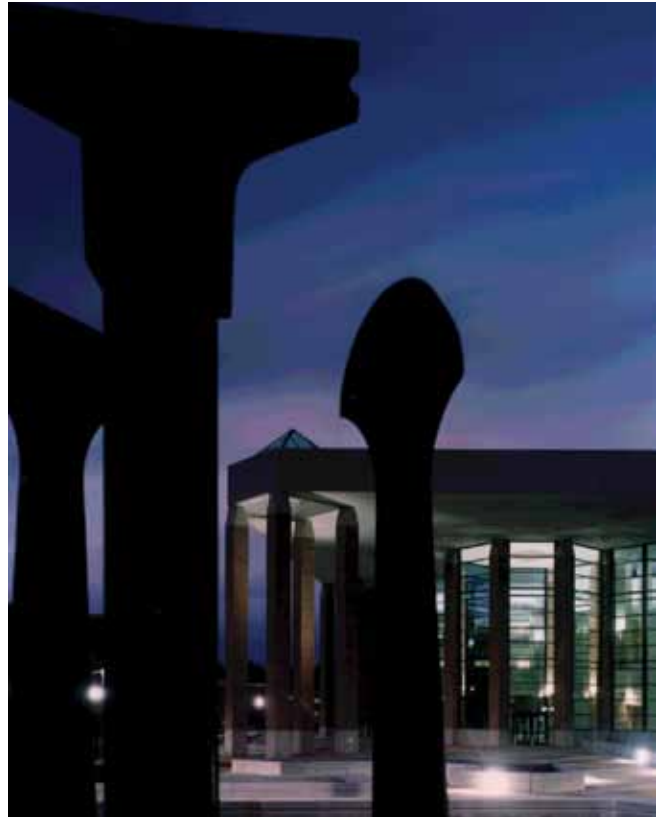
A recurrent theme of this roadmapping exercise involves the need for change in higher education if our college and universities are to serve a rapidly changing world. Of course, the university as a social institution has always been quite remarkable in its capacity to change and adapt to serve society. Higher education has changed quite significantly over time and continues to do so today. Yet the forces of change upon the contemporary university, driven by social change, economic imperatives, and technology, may be far beyond the adaptive capacity of our current educational paradigms. We may have reached the point of crisis in higher education when it is necessary to reconstruct the paradigm of the university from its most fundamental elements, perhaps even to reinvent the university.

To this end, our roadmap proposes at the institutional level a prescription for enabling change.

World-Class Learning: *Colleges and universities should aspire to achieve world-class quality, nimbleness, innovation, efficiency, and the capability of providing our citizens with the higher-order intellectual skills (critical thinking, moral reasoning, an appreciation of cultural and human values, commitment to lifelong learning, adaptive to change, tolerance of diversity) necessary for achieving national prosperity, security, and social well-being in a global, knowledge-driven society. (Now!)*

Preparation for Unknown Futures: *While colleges and universities should be responsive to the interests of students, their employers, and the nation, it is essential that they should also strive to prepare their graduates for the unknown challenges of careers and citizenship of tomorrow by providing the higher-order intellectual skills necessary to cope with a future of continual yet unpredictable change (e.g., critical thinking ability, a commitment to lifelong learning, the ability to adapt to change, and the capacity to thrive in a world of increasing diversity). (Now!)*

Focused Missions, Cost Containment, and Efficiency: *Colleges and universities should develop and demonstrate*



Preparing for unknown futures

the ability (through the necessary changes in governance, leadership, management, and culture) to control costs, focus resources on well-defined missions, and achieve new levels of efficiency while enhancing both quality and capacity. (Now!)

Assessment of Educational Objectives: *It is time to challenge the academy to redefine the purpose and nature of a college education in today's (and tomorrow's) world and develop methods to assess whether these objectives are being achieved. This will require the development of more sophisticated tools to assess the achievement of the more abstract goals of a college education (e.g., critical thinking, communication skills, inductive/deductive reasoning, quantitative skills, cultural appreciation, systems thinking). (Now!)*

The Capacity for Change: *The capacity for change, for renewal, is the key objective that academic institutions must strive to achieve in the years ahead—a capacity that will allow them to transform themselves once again as they have done so many times in the past, to become institutions capable of serving a rapidly changing society and a changing world.*

The remarkable resilience of institutions of higher education, the capacity to adapt to change in the past, has occurred because in many ways academic institutions are intensely entrepreneurial, transactional cultures. They have provided their faculty members with the freedom, the encouragement, and the incentives to move toward their personal goals in highly flexible ways, and they have done so through good times and bad. The challenge is to tap this energy and creativity in efforts to transform our schools, colleges, and universities to better serve a changing world.

Yet this must be done within the context of an exciting and compelling vision for the future of our institutions. Rather than allowing them to evolve as unconstrained, transactional, entrepreneurial cultures, this process needs to be guided in such a way as to preserve their core missions, characteristics, and values. The challenge is to develop university communities where uncertainty is an exhilarating opportunity for learning.

A key element will be efforts to provide universities with the capacity to transform themselves into entirely new paradigms that are better able to serve a rapidly changing society and a profoundly changed world. We must seek to remove the constraints that prevent our institutions from responding to the needs of their social environments, to remove unnecessary processes and administrative structures, to question existing premises and arrangements, and to challenge, excite, and embolden the members of our university communities to embark on this great adventure. Those institutions that can step up to this process of change will thrive. Those that bury their heads in the sand, that rigidly defend the status quo or, even worse, some idyllic vision of a past which never existed, are at very great risk. Institutions that are micromanaged, either from within by faculty politics or governing boards or from without by government or public opinion, stand little chance of flourishing during a time of great change.

Alliances: Colleges and universities should place far greater emphasis on building alliances that will allow them to focus on unique core competencies while joining with other institutions in both the public and private sector to address the broad and diverse needs of society in the face of today's social, economic, and technological challenges. For example,

research universities should work closely with regional universities and independent colleges to provide access to cutting-edge knowledge resources and programs. (Soon)

One of the ironies of the increasingly competitive global marketplace is the need to cooperate through alliances. This is an important approach that should also be adopted by higher education. Here the key is to encourage far more mission differentiation among institutions, where colleges and universities develop strong capacity in unique areas and then form alliances with other institutions, cooperating and sharing resources, to meet the broader needs of the state. For example, a state's flagship research universities will be under great pressure to expand enrollments to address the expanding populations of both college-age and adult students, possibly at the expense of their research and service missions. It might be far more constructive for these institutions to form close alliances with regional universities and community colleges to meet these growing demands for undergraduate education while protecting their unique capacity to conduct the graduate programs and cutting-edge research critical to an economy increasingly dependent on technological innovation. Another example would be alliances between research universities and independent colleges that take mutual advantage of the learning-intensive environment of the latter and the vast intellectual resources of the former.

New Financial and Governance Models: Public colleges and universities need to develop new financial and governance strategies better able to adapt to declining state support and 21st century imperatives. (Eventually)

The past three decades of experience strongly suggests that the states are simply not able—or willing—to provide the resources to sustain growth in public higher education, at least at the rate experienced in the decades following World War II. In many parts of the nation, states will be hard pressed to even sustain the present capacity and quality of their institutions. Today, one might even conclude that America's great experiment of building world-class public universities supported primarily by tax dollars has come to an end. It could well be that the concept of a world-class, comprehensive state university might not be viable over the

longer term. It may not be possible to justify the level of public support necessary to sustain the quality of these institutions in the face of other public priorities, such as health care, K–12 education, and public infrastructure needs—particularly during a time of slowly rising or stagnant economic activity.

One obvious consequence of declining state support is that the leading public universities may increasingly resemble private universities in the way they are financed. Many will follow the path toward becoming increasingly privately financed, even as they strive to retain their public character. In such universities only a small fraction of operating or capital support comes from state appropriation. Like private universities, these hybrid institutions depend primarily upon revenue they generate directly from their activities—tuition, federal grants and contracts, private gifts, and revenue from auxiliary services such as health care—rather than upon direct appropriations.

State universities forced to undergo this “privatization” transition in financing must appeal to a broad array of constituencies at the national—indeed, international—level, while continuing to exhibit a strong mission focused on state needs. In the same way as private universities, they must earn the majority of their support in the competitive marketplace, that is, via tuition, research grants, and gifts, and this will sometimes require actions that come into conflict from time to time with state priorities. Hence the autonomy of the public university will become one of its most critical assets, perhaps even more critical than state support for some institutions.

The public university has always responded quite effectively to the perceived needs—and opportunities—of American society. Today these institutions are straining to balance public needs for greater access, high quality, and cost-effectiveness in a period of limited resources and political turmoil. The incompatibility of the demands placed upon the public university during a time of constrained resources could well erode the quality, the public character, and the civic purpose of these important institutions. It seems clear that we need a new dialogue concerning the future of public higher education in America, one that balances both its democratic purpose with economic imperatives.

Such institutional transformation has become com-

monplace in other sectors of our society. We frequently hear about companies “restructuring” themselves to respond to rapidly changing markets. Government is also challenged to transform itself to be more responsive and accountable to the society that supports it. Yet transformation for the university is necessarily more challenging, since its various missions and diverse array of constituencies give it a complexity far beyond that encountered in business or government. It must be approached strategically rather than reactively, with a deep understanding of the role and character of the university, its important traditions and values from the past, and a clear and compelling vision for its future.

A Higher Education Roadmap for the Nation

To complete this layered set of strategic roadmaps for higher education requires at least some consideration of goals at the national level. Although this task requires an analysis of issues considerably beyond those characterizing the Midwest region, for completeness and context we have provided a sketch of just how national goals might be framed.

It is clear that the United States must demand and be prepared to support a world-class system of post-secondary educational institutions capable of meeting the changing educational, research, and service needs of the nation. Yet this goal faces many challenges, including

- An increasing stratification of access to (and success in) quality higher education based on socioeconomic status,
- Questionable achievement of acceptable student learning outcomes (including critical thinking ability, moral reasoning, communication skills, and quantitative literacy),
- Cost containment and productivity, and the ability of institutions to adapt 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).

There is strong evidence that 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. Yet this leadership is threatened by rising competition from abroad, by stagnant support of advanced education and research in key strategic areas such as physical science and engineering, and by the complacency and resistance to change of the American research university.

The higher education roadmap for the national focuses on several key areas: quality, innovation, access, coordination, research and graduate education, lifelong learning, and public purpose.

Quality: The United States must demand and be prepared to support a world-class higher education system, leveraging market forces shaped by incentives, public-private partnerships, and requirements for evidence-based assessment of educational effectiveness to drive all elements of postsecondary toward higher quality, efficiency, innovation, and nimbleness. (Now!)

The nation should commit itself to building and supporting a postsecondary education enterprise (e.g., colleges and universities, proprietary schools, industry education training programs, and new paradigms such as distance learning and global universities) capable of achieving world-class standards in all important areas, e.g., quality, learning outcomes, access, efficiency, innovation, and responsiveness to changing societal needs. While colleges and universities should be responsive to the projected needs of students, their employers, and the nation, it is also essential that they launch the major transformations of educational programs necessary to prepare students for a much different world, providing them with the knowledge and skills necessary for the jobs of tomorrow and the abilities to face future problems not yet even identified.

In its pursuit of the vision of a world-class system of postsecondary education better aligned with national needs, the United States should rely heavily upon mar-

ket forces shaped by public policy and investment and public-private sector partnerships rather than government regulation. This is consistent with the assumption of constrained public funding and the long and effective decentralization and diversity in American higher education. Market competition within higher education should be strongly encouraged and facilitated by removing unnecessary regulation and bureaucracy at the state and federal level, challenging monopolistic practices, providing information to better educate consumers of educational services, and providing incentives for institutions to develop or adopt best practices in areas such as cost containment, productivity, assessment of student learning outcomes, and innovative academic programs.

Yet it is also clear that if markets are allowed to dominate and reshape the higher education enterprise without constraint, some of the most important values and roles of the university will likely fall by the wayside. Creating an effective higher education market requires thoughtfully structured strategic interventions and enlightened public policy to ensure that the market is a force supporting the broader public purposes of the university.

Access: Access to higher education should receive the highest priority for public funding, whether through financial aid, state appropriations to colleges and universities, or tax policy (e.g., "tax expenditures"). Public funds should be targeted to those students with greatest need. (Now!)

The nation must address and remove factors that have created a strong dependence of access and success in higher education upon socioeconomic status. As a nation, we should aspire to the ideal where family income is nearly irrelevant to the ability of a student to attend the college or university best matched to his or her talents, objectives, and motivation. Yet many studies have revealed the degree to which access to higher education in America has become increasingly stratified according to student financial circumstances, thereby undercutting the fundamental principles of equity in providing educational opportunities for a democratic nation. Today even the most academically talented students in the lowest economic quartile are significantly less likely to have access to the benefits of higher

education than the least qualified students in the top quartile—a situation clearly intolerable for a democratic society. Furthermore, to pay for college more students are borrowing larger amounts at higher interest rates than ever before. Debt burdens are not only influencing student career choices (e.g., students choosing high paying rather than socially-beneficial careers) but also discouraging many low income students from even attempting a college education.

Part of the challenge arises from the patchwork character of current federal, state, and institutional financial aid programs, designed more to address political objectives and benefit the commercial loan industry than address the needs of students in a strategic fashion. Here a key public policy issue is how public funds for higher education should be allocated among students from differing socioeconomic circumstances and among institutions of differing missions. Today a very significant fraction of public funds, whether allocated directly to public institutions to enable low tuition, or through state and federal financial aid programs, go primarily to benefit affluent students with modest economic needs, at a time when close to a quarter of Americans are disproportionately and severely deprived of educational opportunity at colleges and universities.

Although both the states and the federal government have many objectives in providing public funding to higher education, e.g., regional economic development, public health, national security, or, more pragmatically, voter support, the widening gap between the educational opportunities available to affluent students and those of modest means compels us to recommend that access to higher education, regardless of socioeconomic circumstance, receive the highest priority for public funding. Publicly funded financial aid should rely primarily on need-based rather than merit-based programs, with grants as the preferred mechanism for the lowest income quartile of students, while loans and tax benefits are the preferred mechanisms to assist students from more affluent backgrounds with access to postsecondary education and lifelong learning opportunities.

In particular, the current system of federal financial aid programs requires a major overhaul—if not total replacement—to achieve a strategic program of grants, loans, and tax benefits that adequately and efficiently

addresses in an accountable and transparent fashion goals such as enhanced student access, retention, and reduced student debt burden. Such a program should be strategically-oriented, results-driven, and efficient in the utilization of taxpayer dollars, and demonstrably effective.

Innovation: To support a national economy driven by innovation, the nation's colleges and universities must themselves embrace educational innovation, by developing new learning pedagogies, academic paradigms, and educational forms that are more responsive to national priorities. This will require a very substantial increase in the support of research and development associated with learning and education by the federal government and higher education institutions. (Soon)

Leadership in innovation—the transformation of knowledge into products, processes, and services—is critical to competitiveness, long-term productivity growth, and the generation of wealth. It is critical to United States prosperity and security. Institutions of higher learning must collaborate with industry and government to create a national educational climate and culture that enable innovation to thrive. Not only does this challenge our colleges and universities to provide the graduates capable of innovation and adaptation to change, but it also demands that American higher education develop and demonstrate the capacity for continuous innovation and quality improvement at both the institution and enterprise level.

Today many segments of American postsecondary education are not well positioned to meet the changing needs of the nation. Although there are bright spots of innovation, by and large American higher education is a mature industry that has become increasingly risk-averse and frequently complacent and ponderous. Furthermore, much of the enterprise 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 is not enough simply to intensify current stimuli, policies, and management strategies and make incremental improvements to organizational structures and curricula.

Research and Graduate Education: *The erosion of state and private sector support of graduate education and research in recent years makes it apparent that it is time for the federal government to assume the lead responsibility for sustaining America's research universities at world-class levels. (Soon)*

The United States must sustain the capacity of its research universities to achieve global leadership in key strategic areas such as science, engineering, medicine, and other knowledge-intensive professions while attracting talented students and faculty from around the world through adequate public and private investment and stimulating institutional innovation and change. Research universities, government, and industry should strive to create effective mechanisms for ensuring that the new knowledge developed on the campuses serves society through technology transfer, innovation, and entrepreneurial activities.

There are growing concerns that the scientific and technological building blocks of the nation's economic leadership and national security are eroding at a time when many other nations are gathering strength. Federal support of R&D as a fraction of GDP has dropped in half over the past three decades (from 2% to less than 0.8% of GDP), while the nation's research portfolio has become heavily skewed in favor of biomedical research at the expense of research in physical science and engineering, keys to the nation's technological strength. Numerous studies have suggested that the nation's strategic and economic security is threatened by its current course, living on incremental improvements to past developments and gradually conceding technological leadership to international competitors. Instead it is critical the United States invest in the necessary research, producing the world-class graduates, stimulating the innovation, and creating the high-skill, high-value jobs that define a prosperous nation in a knowledge-driven global economy.

The federal government should restore a level of research funding adequate to support its most urgent priorities including national defense, homeland security, health care, energy security, and economic competitiveness, with special attention directed to physical science and engineering. Federal and state governments and industry should invest in upgrading and expanding

university laboratories, equipment, and information technologies and meeting other infrastructural needs of research universities such that the national capacity to conduct world-class research in key strategic disciplines is sufficient to address national priorities. Government and industry should also invest in scholarships, fellowships, curriculum development aimed at enhancing student interest in science, mathematics, engineering, and technology at all educational levels, with particular attention given to encouraging the participation of women and underrepresented minorities, while recruiting talented students from around the world.

Coordination: *Coordination among the various components of the nation's educational enterprise, including K-12, higher education, workplace training, and lifelong learning, should be strongly encouraged and supported at all levels—national, regional, state, and institutional. (Now!)*

In an assessment of higher education, *The Economist* once observed that, "America's system of higher education is the best in the world. That is because there is no system!" Yet it is also the case that the absence of coordination and articulation agreements can be a serious hurdle to students attempting the transition from one education level or institution to another. While competition among institutions is important, particularly in a marketplace increasingly funded from private sources, so too is sufficient coordination to allow smooth, transparent transitions from one stage or institution to the next in a future increasingly dependent upon lifelong learning. Put another way, postsecondary education needs to be better coordinated and integrated vertically, while preserving strong market competition horizontally. In particular, colleges and universities need to work closely with K-12 education, aligning high school curricula with college standards and providing feedback to prospective students about their readiness for college work.

Public Purpose: *Higher education must take decisive action to address current concerns about quality, efficiency, capacity, and accountability if it is to earn the necessary level of public trust and confidence to enable it to pursue its public purpose. (Now!)*



President Obama challenges Michigan graduates to step up to the nation's challenges. (May 1, 2010)

While higher education provides important private benefits to graduates, clients, and industry, in reality it is primarily a public good, created and supported by society to serve a public purpose. While market forces are likely to dominate public investment and public policy, at least for the foreseeable future, it is essential for higher education to retain its public purpose rather than simply responding to the market demands of the moment. After all, it has been a public good of immense importance throughout the history of the nation, and it must remain so. Here, however, it should be recognized and acknowledged that for higher education to regain the necessary degree of public trust and confidence, institutions will have to first listen more attentively to the concerns of its diverse constituencies (e.g., students, parents, employers, public and private patrons) and then respond to these concerns through bold institutional actions and transformation consistent with their public purpose.

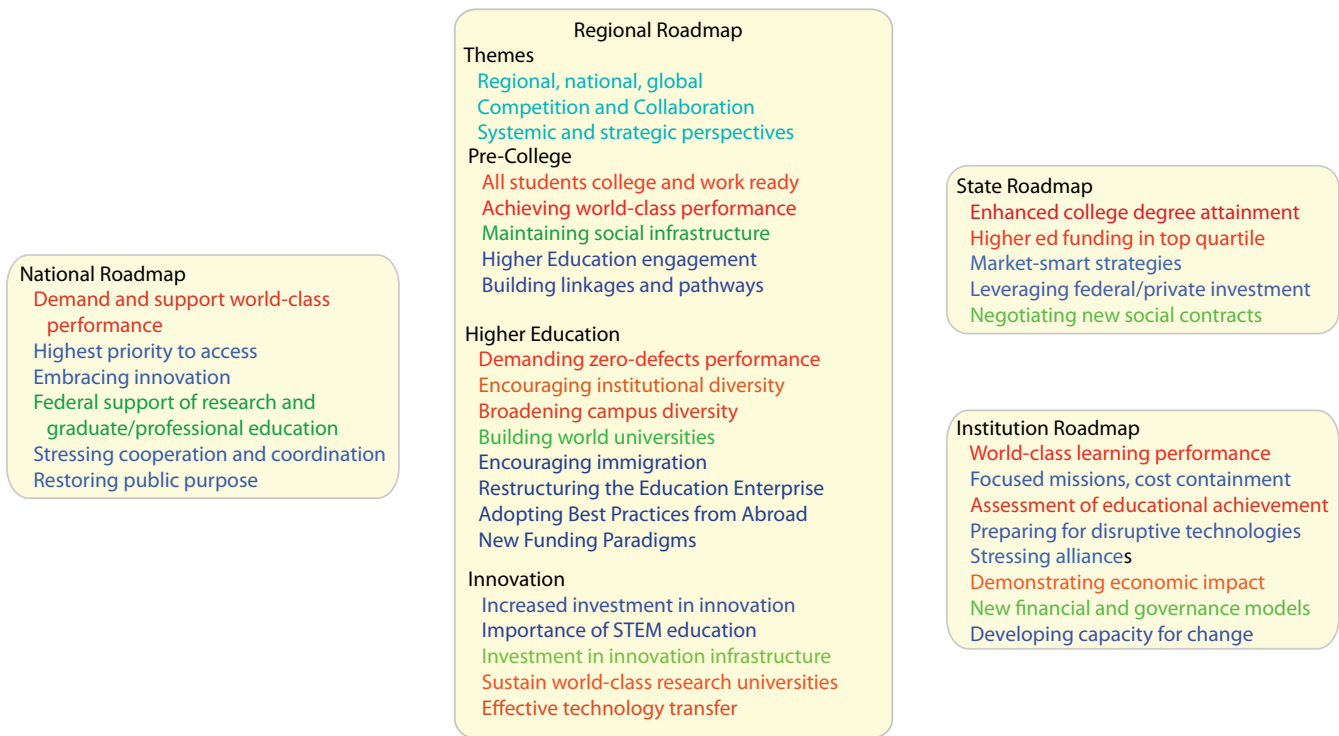
The Last Mile (Or the First?)

While some may continue to debate, to suggest that the status quo will remain intact, to others the choice has become clear. We can either accept the risks and

the uncertainties of attempting to transform the higher education enterprise to serve a society with new needs and new imperatives. Or we can wait for the market to reshape our institutions, perhaps even relegating them to a backwater role in the emerging global knowledge industry. Clearly embracing the status quo, treading water, also has very real risks. After all, there are many commercial sharks swimming just below the surface.

The learners of our future society will demand that their educational experiences prepare them for a lifetime of learning opportunities, fused both with work and with life. They will seek just-in-time and just-for-you learning through networked organizations. They will seek the integration of timeless and timely knowledge.

The systems of higher education that emerge in the decade ahead will almost certainly be far different from today's paradigms. Higher education will either transform itself or be transformed as financial imperatives, changing societal demands, emerging technologies, and new competitors reshape the knowledge enterprise, changing in the process how colleges and universities organize and deliver learning opportunities as well as how they structure and manage their activities (Duderstadt, 2007).



A classification of roadmap elements into specific actions, infrastructure investments, and measurable goals.

Chapter 7

Tactics, Plans, and Processes

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

—Niccolo Machiavelli, The Prince

Reports that recommend major paradigm shifts are not spontaneously or miraculously implemented. The acceptance of and action upon the recommendations in our Midwest roadmap require active involvement and commitment from a variety of stakeholders, especially state policy makers and civic leaders. Without a regional commitment at all levels, e.g., government, business, labor, education, foundations, citizens, and media, long-term or sustained innovation on the scale of magnitude recommended in this report cannot be achieved—unless, of course, revolution returns as an option to influence public policy.

A roadmap is just that, a set of possible directions to the future. But as Machiavelli reminds us, setting a direction is far from arriving at one's destination. Leaders in both the public and private sector require a more definitive operational plan that addresses key questions such as: What are the first steps to be taken? What policy actions are necessary? Are there follow-on studies that need to be commissioned? What about an ongoing process or framework to assess and sustain progress?

Furthermore, while our effort has focused on developing a roadmap for building a regional knowledge economy in the Midwest, it is clear that our vision and our recommendations are highly dependent upon issues at other levels, e.g., federal policy, market forces, and the global economy. Finally, we acknowledge that this roadmapping study has been stated in straightforward—sometimes even blunt—terms. To survive in the political environment of state (and federal) policy, it must be re clothed in more Machiavellian garb.

Of course the initial goal of this roadmapping effort is to shift the conversation away from distracting is-

su es such as how to save dying industries and practices and to focus instead on the imperatives of a knowledge economy: lifelong learning, research and innovation, and knowledge infrastructure. Here our message has been deceptively simple:

1. Knowledge and innovation are the drivers of the global economy today, and their importance will only intensify in the future.

2. Educated people, the knowledge they produce, and the innovation and entrepreneurial skills they possess have become the keys to economic prosperity, public health, national security, and social well-being.

3. While the characteristics of the American culture—a diverse population, democratic values, free-market practices, a predictable legal system—provide a fertile environment for innovation, history has shown that significant public and private investment is necessary to produce the key ingredients of innovation: new knowledge (research), world-class human capital (education), infrastructure (institutions, facilities, networks), and policies (tax, investment, intellectual property).

4. Although action at the state and national level will be important, the vision, power, and opportunity is shifting rapidly to major metropolitan areas at the regional level.

Since both wise investments and visionary policies are the longer-term keys to regional prosperity, it is important to lay out not only a plan for public, civic,

business, and education leaders, the more specific the better, but also a process that can be sustained for the long term. Most important at the outset, public and private institutions at the local, regional, state, and federal level have to get their fundamental priorities and responsibilities aligned with the imperatives of a global, knowledge economy. They should strive to empower families, students, and workers with the resources and responsibilities to choose lifelong learning opportunities that best provide prosperity and security, including early childhood, K-12, postsecondary, and continuing education. The region must provide the infrastructure and the investments necessary to attract federal and private research funding and stimulate innovation and entrepreneurial activities. In these efforts it is critical to strategically blend public policy and market pressures to transform both the economy and culture of the Midwest into a vibrant enterprise of learning and innovation.

In this chapter we first explore some of these related areas and then suggest a series of practical steps that might be taken to move in the directions suggested by the roadmap. It is appropriate to begin with a quick review of approaches that have been taking in similar regional planning activities. First we begin with history.

The Land-Grant Acts

Although of national scope, the Morrill Act of 1862 (and its subsequent "Land-Grant Acts") is perhaps an appropriate place to begin. This act and its successors defined the democratic character of America's public universities and added to their portfolio of activities both public service and eventually research. The Morrill Act put federal largess at the disposal of every state government and thereby helped to develop a whole new network of institutions with a popular and practical orientation, the land-grant colleges, which today enroll more than 20% of all American college students.

Through the Morrill Act each state was given 30,000 acres of public lands in the west for each senator and representative, 10% of the proceeds from sale of the land could be used for the purchase of a site for a new college "where the leading object shall be, without excluding other scientific or classical studies, to teach such branches of learning as are related to agriculture

and the mechanic arts"; however the remainder of the fund was to be maintained as a perpetual endowment. The follow-on Hatch Act of 1887 provided further federal funds for the creation of agricultural and engineering experiment stations, which were instrumental in modernizing American agriculture and industry. What was distinctive about the Morrill Act was that the land grants were not literal gifts of land on which a state would build a college. Rather the act established a complex partnership in which the federal government provided incentives for each state to sell distant Western lands, with the states being obliged to use the proceeds to fund advanced instructional programs.

It should also be noted that the actual motivation behind the Morrill Act had more to do with devising an effective and popular way to dispose of federal lands in the new western territories than supporting American higher education. This pattern in which federal support of higher education was really provided to accomplish other objectives became a frequent pattern over the years, e.g., the G.I. Bill that was really intended to avoid a job crisis with returning veterans from WWII, but also provided mass access to higher education for the middle class, or the government-university research partnership that was aimed at winning the Cold War, and also created the American research university.

The land-grant college movement was a uniquely American approach to meeting the needs of a growing nation for a more democratic and utilitarian approach to higher education, providing both college opportunities for the working class while addressing the technology needs of agriculture and industry. Although Michigan and Wisconsin had already established the importance of the state university prior to the Civil War, the land-grant acts had great impact on the nation, stimulating the appearance of state colleges across the throughout the Midwest and across the nation that would eventually challenge the influence of the eastern colonial colleges. In a very real sense they achieved both the Jeffersonian goals of popular learning necessary for a democratic society and the practical utility necessary for a rapidly industrializing nation.



University of Michigan



University of Wisconsin



University of Illinois



University of Minnesota



Michigan State University



University of Iowa



Purdue University



Penn State University



University of Missouri



Iowa State University



Ohio State University



Cornell University

The great public universities created by the land-grant acts are among the Midwest's most important assets.

The California Master Plan

Perhaps the most successful regional planning effort of the 20th century was the California Master Plan for Higher Education of 1960 that responded to the rapidly changing economy and demographics of that state in the post WWII. (Kerr, 2001) Led by Clark Kerr, president of the University of California, the development of the California Master Plan began with a bold vision of providing universal access to higher education by creating a diverse system of public colleges and universities based on the University of California, the California State University System, and the California Community College System. By defining the unique role of each of these components, the Master Plan was able to provide a very unusual combination of world-class quality with broad access. Today most agree that the California Master Plan played a very critical role in providing the state with exceptional regional advantage, creating the strongest regional economy in the world. As *The Economist* observed: “The extraordinary growth in the California economy during the last half of the 20th century was due to many things: the development of California’s infrastructure (aqueducts and freeways), the development of agriculture, and perhaps the most important factor for today’s high-tech California economy: the creation of a superb set of public universities” (*The Economist*, 2005).

The enduring strength of California’s Master Plan for Higher Education derives from its clarity of purpose. It defined state goals for higher education, as-



The California Master Plan created the greatest higher education system in the world

signed responsibility for achieving those goals, provided the necessary authority and resources, and by linking those goals to very visible and understandable commitments to the public, had a built-in mechanism of accountability. The overarching state goal was “to provide educational opportunity and success to



President Clark Kerr
University of California

the broadest possible range of citizens” at the postsecondary level. At the time, children of the postwar “baby boom” were reaching college age and vast increases in college enrollment were projected. Rather than devising ways to limit access to higher education, the Master Plan committed California to one of most extensive promises any state government has ever made to its citizens. The state chose to open up higher education to all Californians who wished to attend (Douglass, 2010).

Equally important was delineation of a clear strategy to achieve this goal. The Master Plan differentiated the missions of each segment as a mechanism to contain costs and provide broad access to higher education. By distinguishing functions and admissions pools, the state reduced duplication of expensive programs and limited the number of high-cost institutions. High-cost graduate programs were limited in a way that both saved the state money and ensured their high quality. The state assumed responsibility for the costs of instruction and adopted a realistic policy for imposition of other fees. Student financial aid was expanded. All students could receive an education that was affordable.

The Master Plan was the first time in the history of any state in the United States, or any nation in the world, where such a commitment to universal college access was made—that a state or a nation would promise there would be a place ready for every high school graduate. From today’s perspective, the plan looks like

a grand design to achieve great purposes: equality of opportunity through universal access to higher education; provisions for supplying the highest-level skills and the most advanced knowledge to serve both wealth and welfare; concern for the full labor market needs of a technologically advancing society; and preservation of the self-governing ability within institutions of higher education. But to Clark Kerr and the others who participated in its development, the Master Plan seemed at the time more like a desperate attempt to prepare for a tidal wave of students, to escape state legislative domination, to contain escalating warfare among its separate segments. In this sense the California Master Plan was a product of stark necessity, of political calculations, and of pragmatic transactions. But key in its design was an outcome in which all of those involved thought they had won.

It is important to note another important feature of the California Master Plan. In reality, it was a highly elitist public policy that focused most resources on the most talented students and faculty at the University of California, while providing low-cost educational opportunities for the masses at CSU and CCs. (Kerr, 1999) This raises an important question for the Midwest: How important is it to focus resources on achieving world-class excellence necessary to achieve leadership in global economy, as compared to investing in broadening educational opportunities which have the equally compelling social purpose of providing social well being and economic security to the entire population of the region?

Through generations of strong support and stewardship, today the Great Lakes states have a collection of flagship research universities not only comparable to but superior in many characteristics—quality, capacity, breadth, global presence—to those of the California institutions. But in addition it has many of the finest independent colleges in the nation. Hence it is natural to question whether a similar planning effort could be launched to weave these formidable assets into a strategy to build regional advantage. To be sure, working across state boundaries and politics poses certain challenges, although California faced similar challenges (North vs. South, urban vs. agricultural interests).

Yet it should also be added that the “Great Recession” of 2008-2009 has had a more devastating impact

on higher education in California than almost any other state. The state’s direct spending on four-year universities has dropped almost a factor of two, from 11.1% of the general fund budget in 1984 to 6.2 % in 2009. At all levels, California’s public universities are being forced to reduce enrollments and raise tuition, setting aside the principles of the Master Plan. Indeed there is great concern that the state’s bold approach to organizing and funding higher education may no longer be viable in the face of a weakening economy, changing demographics, and political divisions. (Douglass, 2010)

The Bologna Process

Europe’s Bologna Process (and the related Lisbon Strategy) is a decade-long effort in which the ministers of education from dozens of countries have put in place a process of extended consultation and actions that have resulted in greater integration and cooperation among their national higher education systems. (Adelman, 2009) The process has gone a long way toward creating commonality and interchangeability among Europe’s competing systems of higher education and is being celebrated as a remarkable achievement in multinational reform. It was launched in 1998 when the ministers of education from Germany, France, Italy, and the United Kingdom issued the Sorbonne Declaration signaling their goal of achieving greater integration across European higher education. A year later, 26 European ministers of education meeting in Bologna, Italy followed up with a second, more inclusive communiqué spelling out their collective goal of increasing the international competitiveness of the European system of higher education.

The challenge these reformers tackled was a higher education environment that was too fragmented and too dependent on local customs to allow European universities to become major players in the emerging world-wide market for higher education. Two specific problems concerned those who gathered in Bologna in the spring of 1999. First, they wanted to ensure the comparability and transferability of university degrees across Europe; and second, they wanted company as each of their countries began experimenting with the increased tuition and fees that were becoming necessary to supplement, and perhaps in the future supplant,



A meeting of the European University Association to discuss the status of the Bologna Process.

governmental appropriations.

Today 95 percent of European universities (and many in Asia) have adopted the Bologna academic structure of 3-year baccalaureate, 2-year master's, and subsequent PhD degree programs. The ongoing dialog established by the Bologna process has enabled faculty to focus more on what students learn and the student experience. The development of sophisticated quality-control agencies and mechanisms has harmonized degree requirements, so that degrees in the same field mean roughly the same thing across Europe. It has also prepared European nations for the different task of better differentiating among profiles and missions of universities in their effort to build institutions with world-class reputations. Recent surveys have found strong support for the process, particularly in the Scandinavian, Baltic, and Eastern European nations, although some resistance remains in Britain, France, and Germany.

Of most interest to our Midwest roadmapping effort is the process of extensive consultation and cooperation over an extended period (now entering its second decade) that led eventually to major systemic change in European higher education. The Bologna Process was conceived from its beginning as a multiyear, decade-long process. As Zemsky notes, everybody had a role:

ministers of education, university leaders, student leaders, leaders of international organizations, European Union bureaucrats, and policy thinktanks that helped to define the issues and shape the agenda (Zemsky, 2009). Unlike similar large-scale strategic efforts in the United States (such as the Spellings Commission), the underlying idea was to support and extend the value of the continent's universities rather than hold them up to public scrutiny. The Bologna Process was both disciplined and focused with a limited number of goals set with clear benchmarks leading to verifiable implementations.

In many respects the challenges faced by the Midwest states are similar to those of the European Community. Like Europe, the Midwest is a region challenged by the fundamental economic transformations demanded by a global, knowledge-driven economy. It is characterized by an existing infrastructure of diverse institutions, practices, and policies, and a breadth of players from state governments to coordination agencies to governing boards to university leaders, faculties, and students. Hence it seems appropriate to consider along with a plan to achieve the objectives of the Midwest roadmap a Bologna-like process of extensive consultation among key players that might continue for a considerable time.

A Midwest Marshall Plan

We have stressed the importance of regional strategies in which states and cities cooperate rather than compete with one another. Yet, aside from limited examples such as Great Lakes conservation, there has been far more competition than cooperation within the region. Richard Longworth, long-time foreign correspondent of the *Chicago Tribune*, has recently suggested that perhaps the federal government could provide the incentive for regional cooperation, much as the United States did for post-WWII Europe in the Marshall Plan. (Longworth, 2009).

When the Truman administration proposed the Marshall Plan to help the Europeans restore their economies, it stressed that not much money would go to individual countries. Instead the United States told its European allies that while the funding might come from Washington, the ideas had to come from Europe.

The Europeans were challenged to work together across national lines to restore their continental economy. The Marshall Plan forced business, labor, and government to collaborate, to set aside both the long-standing conflicts and join together to create regional economic community, which exists today as the European Union.

It may be stretching things to see the EU as a template for the Midwestern future, but the Obama administration has it in its power to point the Midwest in this direction, if not in the effort to recover from the recent recession itself then in its future spending. In fact, European integration over the past several decades could provide a template for what the Midwest could become, if it set aside its turf squabbles over the crumbs of aging factories and instead united to develop a regional strategy and commitment to the future.

As Longworth stresses, “This collaboration goes against the grain of Midwestern independence, which is the point. Left to ourselves, we may never agree to agree. But billions of dollars make a powerful lure. The Europeans discovered this, to their permanent benefit. Perhaps the same lure would work here. It may even be easier here. We Midwesterners may be ornery, but unlike the Europeans, we’ve never fought a war with each other.”

A Process

History has demonstrated the difficulty of achieving structural, functional, and cultural shifts requiring major resource investments and reallocations and funding policy reforms. To ensure funding and implementation, leaders at the state, local, and institution level will likely need to own these reform plans and platforms, and they will need to be instrumental in their design. However they will also need to be advised, encouraged, and possibly even pressured by broader leadership groups.

One of the important components of this effort involves the identification of key policy issues, appropriate for the consideration of leaders in the public and private sectors. Examples might include the provision of community-based extracurricular learning opportunities in underserved communities (perhaps based on evolving technologies such as knowledge networks), better coordination of existing educational resources (K-12, higher education, industrial training, communi-

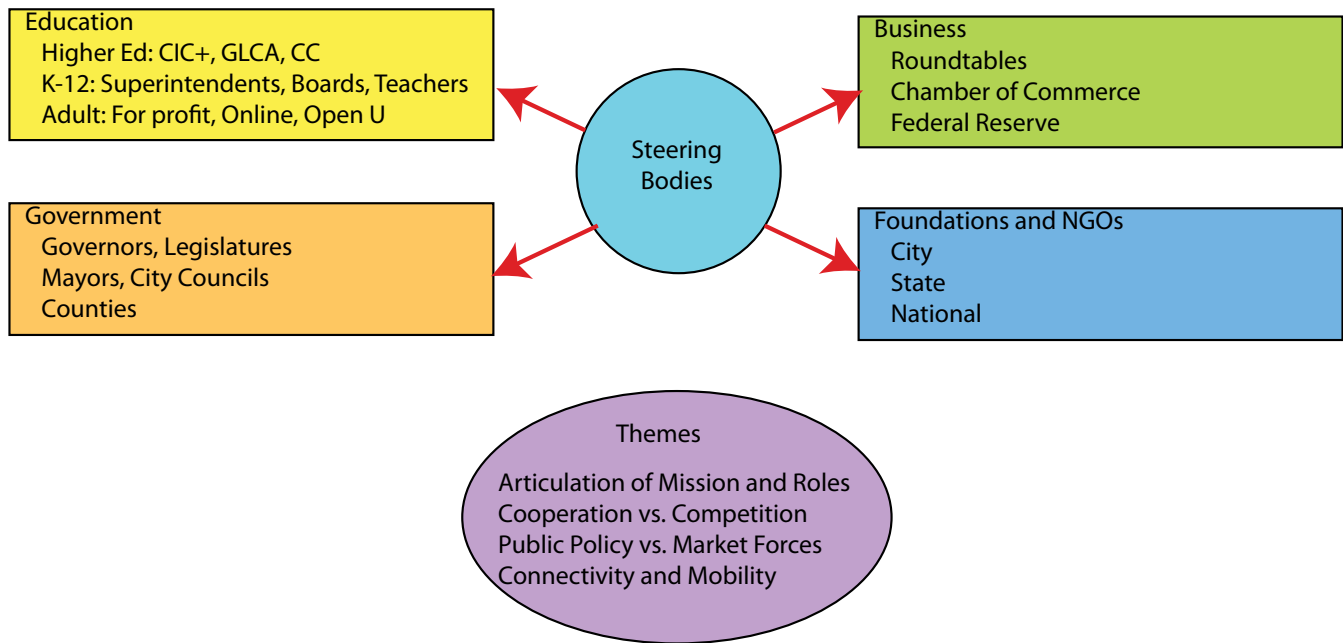


Key organizations for coordinating the Midwest Roadmap project

ty learning centers), and state government responsibility for providing or stimulating the digital infrastructure necessary to build a 21st Century learning environment. Related to this would be an analysis of necessary investments from both the public and private sector.

Here the first step is to engage the attention and commitment of Midwest leaders from the various sectors of society, e.g., business and industry, state and local governments, higher education, foundations, and the media. The region’s research universities might serve as a brain trust, perhaps working closely with other organizations such as the Brookings Institution, to join together to develop a detailed analysis of the economic and social challenges faced by our region as it grapples with the imperatives of a global, knowledge-driven economy, much as we have tried to do through the Midwest Roadmap. The media will play an important role in this effort by raising public awareness of just how much at risk our states will be if they remain trapped in the low-skill industrial economy while the rest of our world evolves into a knowledge economy.

Second, we need to form organizations to link together the leadership of various sectors. This might be a multi-state version of the government-university-industry roundtable groups that exist in other states such as California or at the national level through the



A possible steering framework

National Academies. A coalition of the Federal Reserve Banks (Chicago, Cleveland, Minneapolis) could host such activities. Existing higher education organizations spanning the Midwest region such as the Midwestern Higher Education Compact and the Great Lakes College Association should play key roles in linking colleges and university to such leadership groups.

Third, someone is going to have to bankroll the early work to form these groups, perform the necessary analysis, and develop the roadmap to our future. Here our region is fortunate to have a number of important and influential foundations, e.g., MacArthur, Spencer, Kellogg, Mott, Lumina, Lilly, and others that have invested in the welfare of our states in the past, and that could join together in investing in just such a multi-state effort for the future.

Fourth, there would need to be a broader roadmapping effort within each sector. For example, both state and local governments need to do a better job in identifying and sharing information on best practices, both to provide new ideas to a political system all too frequently backing into the future, and perhaps to provide a political umbrella for the necessary action. Leaders of business and industry—and of course, their shareholders and the investment community—need to look beyond quarterly earnings and consider the longer-term

impact of workforce quality, R&D and innovation, and regional prosperity on their future—indeed, their very survival, in the flat world of the knowledge economy.

Key in any such effort is to build a network linking leaders in the public and private sector. Clearly this network would need to be involved in the development of the vision and the plan to gain participation and commitment. Elements of this leadership network would include: K-12 education, higher education, industry, labor, foundations, community leaders, state government, federal government, and media. One might begin by establishing a standing leadership task force, with sufficient authority, resources, and longevity to propose and achieve the necessary strategic policy and fiscal shifts.

The membership of the task force might consist of leaders from both the public and private sector of the Midwest. Unlike other short-term studies, the task force would remain in existence for at least a decade to oversee the development, implementation, and success of the transformation agenda. It would be charged with sustaining continued interaction with key stakeholders, including college and university presidents, governing boards, and campus communities; local, state, and perhaps federal government leaders; the private sector (business, corporate, foundation); and the public. It is

crucial to stress here the importance of leadership at the level of the governors, demonstrated through action and reflecting in budget requests and policy statements an understanding of the importance of quality, access, performance, and market flexibility in higher education—priorities that have been woefully absent for several decades. Although such planning activities are not unusual at the state level (e.g., ranging from the California Master Plan of the 1950s to the various K-12 planning efforts stimulated by groups such as the Business Roundtable in recent years), this proposed effort would be distinguished both by its regional character and by an unusually broad vision of a society of learning characterized by pervasive educational opportunities for all citizens.

Today a major expansion of educational opportunity could have an extraordinary impact on the future of the heartland of America. It is time to take bold action by providing all of our citizens with universal access to lifelong learning opportunities, thereby enabling participation in the world's most advanced knowledge and learning society. The towns, cities, and states of the Midwest should accept a responsibility to enable all of their citizens to take advantage of the educational, learning, and training opportunities they need and deserve, throughout their lives, thereby enabling both individuals and the nation itself to prosper in an ever more competitive global economy.

Chapter 8

Over the Horizon: Game Changers and Paradigm Shifts

The transition from a paradigm in crisis to a new one is, in effect, a reconstruction of the field from new fundamentals, a reconstruction that changes some of the field's most elementary theoretical generalizations as well as many of its paradigm methods.

—Thomas Kuhn, *The Structure of Scientific Revolutions*

As we look even further into an unknowable future, the possibilities and uncertainties become even more challenging. How will wealth be created and value added in this global, knowledge-driven economy? While many regions (e.g., Bangalore, Shanghai) will prosper with exceptionally high-quality specialization in knowledge-intensive services and low-cost commodity manufacturing, the United States is unlikely to be competitive here, whether because of our high standard of living (and high wage) requirements or population limitations. Instead we will have to stress our capacity to innovate and create, derived from an unusually diverse, market-driven, democratic culture. Although we will still “make things”, we will do so by organizing the financial and human capital on a global level.

But many other possibilities remain. Will increasingly robust communications technologies (always on, always in contact, high-fidelity interaction at a distance) stimulate the evolution of new types of communities (e.g., self-organization, spontaneous emergence, collective intelligence, “hives”)? Suppose info-bio-nano technologies continue to evolve at the current rate of 1,000 fold per decade. Can we really prepare today’s kids for the world of several decades from now when technologies such as neural implants, AI “mind children”, sim-stim, and such may actually exist? During the 20th century, the lifespan in developed nations essentially doubled (from 40 to 80 years). Suppose it happens again in the 21st century?

More generally, it is clear that as the pace of change continues to accelerate, learning organizations and innovation systems will need to become highly adaptive if they are to survive. Here, we might best think of future learning and innovation environments as ecologies that not only adapt but mutate and evolve to serve an

ever-changing world.

Such future challenges to the Midwest’s prosperity and social well-being call for bold initiatives. It is not enough to simply build upon the status quo, for example by doubling the number of post-secondary degree recipients or guaranteeing at a minimum a community college education for all. Instead, it is important that the Midwest consider bolder visions that exploit truly over-the-horizon opportunities and visions. To this end, we conclude this roadmapping exercise by speculating about possible *game changers* that would challenge the current educational infrastructure of the Midwest region and demand *paradigm shifts* in its learning and innovation infrastructure.

Game-Changers

Restructuring of the Higher Education Enterprise

Universities serve as the gatekeepers not only for the definition of the academic disciplines and membership in the academy, but as well controlling entry to the professions that so dominate contemporary society. While there has been competition among institutions for students, faculty, and resources—at least in the United States—the extent to which institutions control the awarding of degrees has led to a tightly controlled competitive market. Furthermore, most colleges and universities serve primarily local or regional areas, where they have particularly strong market positions. As with most monopoly organizations, today’s university is provider-centered, essentially functioning to serve the needs and desires of the faculty rather than the students they teach or the broader society that supports them.

Today this monopoly character is being strongly challenged, however. No university can control the growth of knowledge or the educational needs of a society. Information technology is rapidly eliminating the barriers of space and time that have largely shielded campus activities from competition. As the need for advanced education becomes more intense, there are already signs that some institutions are responding to market forces and moving far beyond their traditional geographical areas to compete for students and resources. There are hundreds of colleges and universities that increasingly view themselves as competing in a national or even international marketplace. Even within regions such as local communities, colleges and universities that used to enjoy a geographical monopoly now find that other institutions are establishing beachheads through extension services, distance learning, or even branch campuses. With advances in communication, transportation, and global commerce, several universities in the United States and abroad increasingly view themselves as international institutions, competing in the global marketplace.

Beyond competition among colleges and universities, there are new educational providers entering the marketplace.¹ Sophisticated for-profit entities such as the Apollo Group (i.e., University of Phoenix) and Laureate are moving into markets throughout the United States, Europe, and Asia. Already hundreds of Internet-based institutions are listed in college directories with over two million students enrolled in their programs, including major efforts such as the Western Governors University. It has been estimated that today there are over one thousand corporate training schools in the United States providing both education and training to employees at the college level. Industry currently spends over \$200 billion per year on corporate training. And, of course, the OpenCourseWare movement and resources such as iTunes U are providing free access to Internet-based courses to millions around the world.

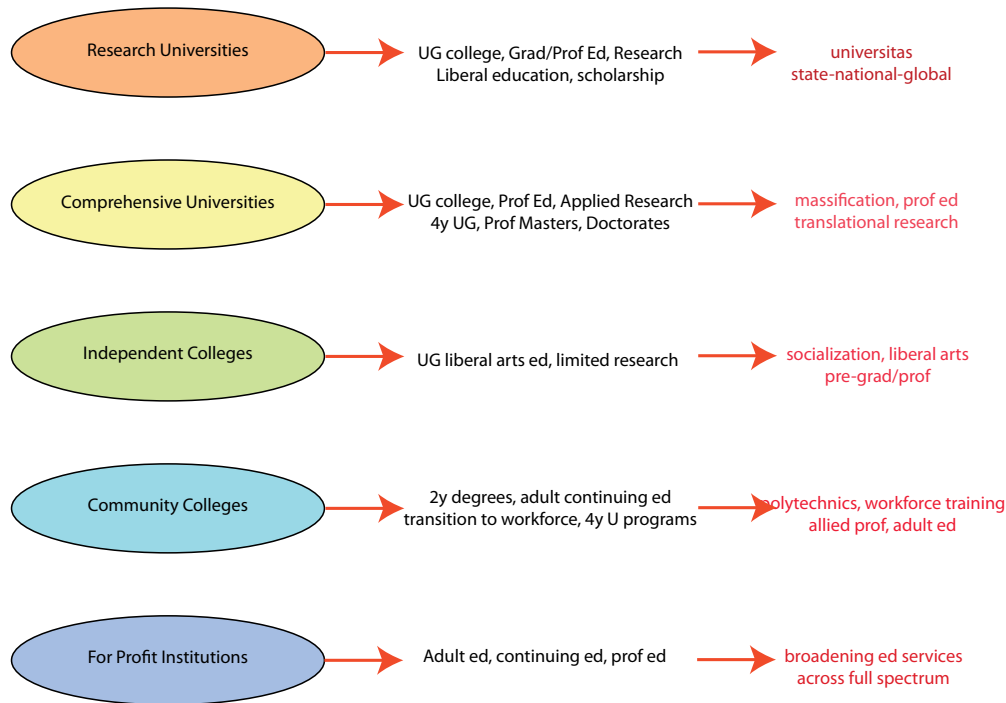
Although traditional colleges and universities enjoy competitive advantages based upon long-standing reputations and control of accreditation and credentialing, these could be eroded quite rapidly by the vast resources from capital markets that the industrial sector is capable of focusing on these efforts. Furthermore, the higher comfort level of industry with technology,

intensely competitive marketplaces, strategic alliances, and rapid decision making could prove to be decisive advantages. Finally, with access to the vast resources of capital markets and unhindered by other social commitments or public governance, for-profit providers could cherry pick the best faculty and most attractive products (learning software, courses, or programs) from traditional educational institutions. The competitive threat is very real.

The faculty has long been accustomed to dictating what it wishes to teach, how it will teach it, and where and when the learning will occur. Students must travel to the campus to learn. They must work their way through the bureaucracy of university admissions, counseling, scheduling, and residential living. And they must pay for the privilege, with little of the power of traditional consumers. If they navigate through the maze of requirements, they are finally awarded a certificate to recognize their experience—a college degree. This process is sustained by accrediting associations, professional societies, and state and federal governments.

This carefully regulated and controlled enterprise could be eroded by several factors. First, the great demand for advanced education and training cannot be met by such a carefully rationed and controlled enterprise. Second, the expanding marketplace will attract new competitors, exploiting new learning paradigms, and increasingly threatening traditional providers. And perhaps most important of all, newly emerging information technology has not only eliminated the constraints of space and time, but it is also transforming students into learners and consumers. Open education resources are providing learners with choice in the marketplace—access to learning opportunities, knowledge-rich networks and digital libraries, collections of scholars and expert consultants, and other mechanisms for the delivery of learning.

The evolution from faculty-centered and -controlled teaching and credentialing institutions to distributed, open learning environments is already happening. The new learning services are increasingly available among many providers, learning agents, and intermediary organizations. Such an open, network-based learning enterprise certainly seems more capable of responding to the staggering demand for advanced education, learn-



Evolution and differentiation of higher education institutions

ing, and knowledge. It also seems certain not only to provide learners with far more choices but also to create far more competition for the provision of knowledge and learning services.

As a result, higher education is likely to evolve from a loosely federated system of colleges and universities serving traditional students from local communities to, in effect, a *global knowledge and learning industry*. With the emergence of new competitive forces and the weakening influence of traditional regulations, education is evolving like other “deregulated” industries, for example, health care, or communications, or energy. Yet, in contrast to these other industries that have been restructured as government regulation has disappeared, the global knowledge industry will be unleashed by emerging information technology as it releases education from the constraints of space, time, and the credentialing monopoly. And, as our society becomes ever more dependent upon new knowledge and educated people, upon knowledge workers, this global knowledge business will represent one of the most active growth industries of our times.³

Many in the academy undoubtedly view with derision or alarm the depiction of the higher education enterprise as an “industry” or “business.” After all,

higher education is a social institution with broader civic purpose and not traditionally driven by concerns about workforce training and economic development. Furthermore, the perspective of higher education as an industry raises concerns that short-term economic and political demands will dominate broader societal responsibilities and investment. Yet, in an age of knowledge, the ability of the university to respond to social, economic, and technological change will likely require a new paradigm for how we think about postsecondary education. No one, no government, is in control of the emerging knowledge and learning industry; instead it responds to forces in the marketplace. Universities will have to learn to cope with the competitive pressures of this marketplace while preserving the most important of their traditional values and character.

Lifelong Learning

The needs for lifelong learning opportunities in a knowledge society are manifold. The shelf life of education early in one’s life, whether K-12 or higher education, is shrinking rapidly in face of the explosion of knowledge in many fields. Today’s students and tomorrow’s graduates are likely to value access to lifelong

learning opportunities more highly than job security, which will be elusive in any event. They understand that in the turbulent world of a knowledge economy, characterized by outsourcing and off-shoring to a global workforce, employees are only one paycheck away from the unemployment line unless they commit to continuous learning and re-skilling to adapt to every 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, e.g. the Land Grant Acts in the 19th century to provide higher education to the working class, universal access to secondary education in the early 20th century, and the G. I. Bill enabling the college education of the returning veterans of World War II, today a major expansion of educational opportunity could have extraordinary impact on the future of the nation. It is time for the United States to take bold action, completing in a sense the series of these earlier federal education initiatives, by providing all American citizens with *universal access to lifelong learning opportunities*, thereby enabling participation in the world's most advanced knowledge society.

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.

Globalization

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, that is, becoming not only universities in the world but also of the world. 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—global climate change being foremost among them. The global knowledge economy requires thoughtful, interdependent and globally identified citizens. Institutional and pedagogical innovations are needed to confront these challenges and insure 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 globalization, through the efforts of an increasing number of established universities to compete in the global marketplace for students, faculty, and resources; through the rapid growth in international partnerships among universities; and through for-profit organizations (e.g., Apollo, Laureate) that seek to expand through acquisition into global enterprises. New types of universities may appear that increasingly define their purpose beyond regional or national priorities to address global needs such as health, environmental sustainability, and international development.

As a new world culture forms, a number of uni-

versities will evolve into learning institutions serving the world, albeit within the context of a particular geographical area (e.g., North America). Many of our leading universities have evolved over time from regional or state universities to, in effect, national universities. Because of their service role in areas such as agriculture and economic development, some universities have gone even beyond this to develop a decidedly international character. Furthermore, the American research university dominates much of the world's scholarship and research, currently enrolling over 450,000 international students and attracting faculty from throughout the world. In view of this global character, some of our institutions may evolve into a new paradigm, the world university

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.” (Bement, 2007) 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.

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. But as Wm. Wulf suggests, “Don’t think about today’s teleconfer-

ence technology, but one whose fidelity is photographic and 3-D. Don’t think about the awkward way we access information on the network, but about a system in which the entire world’s library is as accessible as a cell-phone.” It is only a matter of a decade or so before exponentially evolving information and communications technology will allow human interaction with essentially any degree of fidelity we wish, perhaps even totally immersive in all of our senses as in the “simstim” (simulated stimulus) technologies envisioned by science fiction writers (Gibson, 1984).

To illustrate with an extreme example, if information technology continues to evolve at its present rate, by the year 2030, the thousand-dollar notebook computer will have a data processing speed and memory capacity roughly comparable to the human brain (Kurzweil, 1999). Furthermore, it will be so tiny as to be almost invisible, and it will communicate with billions of other computers through wireless technology.

For planning purposes, we can assume that by the end of the next 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.

Open Educational Resources

Ironically, while we generally think in terms of this in terms such as 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



MIT's OpenCourseWare

use and development. MIT led the way with its OpenCourseWare (OCW) initiative, placing the digital assets supporting almost 2,000 courses into the public domain on the Internet for the world to use (Vest, 2006). Today, over 1,000 universities have adopted the OCW 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, with over 300 million downloads over the past three years.

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, such as Rice University's Connexion Project. 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. More recently major federal research agencies such as NIH and NSF 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



Apple's iTunes U

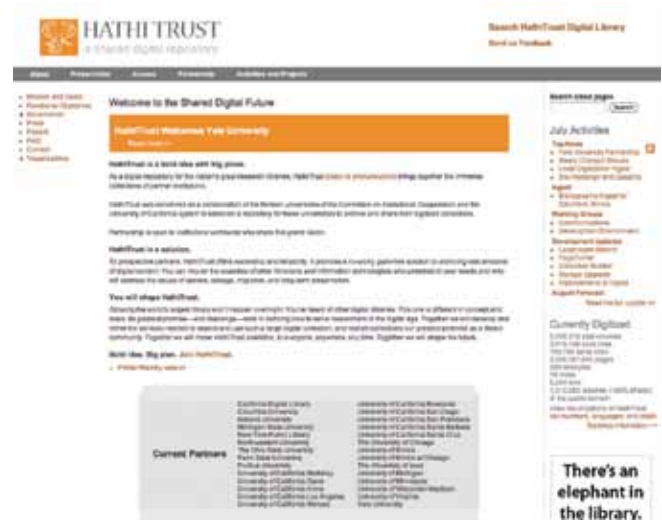
be added efforts to digitize massive quantities of printed material. For example, the Google Book project is currently working with a number of leading libraries (26 at last count in 35 languages) around the world to digitize a substantial portion of their holdings (12 million volumes in 2010, with a goal of 30 million by 2020), making these available for full-text searches using Google's powerful internet search engines. 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 (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 6 million books) of what could become a 21st century analog to the ancient Library of Alexandria. 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.

We should 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 communications technology, with over 4 billion people today having cell-phone connectivity and 1.2 billion with broadband access. It is likely that within a decade the majority of



Google Books



Hathi Trust

the world's population will have some level of cell-phone connectivity, with many using advanced 3G and 4G technologies.

Preparing for Unknowable Futures

There are other possibilities that might be considered for the longer-term future. Balancing population growth in some parts of the world might be new pandemics, such as AIDS or an avian flu virus, that appear out of nowhere to ravage our species. The growing divide between rich and poor, the developed nations and the third world, the North and South hemispheres, could drive even more serious social unrest and terrorism, perhaps armed with even more terrifying weapons.

Then, too, the unrelenting—indeed, accelerating pace—of technology could benefit humankind, extending our lifespan and quality of life (although perhaps aggravating population growth in the process), meeting the world's needs for food and shelter and perhaps even energy, and enabling vastly new forms of communication, transportation, and social interaction. Perhaps we will rekindle our species' fundamental quest for exploration and expansion by resuming human space-flight and eventually colonizing our solar system and beyond.

Sustained progress in the development of new technologies has been the central feature of the past century

and is likely to be even more so in the century ahead. But technology will also present new challenges that almost seem taken from the pages of science fiction. Clearly if digital technology continues to evolve at its current pace for the next decade, creating machines a thousand, a million, a billion times more powerful than those which are so dominating our world today, then phenomena such as the emergence of machine consciousness and intelligence become very real possibilities during this century.

In fact some even suggest that we could encounter a "technological singularity," a point at which technology begins to accelerate so rapidly that we lose not only the ability to control but even to predict the future (Kurzweil, 2005). John von Neumann once speculated, "The ever accelerating progress of technology and changes in the mode of human life gives the appearance of approaching some essential singularity in the history of the race beyond which human affairs, as we know them, could not continue." For example, as digital technology continues to increase in power a thousand-fold each decade, at some point computers (or, more likely, large computer networks) might "awaken" with super-human intelligence. Or biological science may provide the means to improve natural human intellect.

When greater-than-human intelligence drives technological evolution, that progress will accelerate rapidly, including possibly the creation of still more intelligent entities, on a still shorter timescale. To use Von

Neumann's terminology, at such a technological "singularity", our old models must be discarded and a new reality appears, perhaps beyond our comprehension.

Clearly phenomena such as machine consciousness, contact by extraterrestrial intelligence, or cosmic extinction from a wandering asteroid are possibilities for our civilization, but just as clearly they should neither dominate our attention nor our near-term actions. We have the freedom to establish initial conditions, make things happen in ways that are less inimical than others. Indeed, the most effective way to prepare for such unanticipated events is to make certain that our descendants are equipped with education and skills of the highest possible quality.

Paradigm Shifts

The Common Denominators

Clearly, as knowledge and educated people become key to prosperity, security, and social well-being, the university, in all its myriad and rapidly changing forms, has become one of the most important social institutions of our times. Yet many questions remain unanswered. Who will be the learners served by these institutions? Who will teach them? Who will administer and govern these institutions? Who will pay for them? What will be the character of our universities? How will they function? When will they appear? The list goes on.

It is difficult to suggest a particular form for the university of the 21st Century. The ever-increasing diversity of American higher education makes it clear that many types of institutions will serve our society. Nonetheless, a number of themes will almost certainly characterize at least some part of the higher education enterprise:

- Universities will shift from faculty-centered to *learner-centered* institutions, joining other social institutions in the public and private sectors in the recognition that we must become more focused on those we serve.
- They will be more *affordable*, within the resources of all citizens, whether through low cost or societal subsidy.
- They will provide *lifelong learning*, requiring both a willingness to continue to learn on the part of our citizens and a commitment to provide opportunities for this lifelong learning by our institutions.
- All levels of education will be a part of a *seamless web*, as they become both interrelated and blended together.
- Universities will embrace *asynchronous learning*, breaking the constraints of time and space to make learning opportunities more compatible with lifestyles and needs, anyplace, anytime.
- We will continue to develop and practice *interactive and collaborative learning*, appropriate for the digital age, the "plug and play" generation.
- Universities will commit to *diversity* sufficient to serve an increasingly diverse population with diverse needs and goals.
- Universities will need to build learning environments that are both *adaptive and intelligent*, molding to the learning styles and needs of the students they serve.

There is one further modifier that may characterize the university of the future: *ubiquitous*. Today, knowledge has become the coin of the realm. It determines the wealth of nations. It has also become the key to one's personal standard of living, the quality of one's life. We might well make the case that today it has become the responsibility of democratic societies to provide their citizens with the education and training they need throughout their lives, whenever, wherever, and however they desire it, at high quality, and at a cost they can afford.

Of course, this has been one of the great themes of higher education in America. Each evolutionary wave of higher education has aimed at educating a broader segment of society—the public universities, the land-grant universities, the normal and technical colleges, and the community colleges. But today we must do even more to serve an even broader segment of our society.

Learn Grants

It is imperative as a matter of both social justice and economic competitiveness that the nation and the states

address and remove those factors that have created a strong dependence of access and success in higher education upon socioeconomic status. America should aspire to the ideal where family income is nearly irrelevant to the ability of a student to attend the college or university best matched to his or her talents, objectives, and motivation. As a consequence of both the inadequacy and complexity of existing financial aid programs, many economically disadvantaged students (and parents) no longer see higher education as an option open to them but rather view it as a privilege for the more affluent. As a result, these students do not have the incentive to perform well in K-12 (nor do their parents have the incentive to support them); hence they fall behind early or dropping out of the college-bound ranks.

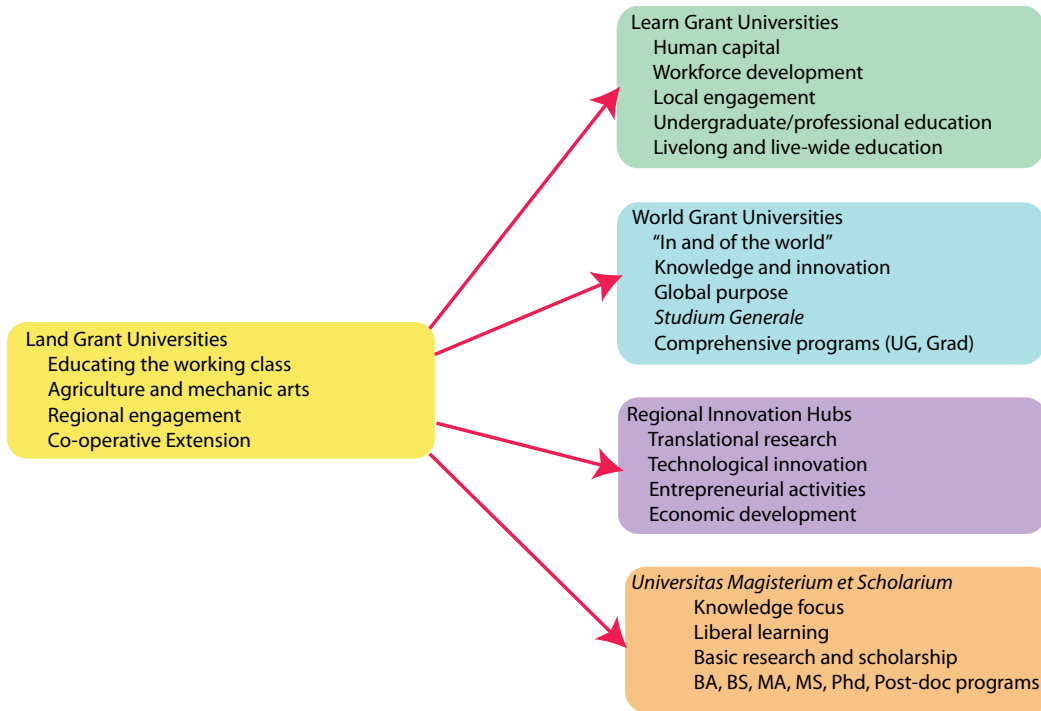
To address this alarming injustice and provide strong incentives for college preparation, we could provide all students with a 529-like college savings account, a “Learn-Grant” when they begin kindergarten. Although this account would be owned by the students (although invested in the equity market by the federal government or its agents), its funds could be used only for post-secondary education upon the successful completion of a high school college-preparatory program. Each year students (and their parents) would receive a statement of the accumulation in their account, with a reminder that this is their money, but it can only be used for their college education (or other post-secondary education). Beyond serving as an important source of financial aid, the Learn Grants would provide a very strong incentive for succeeding in K-12 and preparing for a college education, since the account would be something students own but would lose if they did not continue their education beyond secondary school (after some appropriate grace period).

The program might be funded from any number of sources, e.g., from a federal plus state match, the revenue from the auction of the digital spectrum (most analogous to the Land Grant Act), etc. Although the Learn Grants would be provided to all students when entering K-12 (in order to earn broad political support), they could be augmented with additional contributions from public, private, or parental sources during their pre-college years, based on need and/or performance. An initial contribution of, say, \$10,000 (e.g., \$5,000 from

the federal government with a \$5,000 match from the states) would accumulate over their K-12 education to an amount that when coupled with other financial aid would likely be sufficient for a four-year college education at a public college or university. As to cost, if we assume roughly 4.5 million children enter K-12 each year (the estimate for 2010), then at \$10,000 per student, this would cost \$40 billion (\$20 billion each to the states and the feds). While this seems immense, it is about the cost of one year of K-12 education (or college education, on the average). It also should be compared to other public expenditures (Medicaid/Medicare, corrections, defense, and even student financial aid). From this broader perspective, it really doesn't seem excessive when viewed both as an investment in social justice and the future of the nation! The proposed Learn Grant program would provide a powerful stimulus to building the world-class workforce necessary for America's prosperity and security in an ever more competitive global, knowledge-driven economy.

Learn Grant Universities

Today our society is undergoing a similarly profound transition, this time from an industrial to a knowledge-based society. Hence it may be time for a new social contract aimed at providing the knowledge and the educated citizens necessary for prosperity, security, and social well-being in this new age. Perhaps it is time for a new federal act, similar to the land grant acts of the nineteenth century, that will enable the higher education enterprise to address the needs of the 21st Century. The land-grant paradigm of the 19th and 20th centuries was focused on developing the vast natural resources of our nation to build a modern agricultural and industrial economy. Today, however, we have come to realize that our most important national resource for the future will be our people, their knowledge, and their skills and innovation. At the dawn of the age of knowledge, one could well make the argument that learning and innovation will replace natural resources or national defense as the priority for the twenty-first century. We might even conjecture that a social contract based on developing and maintaining the abilities and talents of our people to their fullest extent could well transform our schools, colleges, and universities



Alternative forms of the land-grant philosophy

into new forms that would rival the earlier land-grant university in importance. In a sense, the 21st Century analog to the land-grant university might be termed a *learn-grant university*.

A learn-grant university for the 21st Century might be designed to develop our most important resource, our human resources, as its top priority, along with the infrastructure necessary to sustain a knowledge-driven society. The field stations and cooperative extension programs—perhaps now as much in cyberspace as in a physical location—could be directed to regional learning and innovation needs. While traditional academic disciplines and professional fields would continue to have major educational and service roles and responsibilities, new interdisciplinary fields such as sustainable technologies and innovation systems might be developed to provide the skills, knowledge, and innovation for a region very much in the land-grant tradition. (A more specific example of such regional innovation hubs is provided in Appendix B.)

Other national priorities such as health care systems, environmental sustainability, globalization, and entrepreneurship might be part of an expanded mission for universities. Institutions and academic researchers would then commit to research and professional ser-

vice associated with such national priorities. To attract the leadership and the long-term public support needed for a valid national public service mission, faculties would be called upon to set new priorities, collaborate across campus boundaries, and build upon their diverse capabilities. This is just one example of many. But the point seems clear. Such a social contract, linking together federal and state investment and interests with higher education and business to serve national and regional needs, could become the elements of a 21st century analog to the land-grant university.

World Grant Universities

There is a strong sense that higher education, long international in participation, may now be 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; through the rapid growth in international partnerships among universities; and through for-profit organizations (e.g., Apollo, Laureate) that seek to expand through acquisition into global enterprises. New types of universities may appear that increasingly define their purpose beyond regional or national priorities

to address global needs such as health, environmental sustainability, and international development.

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, that is, becoming not only universities in the world but also of the world. 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—global climate change being foremost among them. The global knowledge economy requires thoughtful, interdependent and globally identified citizens. Institutional and pedagogical innovations are needed to confront these challenges and insure that the canonical activities of universities – research, teaching and engagement – remain rich, relevant and accessible.

Lou Anna Simon, president of Michigan State University, one of the nation’s earliest land-grant universities, coins the term “world grant university” to describe an extension of the principles inherent in the land-grant tradition adapted to address the global challenges of the twenty-first century and beyond. Such institutions would not be “granted” access to the world in the sense that states were granted tracts of land by the Morrill Act as a resource to support the establishment of land-grant institutions in the United States. Rather, the “world grant” ideal recognizes that fundamental issues unfolding in one’s own backyard link directly to challenges occurring throughout the nation and the world. It not only recognizes this seamless connection but also actively grants to the world a deeply ingrained commitment to access and utilization of the cutting-edge knowledge required to address these challenges.

As *The Economist* notes, “The most significant development in higher education is the emergence of a super-league of global universities. The great universities of the 20th century were shaped by nationalism; the great universities of today are being shaped by globalization. The emerging global university is set to be one of the transformative institutions of the current era. All it needs is to be allowed to flourish.”

Hybrid Public/Private/State/ National/Global Universities

At a time when the strength, prosperity, and welfare of a nation demand a highly educated citizenry and institutions with the ability to discover new knowledge, develop innovative applications of discoveries, and transfer them into the marketplace through entrepreneurial activities, such vital national needs are no longer top state priorities. The model of state-based support of graduate training made sense when university expertise was closely tied to local natural resource bases like agriculture, manufacturing, and mining. But today’s university expertise has implications far beyond state boundaries. Highly trained and skilled labor has become more mobile and innovation more globally distributed. Many of the benefits from graduate training—like the benefits of research—are public goods that provide only limited returns to the states in which they are located. The bulk of the benefits are realized beyond state boundaries.

Hence, it should be no surprise that many states have concluded that they cannot, will not, and probably should not invest to sustain world-class quality in graduate and professional education—particularly at the expense of other priorities such as broadening access to baccalaureate education. Today, not only is state support woefully inadequate to achieve state goals, but state goals no longer accumulate to meet national needs. The declining priority that states have given to public higher education makes sense for them but is a disaster for the nation. The growing mismatch between state priorities and national needs suggests that it is time once again to realign responsibilities between the state and the nation for higher education and provide adequate resources to sustain American leadership.

We write “once again” because this is not a brand new issue. The success of university research in winning World War II—with innovations such as radar and electronics—and Vannevar Bush’s seminal report, “Science, the Endless Frontier: A Report to the President on a Program for Postwar Scientific Research” (1945), convinced national leaders that university research is too important for national security, public health, and economic prosperity to allow it to be entirely dependent upon the vicissitudes of state appropriations and



Aligning support with specific patrons for each mission of the university

philanthropy. Hence, the federal government assumed the primary responsibility for the support of research, now at a level of \$30 billion each year—an effort that has been estimated to have stimulated roughly half of the nation’s economic growth during the latter half of the 20th century, while sustaining the nation’s security and public health.

Once more, it is time for the federal government to step in and provide the support necessary to keep our crucial graduate programs among the best in the world. Educating scientists and engineers, physicians and teachers, business leaders and entrepreneurs is vital to developing the human capital that is now key to national prosperity and security in the global, knowledge-driven economy. It cannot be left dependent on shifting state priorities and declining state support.

So how might this work? A new structure would distribute the primary responsibilities for the support of the nation’s flagship public research universities among the states, the federal government, and private donors. The states, consistent with their current priorities for enhancing workforce quality, would focus their limited resources on providing access to quality education at the associate and baccalaureate levels, augmented by student tuition and private philanthropy. The federal government would become, in addition to a leader in supporting university research, the primary patron of advanced education at the graduate and professional level. Private patrons, including foundations and individual donors, would continue to play a major

role in support of the humanities, the arts, the preservation of knowledge and culture, and the university’s role in serving as an informed critic of society—all roles of great importance to the nation. Those functions would also continue to receive state support, because they are essential to high-quality baccalaureate education.

How much additional federal investment will this new approach require? We suggest a magnitude roughly comparable to those of other major federal programs for the support of higher education such as university research (\$30 billion per year), the Pell Grant program (\$26 billion per year), or the foregone federal tax revenues associated with the beneficial tax treatment of charitable giving and endowment earnings (\$22 billion per year).

Those additional resources would best be allocated to universities based on a combination of merit and impact. For example, competitive traineeship programs might be used in some disciplines, while grants for other fields might be based on graduation rates or the size of graduate faculties or student enrollments. Other grants could be designed to stimulate and support newly emerging disciplines in areas of national priority, like nanotechnology or global sustainability. In all cases, the key objective would be the direct support of graduate programs through sustained block grants to universities—rather than grants to individual faculty members or students.

What matters now is that, more than ever before, America needs to develop a strategy for building

and sustaining a system of research universities that is the best in the world. As the states inevitably play a declining role in the support of advanced education and research, it is time for the federal government to move beyond its policy of giving money only to individuals—students through financial aid and scholars through research grants. It must provide direct support to select institutions with the intent of sustaining those missions of advanced graduate-level training that are of particular importance to the nation. Most developed nations in Europe and Asia have developed this strategic approach to creating and sustaining selected research universities at world-class levels. In fact, today the United States essentially stands alone in its failure to develop a national strategy for sustaining the quality of its research-intensive universities.

The nation's earlier vision and commitment to create public universities competitive in quality to the best universities in the world were a reflection of the democratic spirit of a young America. Flagship public research universities have been vital not only to regional prosperity but also to national security and well being. Today, we face the challenges of a hyper-competitive global, knowledge-driven society in which other nations recognize the positive impact that building world-class universities can have. America already has them. They are one of our nation's greatest assets. Preserving their quality and capacity requires bold national investment.

The "No-Frills" University

In recent years there has been growing discussion about the possibility of accelerated three-year baccalaureate programs in U.S. higher education. In part this has been stimulated by the broad adoption by European universities of the three-year degree programs associated with the Bologna Process. But it has also been proposed as a way to reduce the cost of a college education, or as Senator Lamar Alexander puts it, viewed as "the higher education equivalent of a fuel-efficient car".

In fact, one might go even further and imagine introducing into American higher education streamlined universities more similar those in Europe. Most European universities enroll adult students directly in three-year disciplinary majors after longer and more intense

secondary educations. In contrast, American colleges and universities have inherited from their British antecedents the mission of the socialization of young students. Not only does this require a very substantial investment in supporting infrastructure such as 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, U.S. 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.

In sharp contrast European universities focus their activities on teaching and scholarship for adult students. Entering students enroll in focused three-year discipline-based baccalaureate programs without the preliminary general education experience and socialization programs characterizing American universities. Students are expected to arrange for their own living and social activities, while the university focuses on its "knowledge and learning" mission, thereby avoiding many of the costs associated with socializing young students.

There have been numerous suggestions that the United States explore the "no-frills" approach of European universities by focusing the activities of some of their universities entirely upon teaching and scholarship for adult students, thereby greatly reducing costs and tuition. This would allow the universities to focus their extensive—and expensive—resources where they are most effective: on intellectually mature students who are ready to seek advanced education and training in a specific discipline or profession. It would relieve them of the responsibility of general education and parenting, roles for which many large universities are not very well suited in any event. It might also allow them to shed their activities in remedial education, a rather inappropriate use of the costly resources of the research university. Focusing universities only on advanced education and training for academically mature students could actually enhance the intellectual atmosphere of the campus, thereby improving the quality of both

teaching and scholarship considerably. Adult learners would be far more mature and able to benefit from the resources of these institutions.

Ironically, such a focusing of efforts might even reduce public criticism of higher education. Most students—and parents—appear quite happy with the quality of both upper-class academic majors and of professional education. Furthermore, they seem quite willing to pay the necessary tuition levels, both because they accept the higher costs of advanced education and training, and because they see more clearly the benefits of the degree to their careers, “the light at the end of the tunnel.” In contrast, most of the concern and frustration expressed by students and parents with respect to quality and cost are focused on the early years of a college education, on the general education phase, since they perceive this style of pedagogy very similar to that of secondary education.

Yet the current quality and character of secondary education in the United States probably will not allow this for most students. Secondary education in Europe and much of the rest of the world is characterized by a more extended and intensive pre-college education, e.g., gymnasias, lyceums, and colleges, which provide much of the general education preparation that currently comprises the first two-years of American college education. Hence a major shift to three-year baccalaureate programs or no-frills adult universities would likely require a major restructuring of secondary education in the United States more along the lines of Europe and Canada.

Open Universities

For many years, the educational needs of many nations have been addressed by open universities, institutions relying on both televised or Internet-based courses and local facilitators to enable students to study and earn degrees at home. Perhaps most notable has been the British Open University, but this is only one of many such institutions that now enroll over three million students worldwide.

These institutions are based upon the principle of open learning, in which technology and distance education models are used to break down barriers and provide opportunities for learning to a very broad segment



Most European universities are designed for upper division (adult) students (here at the Sorbonne, U. Paris).

of society. In these models, students become more active participants in learning activities, taking charge of their own academic program as much as possible. Many of these open universities are now embracing information technology, particularly the Internet, to provide educational opportunities to millions of students unable to attend or afford traditional residential campuses (e.g., the University of the People, which aims to provide tuition-free education to developing economies).

The motivation behind open universities involves cost, access, and flexibility. The open university paradigm is based not on the extension of the classroom but rather the one-to-one learning relationship between the tutor and the student. It relies on very high-quality learning materials, such as learning software and digital materials distributed over the Internet, augmented by facilitators at regional learning centers and by independent examiners. Using this paradigm, for example, the British Open University has been able to provide high-quality learning opportunities (currently ranked among the upper 15 percent of British universities) at only a fraction of a cost of residential education (\$7,000 compared to \$20,000 per student year in North America).

To date most open universities rely heavily on self-learning in the home environment, although they do make use of interactive study materials and decentralized learning facilities where students can seek academic assistance when they need it. However, with the rapid evolution of virtual distributed environments

and learning communities, these institutions will soon be able to offer a mix of educational experiences.

Clearly, the open university will become an increasingly important player in higher education at the global level. The interesting question is whether these institutions might also gain a foothold in the United States. Newly emerging institutions such as the Western Governors' University and the University of Phoenix are exploiting many of the concepts pioneered by the open university movement around the world

Already some open universities are moving rapidly to embrace the open educational resources movement, providing instruction through the OpenCourseWare paradigm and access to the massive digital libraries now becoming available. One might even imagine the emergence of "open source" universities, committed to providing extraordinary access to knowledge and learning tools through open learning resources. In fact, some institutions might decide to remove entirely the restrictions imposed by intellectual property ownership by asking all of their students and faculty members to sign a Creative Commons license for any intellectual property they develop at the University (at first copyright but eventually possibly even exploring other intellectual properties such as patents). Perhaps this would even redefine the nature of a "public" university, much in the spirit of the "public" library!

Learning Networks

Driven by information technology, the network has become more than a web that links together learning resources. It has become the architecture of advanced learning organizations. Information, knowledge, and learning opportunities are now distributed across robust computer networks, with over 4 billion people today estimated to have cell-phone connectivity and 1.2 billion with broadband access. Such widespread access, combined with the explosion in the availability of digital information and open learning paradigms such as the OpenCourseware initiative, makes it clear that the knowledge, the learning, the cultural resources that used to be the prerogative of a privileged few are rapidly becoming available anyplace, anytime, to anyone.

To this one should add the changing way that the "net generation" is using these new technologies to

build social communities—instant messaging, blogs, wiki's, virtual worlds, Facebook, Twitter, Wikipedia. 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.

The impact on all social organizations has been profound. Business and industry are moving rapidly away from the hierarchy of the organizational pyramid to networked organizations of relatively autonomous components. The transactional culture of the now bankrupt General Motors should be contrasted with the relational approach of IBM to building global enterprises.

It is important to appreciate how profound this new network architecture is for learning organizations. Today's learners can learn anywhere, anytime, learning and acquiring knowledge from sources in any location. Today, learners are in command of what, how, where, and when they learn, and they will be increasingly in control of what they pay for the learning opportunity as well.

The implications of a networked learning architecture are manifold. First, it makes less and less sense for institutions to attempt to be comprehensive, to go it alone. Rather, the key will be forming alliances, sharing resources, specializing in what they can be really good at, and relying on other focused institutions to provide the rest. The fact learned through painful experience in business and industry is that only world-class, competitively priced products will succeed in a global marketplace. This does not mean that the largest, most prestigious institutions will necessarily be the most successful. Indeed, smaller, more focused, and more nimble institutions may be able to develop world-class learning services that could compete very effectively with traditional offerings.

Learning networks may also work to couple different levels of education. For example, we are already seeing evidence that many high school students are entering college with degree credit in college-level courses taken over the Internet. By the same token, many col-

leges must provide remedial education at the secondary school level. At the other end, adults are seeking further educational services from higher education to respond to changing career requirements. A network architecture works best for the delivery of educational services when and where they are needed—that is, for “just in time” rather than “just in case” education. Granted this may not be the appropriate architecture for the general subjects associated with a liberal education. But it will in all likelihood increasingly dominate professional education and work-related learning.

One can imagine the learning networks evolving into a seamless continuum of educational opportunities and services, in which the degree becomes less and less relevant, and what a person has learned becomes far more significant. Learning communities will be more extended and diverse with a network architecture. Since they will evolve unconstrained by space and time, off-campus learners will vastly outnumber on-campus students. Beyond that, the distinction between learner, teacher, and researcher may become blurred. All will be able to make contributions to learning, teaching, and scholarship.

Today, as knowledge becomes an ever more significant factor in determining both personal and societal well being, and as rapidly emerging information technology provides the capacity to build new types of communities, we might well see the appearance of new social structures. A century ago, stimulated by the philanthropy of Andrew Carnegie, the public library became the focal point for community learning. Today, however, technology allows us to link together public and private resources such as schools, libraries, museums, hospitals, parks, media, and cultural resources. Further, communities can easily be linked with the knowledge resources of the world through the Internet.

There are some interesting trends in technology that suggest that new types of “community knowledge structures” may, in fact, appear, ones that will not be derivative of traditional institutions such as schools or libraries. The first trend involves the evolution of global computer networks such as the Internet. In addition to their ability to link people together into electronic communities, they link us as well to increasingly diverse and rich sources of knowledge. In a sense, they have become “knowledge networks,” giving us the capacity



Will the university continue to exist as a place?

to build communities with access to vast intellectual resources.

The second trend is our growing understanding of how learning and intelligent systems function. Modern computers are increasingly simulating natural cognitive processes, utilizing structures such as massively parallel computers, neural networks, and genetic algorithms. This convergence not only enables us to simulate and understand natural intelligence better, but it may also be the key to building artificial systems capable of learning and intelligent behavior.

The third trend is related to our developing understanding of the behavior of complex adaptive systems. We are learning that even the most primitive systems can frequently exhibit quite complex behavior. And many complex systems can exhibit self-organizing behavior, in which quite sophisticated and complex behavior evolves out of what appears first as chaotic, random processes.

These three themes—knowledge networks, learning and intelligent systems, and complex adaptive systems—may provide the key to understanding the evolution of a global structure, linking together billions of people, their knowledge resources, and their communities through robust communications technology.

A Return to Universitas Magistrorum et Scholarium—in Cyberspace?

It is ironic that the cyberspace paradigm of learning communities may actually return higher learning to the

older tradition of the scholar surrounded by disciples in an intense learning relationship. The term “university” actually originated during the Middle Ages with the appearance of “unions” of students or faculty members who joined together to form communities of teachers or students. The Latin origin, *universitas*, meant “the totality” or “the whole” and was used by medieval jurists as a general term to designate communities or corporations such as guilds, trades, and brotherhoods. Eventually the term university was restricted to these unions of masters and scholars and given the more formal Latin title: *universitas magistrorum et scholarium*.

From time to time, educators have attempted to define university in more intellectual terms. Although historically “university” referred to a union or corporate body of students or faculty, John Henry Newman stressed instead an alternative interpretation of the word: “The university is a place of teaching universal knowledge. This implies that its object is, on the one hand, intellectual, not moral; and on the other, that it is the diffusion and extension of knowledge rather than its advancement. If its object were scientific and philosophical discovery, I do not see why a university would have students; if religious training, I do not see how it can be the seat of literature and science.” In fact, the earliest European universities were designated as *studium generale* by church or state to indicate their role to provide learning of a broad, universal nature to all of the known world (enabled, of course, by the use of Latin as the universal language of the academy).

We tend to prefer a simpler synthesis of these definitions of the university:

A university is a community of masters and scholars (or in medieval terms, universitas magistrorum et scholarium), a school of universal learning (Newman) embracing every branch of knowledge and all possible means for making new investigations and thus advancing knowledge (Tappan).

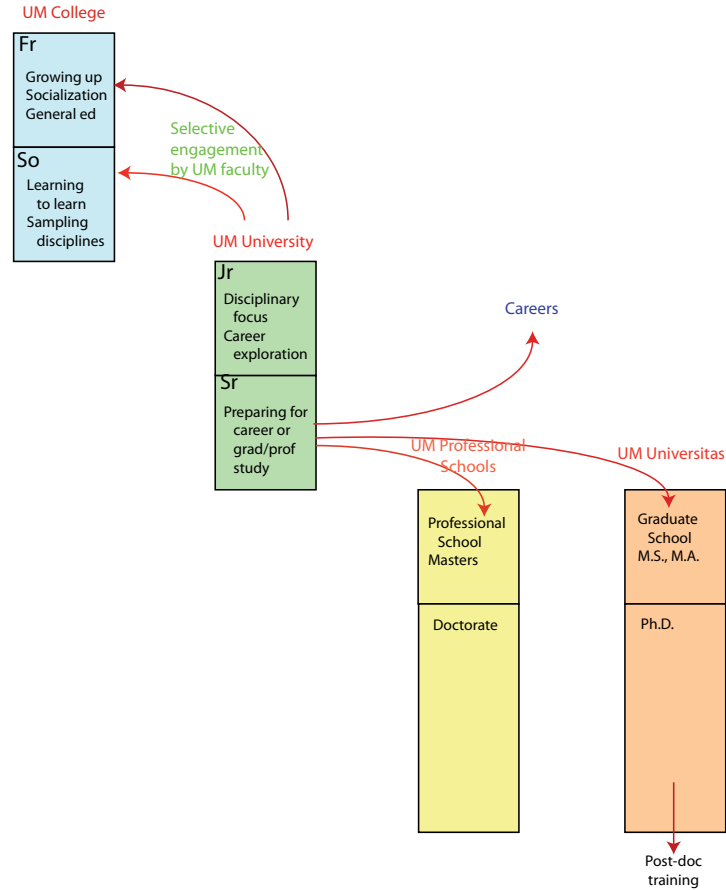
In a sense, this recognizes that the true advantages of universities are in the educational process, in the array of social interactions, counseling, tutorial, and hands-on mentoring activities that require human interaction. In this sense, information technology will not so much transform higher education—at least in the early phases—as enrich the educational opportunities avail-

able to learners. In a sense, technology is enabling the most fundamental character of the medieval university to emerge once again, but this time in cyberspace!

There is an important implication here. Information technology may allow—perhaps even require—new paradigms for learning organizations that go beyond traditional structures such as research universities, federal research laboratories, research projects, centers, and institutes. If this is the case, we should place a far higher priority on moving to link together our students and educators among themselves and with the rest of the world. This would be a modest investment compared with the massive investments we have made in the institutions of the past—university campuses, transportation, and urban infrastructure. It is none too early to consider an overarching agenda to develop deeper understanding of the interplay between advanced information technology and social systems. In some future time we may have the knowledge to synthesize both in an integrated way as a total system.

Yet, even as the university continues to grow and diversify as it evolves, one must always remember that at its core are its academic programs. One might describe the academic programs of the university in terms of the flow of students, first entering the university as undergraduates at the lower division (freshman, sophomore) level with the primary early objectives of socializing young adults, providing foundational learning, and enabling students to sample an array of disciplines for possible majors. Although lower division programs comprises a primary mission of community colleges and four-year liberal arts colleges, most public research universities today assign both instruction and student counseling to non-tenure track faculty (lecturers and instructors) and professional staff, with only occasional student interaction with senior faculty in survey courses. There is a much greater involvement of senior faculty with undergraduate education at the upper division level, where students select to concentrate in an academic discipline and begin to prepare either for careers or further study at the graduate or professional level.

In fact, most students at leading research universities will continue their studies in professional schools at the graduate level in fields such as law, medicine, business administration, or education. These studies



The flow of students through the academic programs of the university.

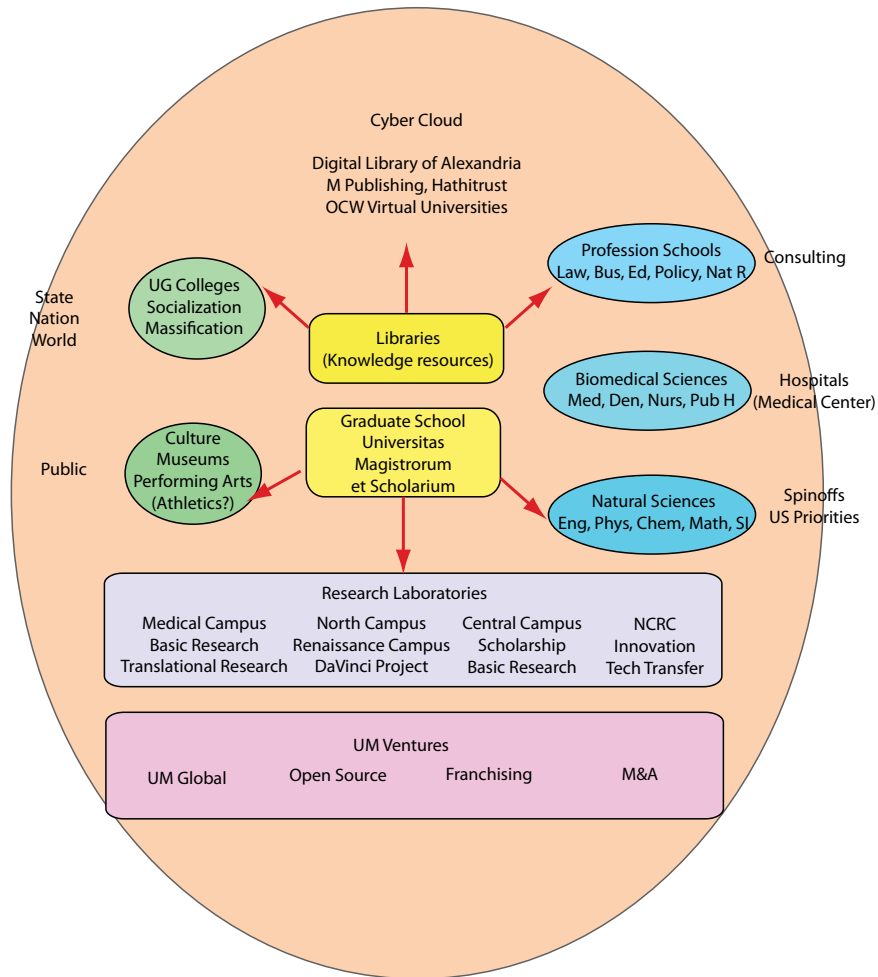
general lead to graduate professional degrees at the masters level (MBA, M.Arch, MAT) or doctorate level (M.D., LL.D.).

A select few undergraduates will choose instead to enter the graduate programs of the university to prepare for careers in research or as college faculty. These graduate programs of the university are the closest analog to the *universitas magisterium et scholarium* of ancient universities since learning and scholarship occurs through unions or communities of masters (the faculty) and scholars (the students) leading to graduate degrees such as the M.S. or M.A. and the Ph.D. In fact, in many fields such as the physical and biomedical sciences, even further education at the postdoctoral level has become the norm for students wishing to enter the academy.

From a more fundamental perspective, these graduate programs (and their associated graduate schools in many universities), along with knowledge resources such as the university libraries, comprise the true aca-

ademic core of the research university. They determine the intellectual vitality and reputation of the university and its various undergraduate and graduate programs. Usually this academic core also has an important physical presence on the university campus, with the graduate school and university library located in the center of the campus, about which are distributed not only the various schools and colleges but as well key cultural resources as the performing arts. Many American research universities have a similar structure, with a clearly identifiable academic core surrounded by an array of schools, colleges, cultural institutions, and research activities.

Yet, as the influence of powerful forces such as the changing needs of society, globalization, and information technology reshape the activities of the university, one can expect its organization and structure to continue to evolve. Many research universities are already evolving into so-called "core in cloud" organizations, in which academic departments or schools conducting



A cyberspace version of the university as a “core-in-cloud”

elite education and basic research, are surrounded by a constellation of peri-university organizations—research institutes, think tanks, corporate R&D centers—that draw intellectual strength from the core university and provide important financial, human, and physical resources in return. Such a structure reflects the blurring of basic and applied research, education and training, the university and broader society.

More specifically, while the academic units at the core retain the traditional university culture of faculty appointments, tenure, and intellectual traditions, for example, disciplinary focus, those peri-academic organizations evolving in the cloud can be far more flexible and adaptive. They can be multidisciplinary and project focused. They can be driven by entrepreneurial cultures and values. Unlike academic programs, they can come and go as the need and opportunity arise. And, although it is common to think of the cloud being situ-

ated quite close to the university core, in today’s world of emerging electronic and virtual communities, there is no reason why the cloud might not be widely distributed, involving organizations located far from the campus. In fact, as virtual universities become more common, there is no reason that the core itself has to have a geographical focus.

To some degree, the core-in-cloud model could revitalize core academic programs by stimulating new ideas and interactions. It can provide a bridge that allows the university to better serve society without compromising its core academic values. But, like the entrepreneurial university, it could also scatter and diffuse the activities of the university, creating a shopping mall character with little coherence.

Learning Ecologies

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 tacit knowledge. A fundamental epistemological shift in learning is occurring from individual to collective learning; from a focus on development of skills to instead dispositions, imagination, and creativity; and enabling the acquisition of both explicit and tacit knowledge.

In a rapidly changing world, innovation no longer depends only upon the explicit dimension characterizing conventional content-focused pedagogy focused on “learning to do”. Rather, one needs to enable an integration of tacit knowledge with explicit knowledge. Emerging ICT technologies that enable social networking to form learning communities and immersive virtual environments for simulation and play facilitate the “deep tinkering” that provides the tacit knowledge necessary to “learn to be”, tools already embraced by the young if not yet the academy. In a sense, learning has become a “culture”, in the sense of the Petri dish that is in a state of constant evolution.

Once we have realized that the core competency of the university is not simply transferring knowledge, but developing it within intricate and robust networks and communities, we realize that the simple distance-learning paradigm of the virtual university is inadequate. The key is to develop computer-mediated communications and communities that are released from the constraints of space and time.

Distance learning based on computer-network-mediated paradigms allows universities to push their campus boundaries outward to serve learners anywhere, anytime. Those institutions willing and capable of building such learning networks will see their learning communities expand by an order of magnitude. In this sense, the traditional paradigm of “time-out-for-

education” can be more easily replaced by the “just in time” learning paradigms, more appropriate for a knowledge-driven society in which work and learning fuse together.

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 sense 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, 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. 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?

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 and AI-based software agents; 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., inexpensive network appliances such as iPhones or iPad). 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, 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.

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. They are still organized into academic and professional disciplines; they still base their educational programs on the traditional undergraduate, graduate, and professional discipline curricula; our universities are still governed, managed, and led as they have been for ages.

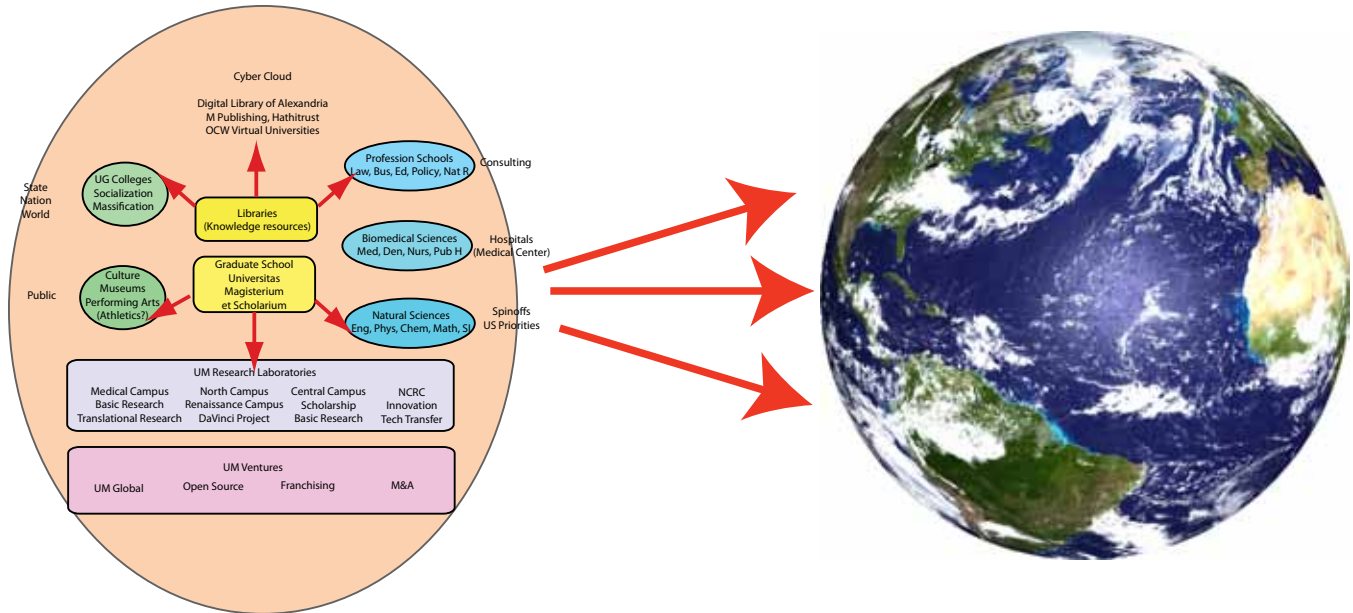
But if one looks more closely at the core activities of students and faculty, the changes over the past decade have been profound indeed. The scholarly activities of the faculty have become heavily dependent upon digital technology—rather cyberinfrastructure—whether in the sciences, humanities, arts, or professions. 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, 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.

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 rogue 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 that is now transforming scholarship and the communications technology enabling new forms of learning communities have not yet propagated into the core of the uni-



The university as an emergent global civilization based on knowledge, learning, and innovation

versity. 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, 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 will necessarily dictate the future of our universities.

Even in the near term, we should again recall Christensen's innovator'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?

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.

While many academics are reluctant to accept the necessity or the validity of formal planning activities, woe be it to the institutions that turn aside from strategic efforts to determine their futures. 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.

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, its service to society, its 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 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.

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 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).

The Last Word

As we stand at the beginning of a new century and a new millennium, the Midwest must adapt to living with change as a fact of life. Change must become woven into the fabric of our daily lives, in the way we work, relate to each other, and experience the world. We must learn the hard way that if we want to fully prosper in this new world, it is absolutely essential that we take the long view and invest in people, their education and skills, innovation and entrepreneurial efforts, and the institutions that enable these abilities, so critical to a region in the global knowledge economy.

The future belongs to those who face it squarely, to those who have the courage to transform themselves to serve a new society. The challenge is to work together to provide the Midwest region with an environment in which such change is regarded not as threatening but rather as an exhilarating opportunity to engage in the primary activity of a university, learning, in all its many forms, to serve our world as best we can.

Though one can never promise the future, we are not relieved of the responsibility of vision. Society is changing. We can either respond to these changes as active participants, constructing our own future, or we will find ourselves driven into the future by social forces beyond our control. To face the opportunities, challenges, and responsibilities of an increasingly uncertain future, the Midwest needs to rekindle the spirit of adventure, creativity, innovation, and boundless hope in the future that has characterized its history. It needs to restore sense of optimism and excitement about the future and a relish for change.

The future is not yet written, but we should not wish it any other way. The excitement that comes with uncertainty and discovery draws us inexorably into tomorrow.

Appendix A

A Summary of the Education Roadmap for Various Levels

The Regional Roadmap

Regional to National to Global: While it is natural to confine policy to state boundaries, in reality such geopolitical boundaries are of no more relevance to public policy than they are to corporate strategies in an ever more integrated and interdependent global society. Hence the Midwest's strategies must broaden to include regional, national, and global elements. **(Now!)**

Competition to Collaboration: Midwestern states, governments, and institutions must shift from Balkanized competition to collaboration to achieve common interests, building relational rather than transactional partnership most capable of responding to global imperatives. **(Now!)**

System and Strategic Perspectives: The Midwest needs to develop a more systemic and strategic perspective of its educational, research, and cultural institutions—both public and private, formal and informal—that views these knowledge resources as comprising a knowledge ecology that must be adequately supported and allowed to adapt and evolve rapidly to serve the needs of the state in a change driven world, free from micromanagement by state government or intrusion by partisan politics. **(Now!)**

Pre-College

All Students College-Ready: The Midwest region should set high goals that ALL students will graduate with a high school degree that signifies they are not only either college- or workplace-ready but furthermore prepared for a world that will require a lifelong commitment to learning. State governments and local communities should provide both the mandate and the resources to achieve these goals. **(Now!)**

Restructuring K-12 to Achieve World-class Performance: To achieve a quantum leap in student learning, Midwestern schools systems will have to restructure themselves to achieve world-class performance, including setting high standards for student and teacher performance, lengthening the school year, investing in modern learning resources, implementing rigorous methods for assessing student learning, preparing and rewarding outstanding teachers, and managing and governing school systems in an accountable fashion. **(Soon)**

Social Infrastructure: Beyond the necessary investments in K-12 education and the standards set for their quality and performance, raising the level of skills, knowledge, and achievement of the Midwest's workforce will require a strong social infrastructure of families and local communities, particularly during times of economic stress. To this end, state and local governments must take action both to re-establish the adequacy of the Midwest's social services while engaging in a broad effort of civic education to convince the public of the importance of providing world-class educational opportunities to all of its citizens. **(Soon)**

Higher Education Engagement with K-12: Higher education must become significantly more engaged with K-12 education, accepting the challenge of improving the quality of our primary and secondary schools as one of its highest priorities with the corresponding commitment of faculty, staff, and financial resources. Each Midwest college and university should be challenged to develop a strategic plan for such engagement, along with measurable performance goals and should be encouraged to join in consortia to address the challenges of K-12 education. **(Now!)**

Linkages and Pathways: The Midwest must create clearer pathways among educational levels and institutions and removing barriers to student mobility and promoting new learning paradigms (e.g., distance education, lifelong learning, workplace programs) to accommodate a far more diverse student cohort. (Soon)

Higher Education

Demanding Zero-Defects Institutional Performance: All Midwestern colleges and universities should be challenged to achieve a “zero-defects, total quality” performance goal in which all enrolled students are expected to graduate in the prescribed period. This will require not only adequate financial, instructional, and counseling support but as well strong incentives and disincentives at the individual and institutional level (e.g., basing public support on graduation rates rather than enrollments, demanding that faculty give highest priority to adequate staffing of required curricula, and setting tuition levels to encourage early graduation). (Soon)

Institutional Diversity: The Midwest should strive to encourage and sustain a more diverse system of higher education, since institutions with diverse missions, core competencies, and funding mechanisms are necessary to serve the diverse needs of its citizens, while creating a knowledge infrastructure more resilient to the challenges presented by unpredictable futures. Using a combination of technology and funding policies, efforts should be made to link elements of the Midwest’s learning, research, and knowledge resources into a market-responsive seamless web, centered on the needs and welfare of its citizens and the prosperity and quality of life in the region rather than the ambitions of institutional and political leaders. (Soon)

Community Colleges and Regional Universities: Key will be enhanced support of the efforts of community colleges and regional universities to integrate the new knowledge developed by research universities into academic programs capable of providing lifelong learning opportunities of world-class quality while supporting their surrounding communities in the transition to knowledge economies by developing addi-

tional professional programs more suited to the needs and interests of adult students. (Now!)

Independent Colleges: The region should encourage affiliations among independent colleges stressing high quality undergraduate education based on the liberal arts and research universities capable of providing the vast resources for state-of-the-art education in advanced subjects such as science and engineering. (Now!)

For-Profit and Proprietary Providers: To meet the expanding needs of a knowledge-driven economy requiring lifelong learning opportunities, the Midwest should recognize the strategic importance of for-profit and proprietary higher education providers who not only have the capacity to access capital markets, but have developed successful paradigms for educating adult learners. Yet it is also important that the for-profit sector be held accountable for student success and employability. (Now!)

World Universities: As a component of the Midwest’s higher education strategies, serious consideration should be given to encouraging the region’s internationally prominent research universities to explore the possibility of evolving into truly world universities, capable of accessing global economic and human capital markets. Key in this effort will be a far more strategic approach to immigration, viewing the region’s research universities as portals to attract talent from around the world.

Immigration: Immigration is vital to transforming the Midwest economy, as a source of both talent and energy and contributing to its innovation and entrepreneurship. The only immigration policy that will help the Midwest is one that opens the door as widely as possible. (Now!)

Expanding Educational Opportunities: The Midwest must recommit itself to the fundamental principles of equal opportunity and social inclusion through the actions of its leaders, the education of its citizens, and the modification of restrictive policies, if it is to enable an increasingly diverse population to compete for

prosperity and security in a intensely competitive, diverse, and knowledge-driven global economy. (Now!)

Restructuring the Higher Education Enterprise: Serious consideration should be given to reconfiguring the Midwest's educational enterprise by exploring new paradigms based on the best practices of other regions and nations. For example, the current segmentation of learning by age (e.g., primary, secondary, collegiate, graduate-professional, workplace) is increasingly irrelevant in a competitive world that requires lifelong learning to keep pace with the exponential growth in new knowledge. More experimentation both in terms of academic programs and institutional types should be encouraged. Academic institutions should be provided with greater agility—albeit accompanied by greater accountability—to adapt and evolve to address new challenges and opportunities. (Eventually)

Adopting Best Practices from Abroad: Beyond strengthening and focusing the existing education infrastructure of the region—its schools, colleges, and universities—it is clear that a changing world will demand these be augmented by new institutions addressing emerging needs. Here the experience and practice of other nations should be considered as possibilities for the Midwest, e.g., European models such as the *Gymnasias* and Sixth-form colleges used for advanced college preparation; the *Fachhochschulen* and polytechnic Institutes stressing rigorous education in the applied sciences; and the open universities used to provide broad educational opportunities for adults.

New Funding Paradigms: Alternative mechanisms for funding higher education should be explored, such as adopting a “reverse social-security” approach in which students pay for their education from future earnings, institutions align the funding of their multiple missions with key patrons, and “learn grants” from public or private sources that provide strong incentives for early learning by providing all students entering K-12 with college investment accounts. (Soon)

Innovation

Increased Investment in Innovation: The Midwest must invest additional public and private resources in

initiatives designed to stimulate R&D, innovation, and entrepreneurial activities. Key elements would include reforming state tax policy to encourage new, high-tech business development, securing sufficient venture capital, state participation in cost-sharing for federal research projects, and a far more aggressive and effective effort by the Midwestern state's Congressional delegations to attract major federal research funding to the region. (Now!)

Importance of Science and Engineering Education: The increasing dependence of the knowledge economy on science and technology, coupled with the Midwest's relatively low ranking in percentage of graduates with science and engineering degrees, motivates a strong recommendation to place a much higher priority on providing targeted funding for program and facilities support in these areas in state universities. (Now!)

Innovation Infrastructure: Providing the educational opportunities and new knowledge necessary to compete in a global, knowledge-driven economy requires an advanced infrastructure: educational and research institutions, physical infrastructure such as laboratories and cyberinfrastructure such as broadband networks, and supportive policies in areas such as tax and intellectual property. The Midwest must invest heavily to transform the current infrastructure designed for a 20th-century industrial economy into that required for a 21st-century knowledge economy. (Soon)

Research Universities and Innovation: The quality and capacity of the Midwest's learning and innovation infrastructure will be determined by the leadership of its research universities in discovering new knowledge, developing innovative applications of these discoveries that can be transferred to society, and educating those capable of working at the frontiers of knowledge and the professions. Because of the importance of research and graduate education to the region's future, these universities should be encouraged to strike an appropriate balance between these activities, while undergraduate education remains the primary mission of the Midwest's other colleges and universities. (Now!)

Engagement in Economic Development: The research universities of the Midwest, must become more strategically engaged in both regional and statewide economic development activities. Intellectual property policies should be simplified and standardized; faculty and staff should be encouraged to participate in the startup and spinoff of high-tech business; and universities should be willing to invest some of their own assets (e.g., endowment funds) in state- and region-based venture capital activities. Furthermore, universities and state governments should work more closely together to go after major high-tech opportunities in both the private and federal sectors (attracting new knowledge-based companies and federally funded R&D centers). (Soon)

A Roadmap for the Midwestern States

Enhanced College Participation: The Midwestern states must commit to increasing very substantially the participation of its citizens in higher education at all levels—community college, baccalaureate, and graduate and professional degree programs. This will require a substantial increase in the funding of higher education from both public and private sources as well as significant changes in public policy. This, in turn, will require a major effort to build adequate public awareness of the importance of higher education to the future of the state and its citizens. (Now!)

Higher Education Funding in the Top Quartile: To achieve and sustain the quality of and access to educational opportunities, the Midwest states should each set an objective to move into the top quartile in their higher education appropriations (on a per student basis). (Soon)

Market-Smart Strategies: As powerful market forces increasingly dominate public policy, the Midwest's higher-education strategy should become market-smart, investing more public resources directly in the marketplace through programs such as vouchers, need-based financial aid, and competitive research grants, while enabling public colleges and universities to compete in this market through encouraging greater flexibility and differentiation in pricing, programs, and

quality aspirations. (Soon)

Leveraging Federal and Private-Sector Investment: The Midwest should target its tax dollars more strategically to leverage both federal and private-sector investment in education and R&D. For example, a shift toward higher tuition/need-based financial aid policies in public universities not only leverages greater federal financial aid but also avoids unnecessary subsidy of high-income students. Furthermore greater state investment in university research capacity would leverage greater federal and industrial support of campus-based R&D. (Now!)

Changing State Higher Education Policies: Key to achieving the agility necessary to respond to market forces will be modernizing the policies that define the relationship between state governments and the Midwest's public colleges and universities to provide them with enhanced market agility in return for greater (and more visible) public accountability with respect to quantifiable deliverables such as graduation rates, student socioeconomic diversity, and intellectual property generated through research and transferred into the marketplace. (Now!)

A Roadmap for Colleges and Universities

World-Class Learning: Colleges and universities should aspire to achieve world-class quality, nimbleness, innovation, efficiency, and the capability of providing our citizens with the higher order intellectual skills (critical thinking, moral reasoning, an appreciation of cultural and human values, commitment to life-long learning, adaptive to change, tolerance of diversity) necessary for achieving national prosperity, security, and social well-being in a global, knowledge-driven society. (Now!)

Preparation for Unknown Futures: While colleges and universities should be responsive to the interests of students, their employers, and the nation, it is essential that they should also strive to prepare their graduates for the unknown challenges of careers and citizenship of tomorrow by providing the higher order intellectual skills necessary to cope with a future of continual yet

unpredictable change (e.g., critical thinking ability, a commitment to lifelong learning, the ability to adapt to change, and the capacity to thrive in a world of increasing diversity). (Now!)

Focused Missions, Cost Containment, and Efficiency: Colleges and universities should develop and demonstrate the ability (through the necessary changes in governance, leadership, management, and culture) to control costs, focus resources on well-defined missions, and achieve new levels of efficiency while enhancing quality and capacity. (Now!)

Assessment of Educational Objectives: It is time to challenge the academy to redefine the purpose and nature of a college education in today's (and tomorrow's) world and develop methods to assess whether these objectives are being achieved. This will require the development of more sophisticated tools to assess the achievement of the more abstract goals of a college education (e.g., critical thinking, communication skills, inductive/deductive reasoning, quantitative skills, cultural appreciation, systems thinking). (Now!)

Alliances: Colleges and universities should place far greater emphasis on building alliances that will allow them to focus on unique core competencies while joining with other institutions in both the public and private sector to address the broad and diverse needs of society in the face of today's social, economic, and technological challenges while addressing the broad and diverse needs of society. For example, research universities should work closely with regional universities and independent colleges to provide access to cutting-edge knowledge resources and programs. (Soon)

New Financial and Governance Models: Public colleges and universities need to develop new financial and governance strategies better able to adapt to declining state support and 21st century imperatives. (Eventually)

A Higher Education Roadmap for the Nation

Quality: The United States must demand and be prepared to support a world-class higher education

system, utilizing market forces shaped by incentives, public-private partnerships, and requirements for evidence-based assessment of educational effectiveness to drive all elements of postsecondary toward higher quality, efficiency, innovation, and nimbleness. (Now!)

Access: Access to higher education should receive the highest priority for public funding, whether through financial aid, state appropriations to colleges and universities, or tax policy (e.g., "tax expenditures"). Public funds should be targeted to those students with greatest need. (Now!)

Innovation: To support American innovation, the nation's colleges and universities must embrace innovation themselves, by developing new learning pedagogies, academic paradigms, and educational forms that are more responsive to national priorities. This will require a very substantial increase in the support of research and development associated with learning and education by the federal government and higher education institutions. (Soon)

Research and Graduate Education: The erosion of state and private sector support of higher education in recent years makes it apparent that it is time for the federal government should assume the lead responsibility for sustaining the capacity of America's research universities to conduct world-class research and graduate education. (Soon)

Coordination: Coordination among the various components of the nation's educational enterprise, including K-12, higher education, workplace training, and lifelong learning—should be strongly encouraged and supported at all levels—national, regional, state, and institutional. (Now!)

Public Purpose: Higher education must take decisive action to address current concerns about quality, efficiency, capacity, and accountability if it is to earn the necessary level of public trust and confidence to enable it to pursue its public purpose. (Now!)

Appendix B

An Example of Regional Cooperation A Midwest Cluster of Energy Innovation Hubs

America needs to transform its energy system and the Great Lakes region possesses many of the needed innovation assets. For that reason, the federal government should leverage a troubled region's research and engineering strengths in support of the national interest through the launch of a region-wide network of collaborative, high-intensity energy innovation research centers called *energy discovery-innovation institutes* (e-DIIs).

Such an initiative would respond as much to America's need to transform its energy system as to the need to revitalize the industrial Midwest.

Currently, U.S. energy innovation efforts remain insufficient to ensure the development and deployment of clean energy technologies and processes. On the one hand, such deployment is impeded by multiple market problems—ranging from relatively low energy prices and information and regulatory uncertainties to the reality of innovation spillovers—that lead private firms to under-invest and focus on short-term, low-risk research and product development. On the other, federal energy efforts—let alone state and local ones—remain at once too small and too poorly organized to deliver the needed breakthroughs, with too much of the nation's exploration conducted in “siloed” labs that remain too far removed from the marketplace and its need for translational, “use inspired” research.

And so the federal government should systematically accelerate national clean energy innovation by launching in the Great Lakes region a series of “themed” e-DIIs strategically situated to draw on the Midwest's rich complex strong public universities, national and corporate research labs, top-flight science and engineering talent. Organized around existing capacities in a hub-spoke structure designed to link fundamental science with innovation and commercialization, these

institutes would engage universities, industries, and labs to work on individual issues to rapidly deploy new technologies to the marketplace. Along the way they might well begin to transform a struggling region's ailing metropolitan economies. Roughly six compelling e-DIIs could reasonably be organized across the Great Lakes states with total annual funding between \$1 and \$2 billion.

Introduction

America needs to transform its energy system in order to create a more competitive “next economy” that is at once export-oriented, lower-carbon, and innovation-driven.

The Great Lakes region possesses what may be the nation's richest complex of innovation assets: renowned public universities, national and corporate research labs, top-flight science and engineering talent.

Is there an exchange to be done? Might these facts—both the nation's needs and a struggling region's assets—be brought together in a transformative intervention in the Great Lakes region?

This brief contends that yes, there is a partnership to be forged, and so proposes that the federal government launch in the auto industry-dependent communities of the Great Lakes a distributed network of federally-funded, commercialization-oriented energy discovery-innovation institutes (e-DIIs) to lead a transformation of the Great Lakes area's—and the nation's—industries and regional economies based upon sustainable energy technologies.

In the spirit of the earlier land-grant university paradigm, this network would involve the region's research universities and national labs and engage strong par-

ticipation by industry, entrepreneurs, and investors as well as state and local government. In this vein, each e-DII would have a different theme, though all would conduct the intense, focused translational research necessary to move fundamental scientific discoveries to the commercialization and deployment of new energy technologies.

As to the impact, it could be transformational. If built out, the unprecedented scale of the university-industry-government partnerships that would emerge from this Great Lakes network of e-DIIs would represent a powerful force for solving the nation's energy crises while also re-invigorating a flagging regional economy through innovation. At a minimum, populating auto country with an array of breakthrough-seeking, high-intensity research institutes would stage a useful experiment in linking national leadership and local capacities to lead the nation and a region toward a more prosperous future.

The Great Lakes Energy System: Predicaments and Possibilities

The Great Lakes region lies at the center of the nation's industrial and energy system trials and possibilities. No region has suffered more from the struggles of America's manufacturing sectors and faltering auto industry, as indicates a new paper from the Metropolitan Policy Program at Brookings entitled "The Next Economy: Rebuilding Auto Communities and Older Industrial Metros in the Great Lakes Region."

Likewise, and relatedly, the region lies at Ground Zero of the nation's need to "green" U.S. industry to boost national economic competitiveness, tackle climate change, and improve energy security. Heavy in the manufacturing of metals, chemicals, glass, and automobiles as well as petroleum refining, the Great Lakes states account for nearly one-third of all U.S. industrial carbon emissions.

And yet, for all that, the Great Lakes region possesses significant assets and capacities necessary to the nation and promising for its own renewal as the "next economy" comes into view. Engines and laboratories of the American economy of the 20th century, the manufacturing communities of the Midwest have the strong educational and medical institutions, advanced manu-

facturing prowess, skills base, and other assets that will be essential to helping the nation move toward, and successfully compete in, the export-oriented, lower-carbon, innovation-fueled economy of tomorrow.

Most notably, the Great Lakes region offers the nation an impressive array of the innovation-related strengths in the energy field that will be necessary to generate the technological breakthroughs that will be necessary to decarbonize the nation's economy in the coming decades. Among many others these capacities and assets include:

- ***Recognized leadership in R&D.*** The Great Lakes accounts for 33 percent of all academic and 30 percent of all industry R&D performed in the U.S.
- ***Strength and specialization in energy, science and engineering.*** The Department of Energy (DOE) sent 26 percent of its federal R&D obligations to the Great Lakes states in FY 2006 and is the second largest federal funder of industrial R&D in the region. Similarly, the National Science Foundation (NSF) sent 30 percent of its R&D obligations there and is the second largest federal funder of the region's academic R&D.
- ***Existing clean energy research investments and assets.*** In biofuels, the University of Illinois is key research partner in the BP-funded, \$500 million Energy Biosciences Institute that aims to prototype new plants for alternative fuel sources. In solar pursuits, Toledo already boasts a growing regional industry cluster; Dow Corning's facilities in Michigan produce leading silicon and silicone-based technology innovation; and the Solar Energy Laboratory at the University of Wisconsin-Madison, the oldest of its kind in the world, boast significant proficiency in developing practical uses for solar energy. In nuclear, finally, the region is home to the largest U.S. nuclear utility (Exelon), the nation's largest concentration of nuclear plants, and some of the country's leading university programs in nuclear engineering.
- ***Industry potential relevant to clean energy.*** Given their existing technological specializations, Mid-

western industries have the potential to excel in the research and manufacture of sophisticated components required for clean energy, such as those in advanced nuclear technologies, precision wind turbines, and complex photovoltaics.

- ***Breadth in energy innovation endeavors and resources.*** In addition to universities and industry, the Great Lakes possesses numerous research specializations of great relevance to national energy challenges, including work on energy storage systems and fuel and engine efficiency taking place at Argonne National Laboratory (ANL); research in high energy physics at the Fermi National Accelerator Laboratory; and the work on bioenergy feedstocks, processing technologies, and fuels occurring at the DOE-funded Great Lakes BioEnergy Research Center (GLBRC)
- ***Regional culture of collaboration.*** Finally, the universities of the Great Lakes have a strong history of collaboration both among themselves and with industry given their origins in the federal land grant compact of market and social engagement. GLBRC—one of the nation’s three competitively awarded DOE Bioenergy Centers—epitomizes the region’s ability to purposefully align academia, industry, and government around one mission. Another example is the NSF-supported Blue Waters Project, a partnership between IBM and the universities and research institutions in the Great Lakes Consortium for Petascale Computation to build the world’s fastest computer for scientific work—a critical tool for advancing smart energy grids and transportation systems.

In short, the Great Lakes states and metropolitan areas—economically troubled and carbon-reliant as they are—nevertheless hold out capabilities that could contribute to their own transformation and that of the nation...if the right policies and investments are put in place.

Remaking America’s Energy System Within a Federal Policy Framework

America as a whole, meanwhile, needs to transform its energy system. Massive sustainability and security challenges plague the nation’s energy production and delivery system. Transformational innovation and commercialization will be required to address these challenges and accelerate the process of reducing the economy’s carbon intensity.

And yet, a welter of market problems is currently impeding decarbonization and limiting the innovation needed to achieve it.

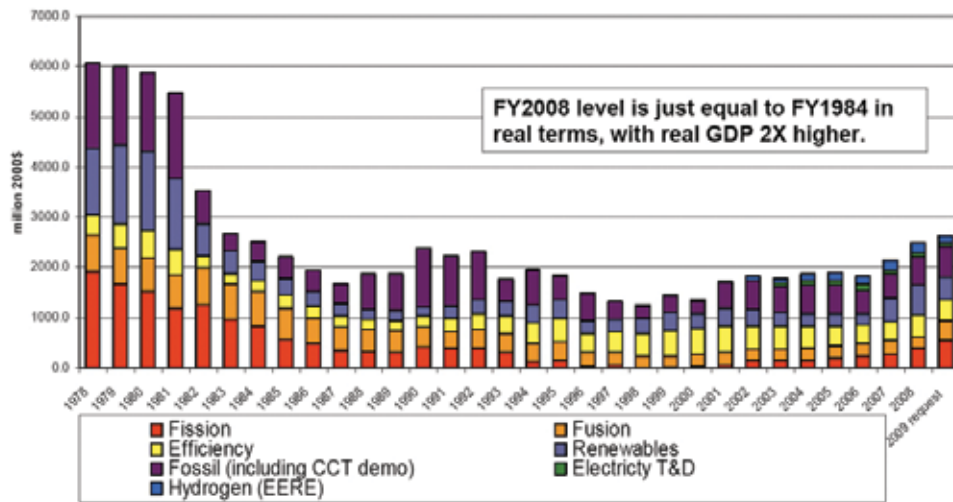
First, energy prices have generally remained too low to provide incentives for companies to commit to clean and efficient energy technologies and processes over the long haul. Second, many of the benefits of long-range innovative activity accrue to parties other than those who make investments so individual firms will tend to under-invest and focus on short-term, low-risk research and product development. Third, uncertainty and lack of information about relevant market and policy conditions and the potential benefits of new energy technologies and processes may be further delaying innovation. Fourth, the benefits of regional industry clustering, which include facilitating technology innovation, have yet to be fully realized for next-generation energy enterprises, which are often isolated in secure laboratory settings. And then, finally, state and local governments—burdened with budgetary pressures—are not likely to be able to fill outstanding gaps in energy innovation investment any time soon.

As a result, the research intensity—and so the innovation intensity—of the energy sector remains woefully insufficient. Currently, for example, the energy sector devotes no more than 0.3 percent of its revenues to R&D. Such a figure lags far behind the 2.0 percent of sales committed to federal and large industrial R&D by the health care sector, the 2.4 percent by agriculture, and the 10 percent by information technology and pharmaceutical industries.

As to the national government’s efforts to respond to the nation’s energy research shortfalls, those remain equally inadequate. Clearly, the federal government has a critical role to play in accelerating the development of new energy technologies given the compelling

US federal energy-technology RD&D, 1978-2009

U.S. DOE Energy RD&D Spending
FY1978-FY2009 Request



Kelly Gallagher, Harvard U, 2-14-08

Federal energy R&D has dropped to insignificant levels (\$3 B/y compared to \$84 B/y for DOD, \$32 B/y for NIH, and \$12 B/y for NASA). Industrial energy R&D is less than 0.25% of revenues!

need for decarbonization of the U.S. economy and the various market failures impeding it. Unfortunately, current efforts fall short of adapting to and meeting 21st century energy needs and realities. Three major problems loom:

The scale of federal energy research funding is insufficient. To begin with, the current federal appropriation of around \$3 billion a year for non-defense energy-related R&D simply remains too small. Such a figure remain well below the \$8 billion (in real 2008 dollars) recorded in 1980, and in fact represents less than a quarter of the 1980 investment level when measured as share of national GDP. If the federal government were to prioritize next-generation energy as much as advances in health care, national defense, or space exploration, the level of investment would be much larger in the neighborhood of \$20 to \$30 billion a year.

Nor do the nation's most recent new efforts to catalyze energy innovation appear sufficient to fill the gap. To be sure, the American Recovery and Reinvestment Act (ARRA) provided nearly \$13 billion for DOE in-

vestments in advanced technology research and innovation—out of which Great Lakes states are slated to receive some 42 percent of all award funds announced to date from the fossil energy R&D program and 39 percent from the Office of Science, a basic research agency widely regarded as critical for the nation's energy future. However, ARRA was a one-time injection that cannot be counted on sustain federal energy R&D at the necessary level into the future.

Relatedly, the region has done well in tapping into two other relatively recent DOE programs: the Advanced Research Projects Agency–Energy (ARPA-E) and Energy Frontier Research Centers (EFRCs). Currently, Great Lakes states account for 44 and 50 percent of ARPA-E and EFRC announced funding, for work on algae harvesting, advanced high-capacity batteries, and solar energy conversion. Yet, with the former program singularly focused on individual signature projects and the latter on basic research, neither initiative alone has the scope to fully engage all regional innovation assets to accelerate the nation's transition to a clean, sustainable energy infrastructure.

The character and format of federal energy R&D remain inadequate. Beyond their scale, though, the character of U.S. energy innovation activities also remains inadequate. In this respect, the DOE national laboratories—which anchor the nation’s present energy research efforts—remain poorly utilized resources. With so many of their activities kept isolated from the private sector and fragmented, the labs are, by in large, too removed from market, legal, and social realities to successfully develop and deploy cost-competitive, multi-disciplinary new energy technologies that are easily adopted on a large-scale.

For example, DOE activities continue to be focused largely on discrete fuel sources (e.g., coal, oil, gas, nuclear) rather than the fully integrated end-use approaches needed to realize affordable, reliable, sustainable energy. Siloed approaches simply do not work well when it comes to tackling the complexity of the nation’s real-world energy challenges. A perfect example of a complicated energy problem requiring an integrated end-use approach is transportation. Moving the nation’s transportation industry toward a clean energy infrastructure is a transition that is going to require a multi-pronged, full-systems approach that depends not only upon R&D in technologies such as alternative propulsion technologies (biofuels, hydrogen, electrification) and vehicle design (power trains, robust materials, advanced computer controls) but also on far broader technology development, including in primary energy sources, electricity generation and transmission, and energy efficient applications that in the end will determine the economic viability of this important industry. Siloed research won’t work; new research and commercialization paradigms are imperative.

Federal programming fails to fully realize regional potential. Related to the structural problems of U.S. energy innovation efforts, finally, is a failure to fully tap or leverage critical preexisting assets within regions that could serve to accelerate technology development and deployment. In the Great Lakes, for example, current federal policy—to the detriment of the national interest—does little to tie together the billions of dollars of science and engineering R&D conducted annually by the region’s academic institutions; all of the available

private- and public-sector clean energy activities and financing; abundant natural resources in wind and biomass; and the region’s wealth of robust, pre-existing industrial platforms for research, next-generation manufacturing, and technology adoption and deployment. In this region and elsewhere, federal policy has yet to play a substantial role in connecting researchers at different organizations, breaking down stovepipes between research and industry, bridging the commercialization “valley of death,” and in establishing mechanisms that incent and reward quickly and smoothly bringing federally-sponsored R&D to the marketplace.

In sum, America needs to remake its energy system but lacks the federal innovation investments, institutions, and policy frameworks needed to do it.

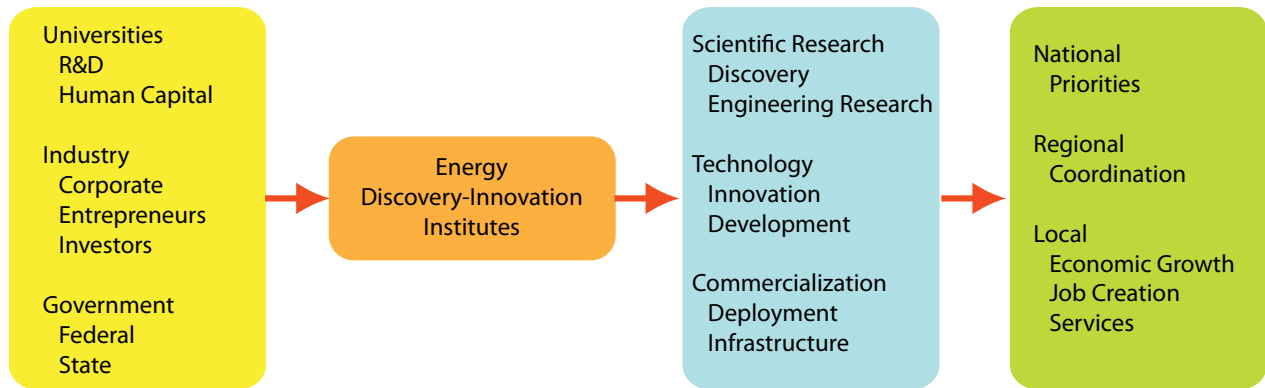
A New Approach to Regional Energy Research and Innovation

And so the federal government should systematically accelerate national clean energy innovation by launching a series of regionally-based Great Lakes energy research centers organized in a hub-spoke structure to link fundamental scientific discoveries with technological innovation and commercialization. Originally introduced in the Brookings policy proposal, “Energy Discovery-Innovation Institutes: A Step Toward America’s Energy Sustainability,” a nationwide network of these *energy discovery-innovation institutes*—or e-DIIs—would join-up universities, labs, and industry to conduct translational energy R&D that at once addresses national sustainability priorities, while also stimulating local regional economies.

In the Great Lakes, specifically, a federal attack to “flood the zone” with a series of roughly six of these high-powered, market-focused e-DIIs could strategically situate institutes across the region so they reach critical mass through their number, size, variety, linkages, and orientation to the pre-existing work of the regional research complex and regional industry clusters.

As envisioned here, the e-DIIs network would do the following:

Organize individual e-DIIs around themes largely determined by the private market. According to local



The National Academy of Engineering has recommended a new research paradigm, the discovery-innovation institutes, to link basic research with technological innovation.

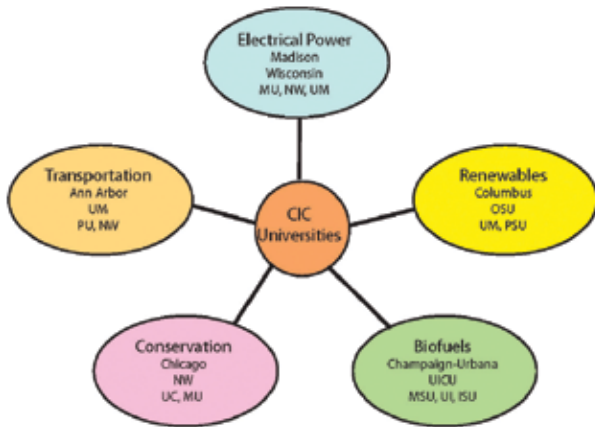
industry research priorities, university capabilities, and the market and commercialization dynamics of various technologies, each Great Lakes e-DII would undertake a different focus, such as renewable energy technologies, biofuels, transportation energy, carbon-free electrical power generation and distribution, and energy efficiency

Foster multidisciplinary and collaborative research partnerships. E-DIIs would better align the nonlinear flow of knowledge and activity across science and non-science disciplines and among companies, entrepreneurs, commercialization specialists, and investors as well as government agencies (federal, state, and local) and research universities. For example, a southeastern Michigan collaboration between University of Michigan, Michigan State, University of Wisconsin and Ford, GM, and Dow could address the development of sustainable transportation technologies. A Chicago partnership between Northwestern and Purdue Universities, the University of Chicago, the University of Illinois, Argonne National Lab and Exelon and Boeing could focus on sustainable electricity generation and distribution. A Columbus group including Ohio State University and Battelle Memorial Institute could address technologies for energy efficiency technologies. In these and other e-DII examples, regional industry representatives would be involved from the earliest stages to define the needs that research should address so that technology advances are relevant and any ensuing commercialization process is as successful as possible

Serve as a distributed “hub-spoke” network linking together campus-based, industry-based, and federal laboratory-based scientists and engineers. The e-DII “hubs” would interact with other R&D programs, centers, and facilities (the “spokes”) through exchanges of participants, regularly scheduled meetings, and advanced information and communications technology to limit unnecessary duplication of efforts and cumbersome management bureaucracy and enhance the coordinated pursuit of larger national goals

Develop and rapidly deploy highly innovation technologies to the market. Rather than aim for revenue maximization, technology transfer in the e-DIIs would be structured to maximize the volume, speed, and positive societal impact of commercialization. As much as possible, the e-DIIs would work out in advance patenting and licensing rights and other intellectual property issues to facilitate fast and appropriate pathways to market. For example, an individual e-DII, might choose to create a standardized template for commercializing lab innovations

Stimulate regional economic development. Like academic medical centers and agricultural experiment stations—both of which combine research, education, and professional practice—e-DIIs could facilitate cross-sector knowledge spillovers, innovation exchange, and prodigate technology transfer to support clusters of start-up firms, private research organizations, suppliers, and other complementary groups and businesses—the true regional seedbeds of greater economic produc-



A possible cluster of energy innovation hubs managed by the CIC universities.

tivity, competitiveness, and job creation

Build the knowledge base necessary to address the nation's energy challenges. The e-DIIs would collaborate with K-12 schools, community colleges, regional universities, and workplace training initiatives to educate future scientists, engineers, innovators, and entrepreneurs and motivate the region's graduating students to contribute to the Great Lakes emerging green economy

Complement efforts at universities and across the DOE innovation infrastructure but be organizationally and managerially separate from either group. E-DIIs would look beyond the pure basic science research at universities to focus much more on commercialization and deployment issues. Further, rather than duplicate the national labs' capacity for large-scale, infrastructure-intensive projects, e-DIIs would utilize a different, collaborative translational research paradigm. And within DOE, e-DII's would occupy a special niche for bottom-up translational research in a suite of new, largely top-down innovation-oriented programs that aim to advance fundamental science (EFRCs), bring energy R&D to scale (Energy Innovation Hubs), and find ways to break the cost barriers of new technology (ARPA-E).

To establish and build out the institute network across the Great Lakes region, meanwhile, the new re-

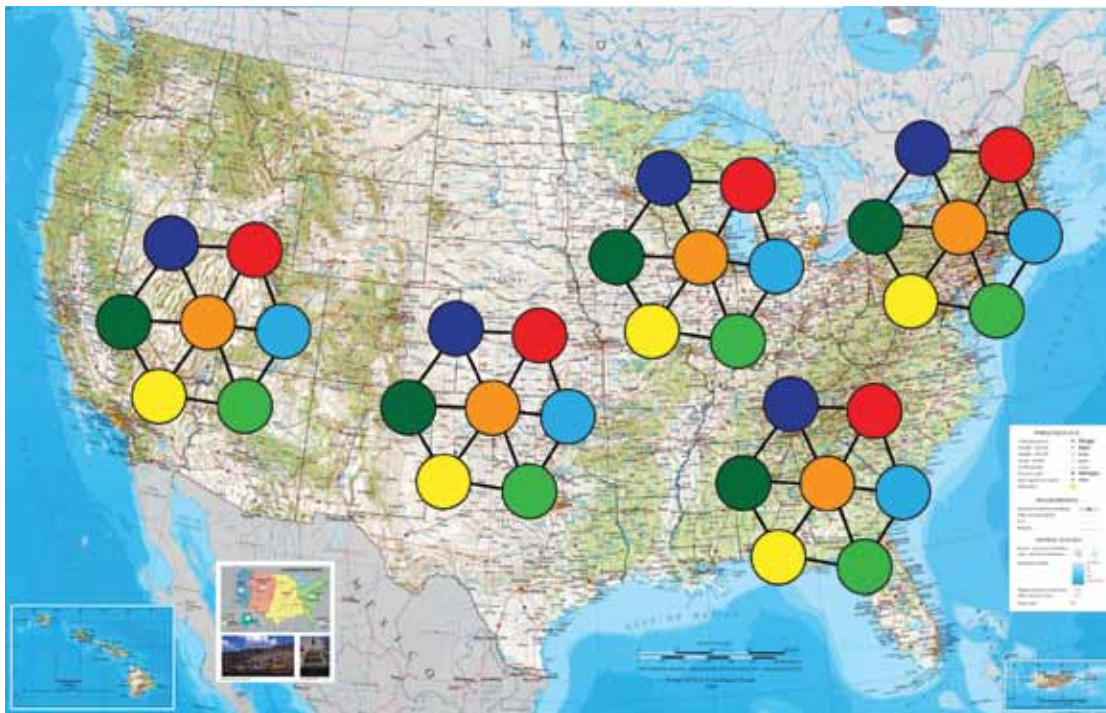
gional energy initiative would:

Utilize a tiered organization and management structure. Each e-DII would have a strong external advisory board representing the participating partners, including all levels of government, industry, universities, nonprofits, entrepreneurs, and investors. In some cases, partners might play direct management roles with executive authority

Adopt a competitive award process with specific selection criteria. A competitive award process would designate e-DIIs for federal support and inclusion in the Great Lakes network. Proposals would be evaluated by an interagency panel and subject to rigorous peer review according to criteria primarily involving scientific merit and capability. Additionally, other selection criteria would consider the commitments of various partners participating in the e-DII; strength of the e-DII management plan; strategies for commercialization, including approaches to tech transfer and intellectual property issues; plans for connecting the proposed e-DII to the surrounding regional industry cluster and the regional e-DII network

Receive as much federal funding as major DOE labs outside the Great Lakes region. Given the massive responsibilities of the proposed Great Lakes e-DIIs, total federal funding for the whole network should be comparable to that of comprehensive DOE labs, such as Los Alamos, Lawrence Livermore, Oak Ridge, Idaho, and Sandia—each of which have FY2010 budgets between \$1 billion and \$2 billion. Additional investment in the Great Lakes e-DIIs network would come from state governments, business and industry, and other investors. One can imagine around six compelling institutes based on the credible industry-university concentrations

The bottom line: The new push would take a bold new approach to both the magnitude and character of national energy research.



A Great Lakes cluster of energy innovation hubs could prototype the broader National Energy Research Network by the Brookings Institution as a 21st century analog to the Land-Grant Acts.

Conclusion

In conclusion, America's national energy infrastructure—based primarily upon fossil fuels—must be updated and replaced with new technologies. At the same time, few regions in the nation are better equipped to deliver the necessary innovations than the troubled Great Lakes area.

For which reason, a resilient nation should move aggressively to build the proposed Great Lakes network of energy discovery-innovation institutes.

Through such an intervention the federal government could catalyze a dynamic new partnership of Midwestern businesses, research universities, federal laboratories, entrepreneurs, and state and local government to transform the nation's carbon-dependent economy. Along the way, the nation could experiment with a dynamic new approach to leveraging for the nation's benefit a powerful regional innovation complex while renewing the flagging manufacturing economy of the Great Lakes.

References

- Adelman, Clifford. *The Bologna Process for U.S. Eyes: Re-learning Higher Education in the Age of Convergence*. San Jose, CA: Institute for Higher Education Policy, 2009.
- Atkins, Daniel E. (chair). *Revolutionizing Science and Engineering Through Cyberinfrastructure*. Report of the National Science Foundation Blue-Ribbon Advisory Panel on Cyberinfrastructure. Washington, DC: National Science Foundation, 2003.
- Atkins, Daniel E., John Seely Brown and Allen L Hammond. *External Review of the Hewlett Foundation's Open Educational Resources (OER) Program: Achievements, Challenges, and Opportunities*. Menlo Park, CA: Hewlett Foundation, February, 2007.
- Augustine, Norman (chair). *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. National Academies Committee on Prospering in the Global Economy of the 21st Century. Washington, DC: National Academies Press, 2005.
- Bement, Arden L. "Cyberinfrastructure: The Second Revolution", *The Chronicle of Higher Education*, January, 2007.
- Bok, Derek. *Our Underachieving Colleges*. Princeton, NJ: Princeton University Press, 2006.
- Boulos, Michael. "Bill Gates and a Prescription for Breneman, David. "Peering Around the Bend: The Leadership Challenges of Privatization, Accountability, and Market-Based State Policy". *Association of Governing Boards*, Washington, DC, 2005.
- Breneman, David. *Are the States and Public Higher Education Striking a New Bargain? Public Policy Paper Series*. Washington, DC: Association of Governing Boards and Colleges, 2005.
- Brown, John Seely. "Minds on Fire", *Educause*, January/February 2009.
- Brown, John Seely and Paul Duguid. *The Social Life of Information*. Cambridge, MA: Harvard Business School Press, 2000.
- Brownstein, Ronald. "The Generational Mismatch", *National Journal*, July, 2010.
- Christensen, Clayton M. *The Innovator's Dilemma*. Cambridge, MA: Harvard Business School Press, 1997.
- Chronicle of Higher Education. "State Appropriations for Higher Education". *Chronicle of Higher Education*, January 11, 2008.
- Drucker, Peter. "A Better Way to Pay for College". *Wall Street Journal*, A14, May 9, 1991.
- Drucker, Peter. "Beyond the Information Revolution". *Atlantic Monthly*, 284:4, October, 1999.
- Duderstadt, James J., Daniel E. Atkins and Douglas Van Houweling. *Higher Education Faces the Digital Age: Technology Issues and Strategies for American Colleges and Universities*. Washington, DC: American Council on Education, 2002.
- Duderstadt, James J. (chair). *Preparing for the Revolution: Information Technology and the Future of the University*. Washington, DC: National Academies Press, 2003.
<http://www.nap.edu>
- Duderstadt, James J., William A. Wulf, and Robert Zemsky. "Envisioning a Transformed University", *Issues in Science and Technology*, 22(1), 35-41, Washington, DC: National Academy Press, 2005.
- Duderstadt, James J. *A Case Study in University Transformation: Positioning the University of Michigan for the New Millennium* (Ann Arbor: University of Michigan, Millennium Project, 1999), <http://milproj.dc.umich.edu/publications/strategy>.
- Duderstadt, James J. *A University for the 21st Century*. Ann Arbor, MI: University of Michigan Press, 2001.
- Duderstadt, James J. and Farris W. Womack. *The Future*

- of the Public University in America: Beyond the Crossroads*. Baltimore, MD: Johns Hopkins University Press, 2002.
- Duderstadt, James J. *The View from the Helm: Leading the American University During an Era of Change*. Ann Arbor, MI: University of Michigan Press, 2007.
- Duderstadt, James J., "Aligning American Higher Education with a Twenty-first-century Public Agenda". *Higher Education in Europe*, Vol 34, No. 3-4, 2009.
- The Economist*. "The Brains Business: A Survey of Higher Education". *The Economist*, September 10, 2005.
- The Economist*. "The Search for Talent: The World's Most Valuable Commodity Is Getting Harder to Find". *The Economist*, October 2006.
- The Economist*. "Now for the Reckoning—Corporate America's Legacy Costs". *The Economist*, October 15, 2005.
- The Economist*. "Special Report: Blacks in America". *The Economist*, August 6, 2005.
- The Economist*. "Detroitosaurus Wrecks: The lessons for America and the car industry from the biggest industrial collapse ever". *The Economist*, June 4, 2009.
- The Economist*. "A Ponzi scheme that works". *The Economist*, December 19, 2009.
- Finley, Nolan. "Attitude May Make Michigan the New Mississippi". *Detroit News*, May 1, 2005.
See also Finley, Nolan. *Detroit News*, December 9, 2007.
- Frey, William H, "Five Myths about the 2010 Census and the U.S. Population", Brookings Institute Report, 2010.
- Friedman, Thomas. *The World Is Flat: A Brief History of the 21st Century*. New York, NY: Farrar, Strauss, and Giroux, 2005.
- Garcia, M.L. and O.H. Bray. *Fundamentals of Technology Roadmapping*. Albuquerque, NM: Sandia National Laboratory, 1997.
- Glazer, Louis. *A New Agenda for Michigan*. Ann Arbor, MI: Michigan Future, 2007.
<http://www.michiganfuture.org>
- Glazer, Louis and Donald Grimes. *Michigan's Transition to a Knowledge-Based Economy, Annual Progress Reports, 2008, 2009, 2010*. Ann Arbor, MI: Michigan Future, Inc., 2010.
- Gratz v. Bollinger*, Docket 02–516, 539 U.S. 244 (2003), Decision: June 23, 2003; *Grutter v. Bollinger*, Docket 02–241, 539 U.S. 306 (2003), Decision: June 23, 2003
- Harpers Magazine, 1887.
- Haycock, Kati and Danette Gerald. *Engines of Inequality*. Washington, DC: Education Trust, 2008.
- Haycock, Kati. *Opportunity Adrift*. Washington, DC: Education Trust, 2010.
- Ito, M., *Hanging Out, Messing Around, and Geeking Out: Kids Living and Learning With New Media*. Cambridge: MIT Press, 2009.
- ITS. "Trends in College Spending (ITS) On-Line". Delta Project on Postsecondary Education Costs, Productivity, and Accountability, 2010.
- Kane, Thomas J. and Peter R. Orzag. "Funding Restrictions at Public Universities: Effects and Policy Implications" (working paper, Brookings Institution, Washington, DC, September 2003).
- Kelly, Kevin. "Scan This Book!". *New York Times Sunday Magazine*, May 14, 2006.
- Kerr, Clark. *The Gold and the Blue: A Personal Memoir of the University of California, 1949-1967*. Volume One: Academic Triumphs. Berkeley, CA: University of California Press, pp. 172-190, 2001.
- Krug, Edward A., ed., *Charles W. Eliot and Popular Education*, Classics in Education, vol. 8 (New York: Teachers College, Columbia University, 1961).
- Kuhn, Thomas S. *The Structure of Scientific Revolutions*. Chicago, IL: University of Chicago Press, 1963.
- Kurzweil, Ray. *The Age of Spiritual Machines: When Computers Exceed Human Intelligence*. New York, NY: Viking, 1999.
- Kurzweil, Ray. *The Singularity Is Near: When Humans Transcend Biology*. New York, NY: Viking Penguin, 2005.
- Lingenfelter, Paul E. "The Firing of Henry Philip Tappan, University Builder" (master's thesis, University of Michigan, 1970) Longworth, Richard C. *Caught in the Middle: America's Heartland in the Age of Globalization*. New York, NY: Bloomsbury, 2008.
- Lohmann, Susanne. Meeting of the National Academics IT Forum with the Provosts of the Association of American Universities, Beckman Center, Irvine, CA, September 9, 2003. McPherson, Peter. *Assuring That Public Research Universities Remain Vital*. Washington: Association of Public and Land-Grant Universities, 2010.
- Miller, Charles (chair). *A Test of Leadership: Charting the*

- Future of U.S. Higher Education*. National Commission on the Future of Higher Education in America ("The Spellings Commission"). Washington, DC: Department of Education, 2006.
- Moe, Michael. *The Knowledge Web: People Power— Fuel for the New Economy*. New York, NY: Merrill-Lynch, 2000.
- National Intelligence Council. *Mapping the Global Future, Project 2020*. Washington, DC: Government Printing Office, 2004.
- National Park Service. "Greenfield Village and Henry Newman, Frank, Lara Couturier, and Jamie Scurry. *The Future of Higher Education: Rhetoric, Reality, and the Risks of Market*. San Francisco, CA: Jossey-Bass Publishers, 2004.
- New York Times Editorial, "Keeping the Public Colleges Afloat". New York Times, 2004.
- Newman, John Henry. *The Idea of a University* (New Haven, CT: Yale University Press, 1996; 1st ed., New York: Longman, Green, 1899)
- Northwest Ordinance, Article 3., printed in F. N. Thorpe, ed. *The Federal and State Constitutions, Colonial Charters, and Other Organic Laws*. Washington, DC: U.S. Government Printing Office, pp. 957, 1909.
- NRC, Committee on Developments in the Science of Learning. *How People Learn: Brain, Mind, Experience, and School*. National Research Council. Washington, DC: National Academy Press, 2000.
- NRC. *The Impact of Academic Research on Industrial Performance*. National Research Council. Washington, D.C.: National Academies Press, 2003.
- Palmisano, Samuel J. "The Globally Integrated Enterprise". *Foreign Affairs*, May/June 2006.
- Peckham, Howard H. *The Making of the University of Michigan 1817–1992*, ed. and updated by Margaret L. Steneck and Nicholas H. Steneck (Ann Arbor: University of Michigan Bentley Historical Library, 1994)
- Pensky, Marc. "Digital Natives, Digital Immigrants". NCB University Press, 9 (5), 2001.
- Prahalad, C.K. and Gary Hamel. *Competing for the Future*. Cambridge, MA: Harvard Business School Press, 1994.
- Price, Richard Rees. "The University of Michigan: Its Origin and Development," *Harvard Bulletin in Education* 3 (January 1923) Raschke, Carl A. *The Digital Revolution and the Coming of the Postmodern University*. New York, NY: Routledge Falmer, 2003.
- Reed, Dan. "Computing for the Future: Release 2016". Chapel Hill, NC: Renaissance Computing Institute, 2006.
- Rhodes, Frank H. T. *The Creation of the Future: The Role of the American University*. Ithaca, NY: Cornell University Press, pp. 137-39, 2001.
- Rhodes is the former president of the first of the nation's truly public-private hybrids, Cornell University.
- Rudolph, Frederick. *The American College and University: A History* (Athens: University of Georgia Press, 1962)
- SHEEO. *State Higher Education Finance*. Washington, DC: State Higher Education Executive Officers, 2010.
- Thomas, Douglas and John S. Brown, *A New Culture of Learning*. San Francisco: Douglas-Brown, 2010.
- Tappan, Henry Philip. *University Education* (New York: George P. Putnam, 1851) Vest, Charles M. *Clark Kerr Lectures, The University of California, Berkeley*. Berkeley, CA: University of California Press, 2005.
- Weber, Luc and James J. Duderstadt, eds. *The Globalization of Higher Education*, VI Glion Colloquium. Paris: Economica, 2007.
- Weber, Luc and James J. Duderstadt, eds. *Innovation and University Research*, VII Glion Colloquium. Paris: Economica, 2009.
- Wiley, John. *Forward Thinking: The University and Wisconsin's Economic Recovery*. Chancellor's Report. Madison, WI: University of Wisconsin, 2003.
- Wulf, William A. "Warning: Information Technology Will Transform the University," *Issues in Science and Technology*, pp. 46-52, Summer 1995.
- Zemsky, Robert, William Massey and Gregory Wegner. *Remaking the American University: Market-Smart and Mission Centered*. New York, NY: 2005.
- Zemsky, Robert. *Making Reform Work: The Case for Transforming American Higher Education*. Rutgers, NJ: University of Rutgers Press, 2009.
- See also Robert Zemsky, "Will Higher Education Ever Change as it Should?". *Chronicle of Higher Education Commentary*, August 3, 2009.