

A New American University Reader: Selected Writings On University Design And Related Topics

**Michael M. Crow, President, Arizona State University
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About this volume

As we approach the tenth anniversary of the initiation of the design process that led to the reconceptualization of Arizona State University as the foundational model for what I term the New American University, I have assembled some relevant writings about our progress to date. This reader includes my recent publications on ASU, the design of knowledge enterprises, and a number of related topics in addition to news coverage of ASU's transformation. The New American University (<http://newamericanuniversity.asu.edu>) represents a new model for the American research university, an institution that combines the highest levels of academic excellence, inclusiveness to a broad demographic, and maximum societal impact. Most of the articles and book chapters in this volume focus on the transformation of ASU as a case study for the operationalization of the New American University model.

This journey of transformation represents the successful effort of the administration and our academic community to accelerate a process of institutional evolution that might otherwise have taken more than a quarter-century, compressing it into a single decade (2002–2012). The task has been particularly challenging because ASU is our nation's youngest major research institution, and with an enrollment approaching 70,000 undergraduate, graduate, and professional students, the largest American university governed by a single administration. During this first phase of its reconceptualization, ASU crossed a threshold to join the ranks of competitive global knowledge enterprises possessing the capacity to advance on any challenge that confronts our nation through discovery, innovation, and creativity. Throughout we remain committed to our pledge to offer access to a world-class education to all qualified Arizona students.

Within this context, my analysis in these publications considers the evolution of the American research university, offering historical perspective on its emergence as well as the inherent limitations of the current model. Interrelated concerns include the need for our academic institutions to foster teaching and research focused on the grand challenges, spur innovation to maintain the economic competitiveness of our nation, and advance transdisciplinary knowledge to encourage sustainable development. Throughout one will find discussion regarding my concern with the design of knowledge enterprises, academic enterprise, science and technology policy, and the practice and theory of public policy.

The volume concludes with some articles about the emergence of ASU to national and international prominence. *Newsweek* termed ASU's experiment "one of the most radical redesigns in higher learning since the modern research university took shape in nineteenth-century Germany" (August 9, 2008). An editorial from the journal *Nature* observed that questions about the future of the contemporary research university are being examined "nowhere more searchingly than at Arizona State University" (April 26, 2007). Accordingly, we invite scrutiny and encourage critique as we look forward to the next phase of the process.



Michael M. Crow
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Writings on the New American University by Michael M. Crow

- "Differentiating America's Colleges and Universities: Institutional Innovation in Arizona." *Change: The Magazine of Higher Learning* (September/October 2010): 34–39.
- "Toward Institutional Innovation in America's Colleges and Universities." *Trusteeship* (Association of Governing Boards of Colleges and Universities) 18, no. 3 (May/June 2010): 8–13.
- "The Research University as Comprehensive Knowledge Enterprise: A Prototype for a New American University." In *University Research for Innovation*. Edited by Luc E. Weber and James D. Duderstadt, 211–225. Glion Colloquium, no. 6. London: Economica, 2010.
- "Beyond the 'New Normal' in American Higher Education: Toward Perpetual Innovation." In *Smart Leadership for Higher Education in Difficult Times*. Edited by David W. Breneman and Paul J. Yakoboski, 50–69. TIAA-CREF Institute Series on Higher Education. Cheltenham, UK: Edward Elgar, 2011.
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- "Sustainability: An Organizing Principle for Colleges and Universities." *University Business* 10, no. 6 (June 2007): S8–10.
- "Sustainability: A New Organizing Principle." *Sustainability for Arizona: The Issue of our Age*. Phoenix: Morrison Institute for Public Policy, November 2007: 78–81.
- "Organizing Teaching and Research to Address the Grand Challenges of Sustainable Development." *Bioscience* (American Institute of Biological Sciences) 60, no. 7 (July/August 2010): 488–489.
- "Sustainability as a Founding Principle of the United States." In *Moral Ground: Ethical Action for a Planet in Peril*. Edited by Kathleen Dean Moore and Michael P. Nelson, 301–305. San Antonio: Trinity University Press, 2010.
- "None Dare Call it Hubris: The Limits of Knowledge." *Issues in Science and Technology* 23, no. 2 (2007): 29–32.
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Change Magazine / September 2010

Differentiating America's Colleges and Universities: Institutional Innovation In Arizona

DIFFERENTIATING AMERICA'S COLLEGES AND UNIVERSITIES:

INSTITUTIONAL INNOVATION IN ARIZONA

BY MICHAEL M. CROW

Michael M. Crow became the sixteenth president of Arizona State University in 2002. He was previously executive vice provost of Columbia University. A fellow of the National Academy of Public Administration, he is the author of books and articles analyzing knowledge organizations and science and technology policy.

Colleges and universities negotiating their recovery from the most severe recession in nearly a century are currently implementing a welter of hastily devised measures aimed at reducing operating costs, becoming more efficient, and restoring a prior equilibrium. But administrators reacting to the downturn should not restrict their focus to the short term, fixating exclusively on cost cutting or reshuffling longstanding priorities. They should instead engage in comprehensive long-range planning that uncovers and fixes “design flaws” and advances new and differentiated models for the nation’s colleges and universities.

The reconceptualization of Arizona State University (ASU) is considered here as a case study of how one university has accomplished such a redesign. As president of ASU, I have led an effort to reinvent the youngest major public research institution in the United States through a comprehensive “design process” that has included both an exhaustive reevaluation of our academic organization and operations and an effort to pioneer what we term the “New American University”—an egalitarian institution committed to academic excellence, access, and maximum societal impact.

Newsweek has termed ASU’s experiment “one of the most radical redesigns in higher learning since the modern research university took shape in nineteenth-century Germany” (August 9, 2008). An editorial from the journal *Nature* observes that questions about the future of the contemporary research university are being examined “nowhere more searchingly than at Arizona State University” (April 26, 2007). Accordingly, we invite scrutiny and encourage critique of the process, since we consider our effort a case study in institutional innovation.

Our objective has been to accelerate a process of institutional evolution that might otherwise have taken more than a quarter-century and compress it into a single decade (2002–2012). Such self-determination has meant embracing transformational change: we have confronted the complexities associated with advancing robust institutional innovation at scale and in real time.

TOWARD DIFFERENTIATION AMONG COLLEGES AND UNIVERSITIES

Differentiation is the process by which nature prospers, offering new prospects to organisms and the potential for species to evolve. The concept applied to organizations and institutions presumes a trajectory of change and adaptation that we term institutional evolution. Its antithesis is “ossification”—a lack of innovation in the organization and practices of our institutions—which too often characterizes academic culture.

Most colleges and universities define themselves in comparison to a set of institutions that comprise the “gold standard” in American higher education: the Ivies, the great land-grant universities, and the elite institutions constructed on the foundation of private fortunes. Private institutions seek Harvardization and public institutions attempt to replicate the patterns established by Berkeley and Michigan; each would do better to seek its own unique identity and situate itself in a synergistic network of collaboration.

The lack of innovation in our colleges and universities results in an insufficient differentiation between distinct categories of institutions as well as a stultifying homogeneity among institutions of the same type. While our nation urgently needs more research-intensive and research-active institutions, both public and private, it also needs more liberal arts colleges, four-year

regional colleges, community colleges, professional schools, technical institutes, and for-profit enterprises focused primarily on workforce training. And institutions of the same type must develop distinctly different competencies if our national innovation system is to remain robust.

While conventional wisdom suggests that all great universities must function equally as centers for humanistic and social scientific scholarship as well as world-class science, engineering, and medical research, not every institution can support a comprehensive spectrum of programs. Institutions must cultivate unique and differentiated research and learning environments that address the needs of students with different levels of academic preparation and differing types of potential. Ubiquitous information technologies provide an important augmentation of the learning environment, but for institutions charged with imparting advanced knowledge and instilling the capacity for critical thinking, these are not substitutes for personalized instruction.

INSTITUTIONAL INNOVATION AND ACCESS TO EXCELLENCE

Here I will focus on the American research university. In his new book on the topic, Jonathan R. Cole, the longtime provost of Columbia University, listed some of the transformational discoveries that originated at our nation's research universities.

From lasers to magnetic resonance imaging to global positioning systems to the algorithm for Google searches, he points out, the breakthrough technologies of university-based innovation have improved our quality of life and fostered economic growth. But despite the critical niche that research universities occupy in the global knowledge economy, institutions committed primarily to discovery and innovation restrict the potential of their contribution unless they explicitly embrace a broader societal role.

We take for granted that the fundamental model for higher education in the United States is sound. We mistakenly assume that the intellectual objectives of our institutions, especially in terms of scientific and technological research, are automatically and inevitably aligned with our most important goals as a society. The challenge in this context is to reinvent knowledge-producing enterprises so that they respond to their multiple constituencies and advance constructive social and economic outcomes.

This is an era when learning has become the single most critical adaptive function for individuals in society, and the full

development of each individual is in turn critical for the society as a whole. But while nations worldwide are investing strategically to educate their citizens for the new global knowledge economy, America's educational infrastructure remains unable to accommodate projected enrollment demands. Our leading institutions have become increasingly "exclusive"—that is, they define their excellence through admissions practices based on exclusion. We underperform in providing opportunities for the increasing number of students of all ages, socioeconomic backgrounds, levels of academic preparation, and differing types of intelligence and creativity seeking enrollment in our colleges and universities.

While our nation's leading universities, both public and private, consistently dominate global rankings, our success in establishing excellence in a relative handful of elite institutions does little to ensure continued national competitiveness, especially when one considers how few students attend those universities. The challenge of providing access to higher education for most Americans thus falls to less selective schools. But the scale and speed of new knowledge production is unprecedented, and with more and more knowledge required for entry into the workforce, university-level instruction several steps removed from the cutting edge of innovation may entail diminished prospects for the individual and a reduction in the standard of living for subsequent generations.

What is required is a new model for the American research university that offers access to excellence to a broad demographic range of students. In order for our nation to achieve the ambitious objectives for educational attainment laid out by President Obama, we must first build a higher education infrastructure adequate to the task.

Without sufficient resources, our schools cannot hope to offer the curricula, programs, student services, and facilities that will produce the graduation rates called for by the President. But while the condition is generally exacerbated by public disinvestment in higher education, we must not attribute lack of innovation primarily to insufficient resources.

AN EXPERIMENT IN INSTITUTIONAL INNOVATION

In its present form Arizona State University is the youngest of the roughly one hundred major research institutions in the United States, both public and private, and—with an enrollment approaching seventy thousand undergraduate, graduate, and professional students—the largest American public research

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university governed by a single administration.

Situated in the heart of the so-called Sun Corridor, an emerging megapolitan area stretching from the Prescott region of central Arizona to the border with Mexico, ASU is the sole comprehensive baccalaureate-granting university in a metropolitan region of four million (projected to increase to eight million). Responsibility for higher education in other large metropolitan regions is shared by a number of institutions. Metropolitan Los Angeles, for example, boasts major research institutions such as UCLA, USC, and Caltech, with four additional UC campuses within close proximity. A number of Cal State campuses and private institutions such as Occidental College, the Claremont Colleges, and Claremont Graduate University fill out the roster. And while the population of Maricopa County is the same as the entire state of Colorado, the latter by contrast boasts the University of Colorado at Boulder; CU Denver, now consolidated with the medical school; CU Colorado Springs; Colorado State University; the University of Northern Colorado; and some noted private institutions such as the University of Denver and Colorado College.

Arizona will continue to experience large increases in its college-age population but boasts an insufficient four-year college infrastructure to accommodate that growth. Our efforts to make operational the vision of a New American University in Arizona were to a large extent shaped by the imperative to accommodate the demands and requirements of the locale—which meant combining academic excellence with broad access, promoting diversity, and meeting the special needs of underserved populations. Meanwhile, with an economy insufficiently diversified to accommodate its population expansion, Arizona is confronted with major challenges associated with the environment, health-care, social services, immigration, and the performance of P-12 education, all of which place implicit demands on the university’s researchers.

While in some measure the initiation of our efforts was inspired by the call for a “new university” issued by Cornell University president *emeritus* Frank Rhodes, the implementation of the New American University model has in practice been shaped through exhaustive trial and error, a number of course corrections, and the application of common sense. As first set forth in the white paper “One University in Many Places: Transitional Design to Twenty-First Century Excellence” (2004, rev. 2009-- http://provost.asu.edu/files/shared/presentations/OneUniv_110209.pdf), the objective of the design process has been to build a comprehensive metropolitan research university

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that is an “unparalleled combination of academic excellence and commitment to its social, economic, cultural, and environmental setting.”

Four interdependent university goals are critical to achieving a set of eight “design aspirations,” considered in the following section. The goal of “access and quality for all” recognizes our responsibility to provide a high-quality higher education to all qualified citizens of Arizona. A second goal is the establishment of “national standing for colleges and schools in every field.” The third goal, “becoming a national comprehensive university by 2012,” is intended to build regional competitiveness. The fourth goal enjoins the university to “enhance our local impact and social embeddedness.” While the advancement of the university remains a perpetual process, as of early 2010—more than two years ahead of schedule—we had not only made demonstrable progress but had in fact accomplished these four goals.

Rather than advancing a trajectory model that would guide evolution according to linear extrapolation or a replication model that would attempt to recreate the organization of leading research universities, we chose to develop a distinctive institutional profile by building on existing strengths. The result was a federation of distinctive colleges, schools, interdisciplinary research centers, and departments and a deliberate and complementary clustering of programs on each of four differentiated campuses of equally high quality distributed across metropolitan Phoenix. Predicated on devolving intellectual and entrepreneurial responsibility to the level of the college or school, the model calls for each school to compete for status, not with other schools within the university but with peer entities around the country and world.

More than a dozen new transdisciplinary schools—including such units as the School of Human Evolution and Social Change; the School of Historical, Philosophical, and Religious Studies; the School of Computing, Informatics, and Decision Systems Engineering; and the School of Earth and Space Exploration—complement large-scale research initiatives. These include the Global Institute of Sustainability (GIOS), which incorporates the first-of-its-kind School of Sustainability, and the Biodesign Institute, a large-scale multidisciplinary research center dedicated to biologically inspired innovations in healthcare, energy and the environment, and national security. As described by our provost, Elizabeth Capaldi, in a previous issue of *Change* (July/August 2009), in the process we have eliminated a number of traditional academic departments, including biology, sociology, anthropology, and geology.

ARIZONA STATE UNIVERSITY CAMPUSES



Downtown campus

Walter Cronkite School of Journalism and Mass Communication
 School of Letters and Sciences
 College of Nursing and Health Innovation
 College of Public Programs
 Mary Lou Fulton Teachers College
 Graduate College
 Barrett, the Honors College

Tempe campus

W. P. Carey School of Business
 Herberger Institute for Design and the Arts
 Ira A. Fulton Schools of Engineering
 Graduate College
 Sandra Day O'Connor College of Law
 School of Letters and Sciences
 College of Liberal Arts and Sciences
 School of Sustainability
 Mary Lou Fulton Teachers College
 Barrett, the Honors College

Polytechnic campus

Morrison School of Management and Agribusiness (W. P. Carey School of Business)
 School of Letters and Sciences
 College of Nursing and Health Innovation
 Mary Lou Fulton Teachers College
 College of Technology and Innovation
 Graduate College
 Barrett, the Honors College

West campus

W. P. Carey School of Business
 New College of Interdisciplinary Arts and Sciences
 Mary Lou Fulton Teachers College
 Graduate College
 Barrett, the Honors College

As evidence of the model's viability, we note that during the past six years our research enterprise more than doubled its expenditures, surpassing the \$300 million level for the first time in FY 2009. Estimates for FY 2010 expenditures exceed \$370 million. ASU is one of only a handful of institutions without either an agricultural or medical school to have surpassed the \$200 million level in funding, with institutional peers in this category including Caltech, MIT, and Princeton.

In terms of competitive funding, ASU now ranks among the top 20 leading research universities in the nation without a medical school, according to the National Science Foundation, and for the third consecutive year it has been ranked as one of the top 100 universities globally in the international assessment conducted by the Institute of Higher Education, Shanghai Jiao Tong University, placing 94th in their 2009 *Academic Ranking of World Universities*. To provide some perspective on the momentum of the trajectory, ASU conducted no significant funded research prior to 1980.

The faculty roster includes growing numbers of recipients of prestigious national and international honors. More members of the National Academies have joined our faculty during the past six years than have served on the faculty during the past five decades, and among our ranks we now count three Nobel laureates.

Similarly, ASU has made remarkable progress in the academic profile of its student body. The fall 2009 freshman class numbered 9,344, with 31 percent in the top 10 percent of their high school class. While ASU awarded a record 15,610 degrees in AY 2009, up 38 percent since the end of FY 2002, the university's five-year graduation rate increased by almost 9 percent and now exceeds the average for all US public universities by more than 12 percent. ASU is one of the top 10 producers of Fulbright Scholars in the nation, and in fall 2009 boasted 613 National Merit Scholars, placing ASU among the top 10 public universities nationally. The number of National Merit Scholars has increased 61 percent since 2002.

At the same time, we reject the notion that excellence and access cannot be integrated within a single institution, and we have sought to redefine the notion of egalitarian admissions standards by offering access to as many students as are qualified to attend. Our keystone initiative in this context is the President Barack Obama Scholars Program, which ensures that in-state freshmen from families with annual incomes below \$60,000 are able to graduate with baccalaureate degrees debt free. During fall semester 2009, more than 1,700 freshmen participated in the program. President Obama has asked other colleges and universities across the nation to follow ASU's lead in providing this type of program.

The Obama Scholars Program epitomizes our pledge to Arizona that no qualified student will face a financial barrier to attending ASU. It also underscores the success of the long-standing efforts that have led to record levels of diversity in our student body. While the freshman class has increased in size by 42 percent since 2002, for example, enrollment of students of color has increased by more than 100 percent. And from FY

2003 through FY 2008, the enrollment of low-income Arizona freshmen increased by 873 percent.

DESIGN ASPIRATIONS

The design aspirations guiding the reconceptualization call for the university to

- respond to its cultural, socioeconomic, and physical setting;
- become a force for societal transformation;
- pursue a culture of academic enterprise and knowledge entrepreneurship;
- conduct use-inspired research;
- focus on the individual in a milieu of intellectual and cultural diversity;
- transcend disciplinary limitations in pursuit of intellectual fusion (transdisciplinarity);
- embed the university socially, thereby advancing social enterprise development through direct engagement; and
- advance global engagement.

These aspirations are inherently interrelated. For example, our response to the unique challenges associated with the setting of the university and the demographics of the American Southwest inform the recommendations that we respond to our locale, transform society, enable student success, and advance social embeddedness. The aspiration to value entrepreneurship conceptualizes academic enterprise as the spirit of creative risk-taking in all fields through which knowledge is brought to scale to spur social development and economic competitiveness.

The interaction between the design aspiration of intellectual fusion and sustainability is representative of the interplay's dynamics. Intellectual fusion seeks to transcend the limitations of traditional discipline-based departmental organization. Entrenchment in disciplinary silos undermines the capacity of our institutions to address the grand challenges—one need only think of hunger and poverty, global climate change, the extinction of species, the exhaustion of natural resources, and the destruction of ecosystems. A response commensurate to these intractable problems requires that we advance research that can provide us with the means to balance wealth generation with continuously enhanced environmental quality and social well-being.

With the establishment of the Global Institute of Sustainability (GIOS) in 2004 and the School of Sustainability (SOS) three years later, ASU has consolidated its position in the vanguard of interdisciplinary research on sustainable development. GIOS researchers include life scientists, social scientists, engineers, humanists, and legal scholars collaborating with policymakers and leaders from business and industry.

With a special focus on the complex interactions between urban environments and natural systems, GIOS researchers and practitioners advance knowledge and seek practical solutions in areas as diverse as agriculture, air quality, marine ecology, materials design, nanotechnology, policy and governance, renewable energy, risk assessment, transportation, and urban infrastructure. Collaboration in sustainability initiatives engages premier insti-

tutions around the world, including Stanford, Harvard, MIT, the University of Washington, Tec de Monterrey, and Cambridge.

Meanwhile, the School of Sustainability offers both undergraduate and graduate degree programs. The school is educating a new generation of leaders through collaborative, transdisciplinary, and problem-oriented training that addresses environmental, economic, and social challenges such as rapid urbanization; water quality; habitat transformation; the loss of biodiversity; and the development of sustainable energy, materials, and technologies.

While GIOS remains our front line of engagement in sustainability, we are also engendering an institutional culture of sustainability. ASU offered sustainability-themed courses in twenty-five subject areas during the past academic year, including anthropology, architecture, biology, economics, engineering, industrial design, law, philosophy, nonprofit leadership, and urban planning.

A further objective is to engage the community in supporting sustainability initiatives, including widespread reductions in greenhouse gas emissions. ASU is committed to reducing its energy consumption, increasing efficiency, and minimizing harmful emissions related to energy consumption.

The university has invested heavily in energy efficiency across all campuses, saving an estimated 33 million kWh and 70 million pounds of CO₂ annually. Since 2005 ASU requires, to the fullest extent practicable, Leadership in Energy and Environmental Design (LEED) Silver certification for all new construction of university-owned and operated buildings. The university-wide solar initiative has already installed 2.04 MW of photovoltaic power on the Tempe campus, providing 7 percent of the campus's electric demand, and a 4.65 MW solar installation is underway on the West campus. Plans call for 10 MW of solar power capacity by the end of 2010 and 20 MW at the end of future phases. These efforts helped advance the university's carbon-neutral goal and reaffirmed its leadership position in the American College and University Presidents Climate Commitment.

TOWARD A NEW AMERICAN UNIVERSITY

The elite universities and colleges in our nation, both public and private, have established and maintained a gold standard for higher education that others feel compelled to emulate, but

institutions today must overcome their identification with this historical model of elitism and isolation from society. While the genetic code of the first universities to emerge in medieval Europe is still present in the interstices of Arizona State University, as a New American University situated in the heart of the American Southwest in the twenty-first century, ASU must address the needs of its region even as it seeks solutions for global challenges.

We have sought to rethink the institution from the ground up.

And by establishing new criteria for success, we have chosen to redefine the terms of our competition with institutions that have matured over the course of centuries. Although ASU traces its origins to a territorial teachers college in the nineteenth century, its trajectory as a comprehensive research university did not begin until 1958. So despite having been shaped by the organizational principles and practices of the past, ASU refuses to be determined by them: ASU does not seek Harvardization.

While all public research universities are committed to teaching and discovery, there is no reason why each cannot advance unique and differentiated research and learning environments that address the needs of their particular region. In ASU's case, our reconceptualized mission requires that we embrace fundamental change, and in so doing, pioneer

a model for the American research university that recovers the egalitarian tenets of the true public university.

During the past several decades, academic culture in our nation has been characterized largely by self-satisfaction arising from steady progress by the top research universities. But in a keynote address to the American Council on Education, Gordon Gee, president of Ohio State University, expressed with particular eloquence the imperative for the "radical reformation" of our colleges and universities: "The choice, it seems to me, is this: reinvention or extinction."

Such change is clearly essential, but we are nowhere near the broad consensus or collective sense of urgency that would transform analysis into action. In this new era of dramatically escalating complexity, the question remains yet to be resolved whether American universities can adapt fast enough to meet the challenges of the global economy in the twenty-first century. □

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Toward Institutional Innovation in America's Colleges and Universities

Toward Institutional Innovation in America's Colleges and Universities

BY MICHAEL M. CROW

TAKEAWAYS

- 1 More than just a restoration of “normalcy” is required on college campuses in the wake of the recent global economic crisis.
- 2 Just as universities seek to expand knowledge and innovation on the academic side of the enterprise, it also is imperative that they seek comparable innovation in their own academic structures, practices, and operations.
- 3 To achieve the ambitious objectives for educational attainment set by the Obama administration, we must first build a higher-education infrastructure commensurate to the task.
- 4 Colleges and universities need a new set of assumptions that encourage institutions to innovate and differentiate and become useful to their local communities, while at the same time seeking solutions to global challenges.

WHAT IS MOST STRIKING ABOUT THE EFFORTS OF our colleges and universities to recover from the repercussions of the global financial crisis is the extent to which many are determined to frame the moment as an opportunity. Much of the discourse surrounding the response of academic institutions to the recession, however, has been couched in the context of using this “opportunity” either to emerge as more efficient or to restore “normalcy.” I would maintain that efforts directed toward the restoration

of normalcy in the academic sector are inherently misguided because, long before the economy proved that our sense of mastery over the course of events was not fully justified, American higher education had been marked not by advancement or even equilibrium but rather ossification, if not outright decline.

Institutional efforts in the wake of the downturn should be focused not on retrenchment or reassessment but rather directed toward embracing change and complexity. I am suggesting that universities and colleges, confronted by the entirely new environment in which colleges must operate, should seek to establish *institutional cultures of innovation*.

In my usage of the term, “ossification” refers to the lack of innovation in the organization and practices of our institutions. The condition is generally exacerbated by disinvestment—the diminishing decline in investment, particularly from the public sector, in the infrastructure of higher education. But we must not attribute lack of innovation primarily to insufficient resources, whether from dwindling endowments or reduced investment from state legislatures habitually strapped for funds. Those of us in the academy are ourselves responsible for tolerating and perpetuating “design flaws” in our colleges and universities. And unless we come to appreciate the extent and severity of these design

flaws, as well as the shortcomings in our overall model of higher education, our best efforts to turn crisis into opportunity will prove insufficient.

In a nation boasting more than 5,000 institutions of higher education, it is difficult to offer assessments that are broadly applicable, so in the following I largely confine my focus to our nation's research universities, and especially to our public universities, which are particularly vulnerable given their funding structures. I contend that these complex institutions, which should be understood as comprehensive knowledge enterprises committed to discovery, creativity, and innovation, are the critical catalysts for American adaptability and economic robustness. While each institution endeavors to stimulate the creation, synthesis, storage, and transfer of knowledge on a massive scale, "perpetual innovation"—in ideas, products, and processes—must be their chief product. What is less often recognized is the imperative for universities to seek comparable degrees of innovation in their own academic structures, practices, and operations.

Consistent with these objectives, and with the approval and strong support of the Arizona Board of Regents, as president of Arizona State University I have guided the task of pioneering the foundational model for what we term the "New American University"—an egalitarian institution committed to academic excellence, inclusiveness for a broad demographic, and maximum societal impact. As a case study in institutional innovation, I'll summarize below selected aspects of the reconceptualization of ASU that we initiated in 2002, but first a clear understanding of the backdrop for our efforts is crucial.

Lack of Infrastructure and the Challenge of Access

Perhaps the chief consequence of the confluence of ossification and disinvestment is lack of access to higher education. The momentum of increased access to higher education by a wider range of students that marked much of the 20th century has faltered in the past several decades, with the result that more and more students who would most benefit from access to this most obvious avenue of upward mobility choose not to pursue, or are not aware of the option to pursue, a high-quality, four-year university education.

In order for our nation to achieve the ambitious objectives for educational attainment set by the Obama administration—the president envisions an America in which all children graduate from high school and most go on to college—we must first build a higher-education infrastructure commensurate to the task. Unfortunately, our colleges and universities, both public and private, lack the capacity to offer access to the number of qualified applicants seeking admission. More and more Americans of all ages, socioeconomic backgrounds, levels of academic preparation, and differing types of intelligence and creativity are seeking to enroll in our colleges and universities, overwhelming a set of

institutions built to accommodate the needs of our country in the mid-20th century.

The issue of access is far more urgent than most realize, even those on the national stage charged with advancing higher-education policy. While nations worldwide are investing strategically to educate broader segments of their populations for the new global knowledge economy, America has allowed its university system, despite its historical preeminence, to lose its adaptive capacities and stop growing. Unable to accommodate projected enrollment demands with their current infrastructure, our leading institutions have become increasingly "exclusive"—that is, they have chosen to define their excellence through admissions practices based on exclusion. American higher education has thus become thoroughly bifurcated: The small cadre of elite institutions that focuses on academic excellence and discovery contrasts with the majority of less-selective schools that offer access, yet more standardized instruction.

And while our leading universities, both public and private, consistently dominate global rankings, our success in establishing excellence in a relative handful of elite institutions does little to ensure our continued national competitiveness, especially when one considers the disproportionately few students fortunate enough to attend our top schools.

The direct correlation between educational attainment and standard-of-living and quality-of-life indicators has been widely documented—corresponding to the correlation between a highly educated populace and national economic competitiveness. Thus for the first time in our national history, we risk broad decline as a consequence of the insufficient evolution of our institutions and the disinvestment that characterizes our policies toward higher education.

Additional Challenges in the Decade Ahead

While the primary challenge confronting American higher education is expanding its capacity, during the next 10 to 15 years public universities and colleges also will have to negotiate substantial reduction or outright elimination of state support. With costs for competing priorities such as prisons and healthcare skyrocketing, state legislatures increasingly frame higher education as a private good and exercise the option to reduce investment. According to our university economists, the percentage of personal wealth per \$1,000 allocated to higher education within the vast majority of states is in decline.

While this does not mean that states are no longer willing to invest in higher education, it does suggest that they are going to be largely unwilling to finance it according to standard historical models, such as headcounts. Until new models are in place, institutions will likely continue to experience reductions in funding. In this context, competition from for-profit institutions will certainly increase. If traditional institutions cannot build capacity to meet demand

and the private sector builds platforms that do not require tax incentives or state contributions, the model will shift in short order.

Such disinvestment is by no means the only challenge confronting institutions. Our universities and colleges must prepare to embrace technological innovation in instruction to a greater degree than they have in the past. With the advent of ubiquitous information technologies, traditional institutions no longer enjoy their historic monopoly on higher learning. During the next 10 to 15 years, developers of new technologies will be leveraging all of their resources and talent to create new learning tools and information-acquisition platforms that make current efforts look like Tinkertoys.TM These tools lower the costs of productivity and demonstrate the potential to enhance learning processes and make complex subjects comprehensible. When conceived and executed properly, distance learning provides an important complement, or for some an alternative, to the traditional undergraduate experience. But its potential may lead us to assume mistakenly that sufficient alternative capacity for higher education, secured by market forces, is already in place. This in turn suggests that mere access to some or any form of higher education is sufficient. It is not.

Colleges and universities must also prepare to negotiate international competition. As a frontline global power, China, for example, intends to compete by making massive investments in education and research. China well understands the relationship between higher education and the global knowledge economy, as demonstrated last fall by a *China Daily* editorial headlined, “Chinese Ivy League” (October 21, 2009). While the newspaper takes the position that the Chinese government’s planning for development of a consortium of world-class institutions to rival the Ivy League places undue emphasis on international status, at the cost of concerns for providing access to higher education for the people (a contention with which I concur), the inherent competitive intent epitomizes the ambitions of knowledge enterprises worldwide. It is almost certain that the universities that have been created by emerging economies between 1990 and 2010 will alter the competitive position of the bulk of the world’s economies.

Even more disruptive to rank-and-file institutions in the long term is the coming emergence of what I refer to as “mega-universities”—a class of large American research universities with an expansive global presence and research expenditures that total more than \$750 million per year. Following the lead of such institutions as Johns Hopkins, the University of Washington, and UCLA, these universities are generating ambitious portfolios of intellectual property and engaging business, industry, and governments around the world. With their resources, these institutions will affect the competitive posture of all other colleges and universities, especially in terms of such factors as salary structures for faculty recruitment.

The establishment of full-scale operations abroad demon-

strates this emerging trend—one need only think of Cornell, for example, setting up a medical school in Qatar and the University of Chicago a business school in Singapore. How many such global institutions will emerge cannot be foreseen, but I perceive the potential for as many as 30 or 40. The emergence of global institutions is only the most recent stage in the millennium-long trajectory of continuous institutional evolution that characterizes the history of the university.

Implicit throughout this discussion is the imperative for universities, beginning with their governing boards and presidents, to adapt to the accelerating velocity of change. While clock time in academia is often measured in quarters or semesters, dramatic shifts in policy and culture and technology now occur at warp speed. Universities generally err on the side of being too deliberative, which means that they often miss out on opportunities. Academe might well learn from the private sector the imperative for adaptability, rigor, and quick but intelligent decision-making. Public institutions must reject the status of being no more than agencies of the state and move toward an enterprise model, which is to say, toward a mindset that is energetic, responsive, and adaptive.

Institutional Evolution: An Experiment in Real Time

The reconceptualization of Arizona State University as the model for the New American University represents an effort by the university’s administration, supported by the board of regents, to accelerate a process of institutional evolution that might otherwise have taken more than a quarter-century, compressing it into a single decade (2002–2012). The task has been particularly challenging because ASU is the youngest of the roughly 100 major research institutions in the United States, and, with an enrollment approaching 70,000 undergraduate, graduate, and professional students, it is the largest American university governed by a single administration. The unprecedented transformation of the regional demographic profile in one of the fastest-growing states in the nation has determined the profile of our student body and thus shaped our “design process,” informing our decisions to match academic excellence with broad access, promote diversity, and strive to meet the special needs of underserved populations.

While in some measure the initiation of our efforts was inspired by the call some years ago for a “new university” issued by Frank Rhodes, president emeritus of Cornell University, the implementation of the New American University model we are advancing has, in practice, been shaped through exhaustive trial and error, a number of course corrections, and our best efforts at the application of common sense. Initial planning began with conceptualization from the University Design Team, made up of the provost and a number of vice presidents, deans, department chairs, and senior faculty members whose dedication, creativity, and

thoughtfulness advanced the process. Ongoing strategic planning continues with participation from all sectors of the university, as well as input from policymakers and the public.

A re-examination of academic operations and organization produced a model of differentiation. Rather than simply trying to expand our existing operations or model an expansion after the organization of leading research universities, we chose to create a distinctive institutional profile by building on existing strengths to produce a federation of unique colleges, schools, interdisciplinary research centers, and departments—with a deliberate and complementary clustering of programs on each of our four campuses. With “school-centrism,” schools compete for status not with other schools within the university but with peer entities globally. More than 20 new transdisciplinary schools, including such entities as the School of Human Evolution and Social Change and the School of Earth and Space Exploration, complement large-scale initiatives such as the Global Institute of Sustainability (GIOS) and the Biodesign Institute, a large-scale, multidisciplinary research center dedicated to innovation in healthcare, energy and the environment, and national security. In the process, we have eliminated a number of traditional academic departments, including biology, sociology, anthropology, and geology.

Integrating Access and Excellence

At ASU, we reject the notion that excellence and access cannot be integrated within a single institution, and rather than adopting an elitist model, we have sought to redefine the notion of egalitarian admissions standards by offering access to as many students as are qualified to attend. Our keystone initiative here is the President Barack Obama Scholars Program, which ensures that in-state freshmen from families with annual incomes below \$60,000 are able to graduate with baccalaureate degrees debt free. During fall semester 2009, the program included more than 1,700 freshmen. The initiative epitomizes our pledge to Arizona that no qualified student will face a financial barrier to attend ASU, and it underscores the success of the longstanding efforts that have led to record levels of diversity in our student body.

While the freshman class has increased in size by 42 percent since 2002, for example, enrollment of students of color has increased by 100 percent, and the number of students enrolled from families below the poverty line has risen by roughly 500 percent. We consider our success in offering

access regardless of financial need to be one of the most significant achievements in the history of the institution.

While America was far less populous a century ago and the world arguably less complex, national ambitions for societal progress apparently flourished then because, during the final decades of the 19th century, our country witnessed an unprecedented spurt in the establishment of four-year colleges. The forces motivating their establishment were national as opposed to global and in many instances even regional and municipal, determined by the aspirations of citizens who wanted a local college to educate broader segments of the populace. Whether we consider small-town citizens who organized to convert a normal school into a state college, or tycoons and industrialists such as Johns Hopkins and Leland Stanford whose bequests established world-class institutions, we may well regard such forward-looking ambitions as remarkable, given the current apparent lack of comparable motivation.

In our own century, education has become the most critical adaptive function in the competitive, global knowledge economy. Our national discussion concerning higher education thus must not be limited to arbitrary goals for the production of more college graduates. Mere access to higher education is in itself inadequate and will not produce the outcomes we desire unless we educate greater numbers of individuals successfully and also educate at higher levels of attainment. Thus concomitant with building access, we must also unleash evolutionary change in our institutions.

What is required is a new model for our colleges and universities, a new set of assumptions that encourages institutions to innovate and differentiate and become useful to their local communities, while at the same time seeking solutions to global challenges. What will be required are institutional models that offer access to excellence to a broad demographic range of students. This, then, is a call for our colleges and universities to recover some of our nation’s core egalitarian values to advance a system of higher education that will meet our needs in the future. It is imperative that we get started immediately. ■

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The Research University as Comprehensive Knowledge Enterprise: A Prototype for a New American University

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CHAPTER 14

The Research University as Comprehensive Knowledge Enterprise: A Prototype for a New American University

Michael M. Crow

While the Glion Colloquia have brought university leaders together to exchange perspectives on an array of critical issues confronting higher education, perhaps none is more imperative to consider than the role of the research university in an innovation-driven society. Research universities are the primary source of the new knowledge and innovation that drives the global economy and provides those of us in advanced nations with the standard of living we have come to take for granted (Atkinson & Blanpied, 2008; Blakemore & Herrendorf, 2009). The intrinsic impetus to advance innovation distinguishes the research university from other institutional forms in higher education. Indeed I seek to redefine the research university as a *comprehensive knowledge enterprise committed to discovery, creativity and innovation*. If we do not embrace what has been termed “perpetual innovation” — and by this I mean innovation in products and processes and ideas, as well as in the institutional design of knowledge enterprises themselves — not only the outcomes of academic research but also our collective standard of living will decline, and opportunities for the success of future generations will be diminished (Atkinson, 2007; Crow, 2007a, 2008a; Kash, 1989; McPherson *et al.*, 2009).

Despite the critical niche that research universities occupy in the global knowledge economy, however, institutions committed thus primarily to inno-

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vation restrict the potential of their contribution unless they explicitly embrace a broader societal role. Innovation inevitably flourishes in a number of organizational settings, such as corporate research and development laboratories, but with their complex institutional missions spanning teaching, research and public service, universities should feel compelled to construe their research enterprises in a context of engagement and purpose. We mistakenly assume that the intellectual objectives of our institutions, especially in terms of scientific and technological research, are automatically and inevitably aligned with our most important goals as a society. The challenge in this context is therefore one of institutional design — about reinventing knowledge-producing enterprises to create institutions that understand and respond to their multiple constituencies and advance broader social and economic outcomes (Kitcher, 2001; Sarewitz, 1996; Sarewitz & Pielke, 2007). If research universities are to create knowledge that is as socially useful as it is scientifically meritorious, in areas as broad and complex as social justice, poverty alleviation, access to clean water, sustainable development and technological innovation, they must integrate their quest to advance discovery, creativity and innovation with an explicit mandate to assume responsibility for the societies they serve (Bok, 1982; Duderstadt, 2000; Kerr, 2001; Kitcher, 2001; Rhodes, 2001).

But our academic culture is not outcome-driven and instead values knowledge for its own sake. The proliferation of increasingly specialized knowledge that universities produce brings diminishing returns on investment as its impact on the world is measured in smaller and smaller ratios. But there is no reason why universities must confine themselves solely to the analysis of increasingly specialized knowledge. In our valorization of basic research, motivated solely by curiosity rather than with any higher purpose in mind, we lose sight of the potential for application when research is use-inspired (Kitcher, 2001). This is not to posit a dichotomy between basic and applied research — both are crucial, and in many cases the boundary between them is so permeable as to be meaningless (Stokes, 1997). In our accustomed effort to produce abstract knowledge, however, many research universities have lost sight of the fact that they possess the capacity to advance desired outcomes or to create useful products and processes and ideas with entrepreneurial potential (Geiger, 2004; Schramm, 2006). Prestige will always attach to the pursuit of the unknown, but I would argue that we must reprioritize our practices and rethink our assumptions if we are not to minimize the potential contributions of academic research.

Other manifestations of institutional responsibility might include a commitment to the production in sufficient numbers of scientists and engineers and artists and philosophers and economists and doctors and lawyers — in short, the human capital from which we draw our future leaders in every sector (Committee on Prospering in the Global Economy of the Twenty-First Cen-

tury [U.S.], 2007). Our institutions would further also embrace ambitious and multifaceted public outreach and engagement programs dedicated to societal advancement and regional economic development.

With my formulation of the research university as a “comprehensive knowledge enterprise”, I seek to underscore the potential inherent in the concept of “enterprise”, through some strange elitist logic generally wholly lacking in discussions about higher education. In this context I advocate the designation “academic enterprise”, representing an entrepreneurial academic culture that inspires creativity and innovation — the intellectual capital that is the primary asset of every college and university. Generally associated with the private sector, the spirit of enterprise is critical to the advancement of innovation (Schramm, 2006). My focus on enterprise is deliberate because since becoming the president of Arizona State University in July 2002, I have been coordinating an effort to reconceptualize a large public university as a competitive academic enterprise dedicated to leading the vanguard of innovation while simultaneously addressing the grand challenges of our era (Crow, 2007b). At ASU we have undertaken the task of pioneering the foundational model for what we term the “New American University” — an egalitarian institution committed to the topmost echelons of academic excellence, inclusiveness to a broad demographic, and maximum societal impact (Crow, 2002; “A New American University,” 2008).

In the following I consider the New American University model at length and offer an account of the reconceptualization of Arizona State University, initiated in 2002, as a case study in institutional innovation in higher education. My objective is also to establish a context for subsequent discussion of the fundamental design flaws in our knowledge enterprises. These intrinsic flaws obstruct progress toward the integration of knowledge with action. In speaking of research universities as knowledge enterprises, my objective is also to underscore the potential for differentiation between institutions. Research-grade universities are but one of a number of institutional types in American higher education, but even institutions so categorized need not be cut from the same cloth. As the lead architect in the design of a new class of large-scale multidisciplinary and transdisciplinary institutions and organizations at the forefront of education and research during the past two decades, both at Columbia University, where I most recently served as executive vice provost, and now in Arizona, I recognize that while institutional design requires considerable investment of time and effort and is not without challenge because of inherent sociocultural barriers, new designs offer new ways of shaping and examining problems and advancing questions through cooperation between large numbers of groups, programs, and initiatives. It is the inherent and fraught complexity of these various dimensions to the research university, as well as their interaction and interplay, that is the context of this assessment and analysis.

TOWARD INSTITUTIONAL INNOVATION IN RESEARCH UNIVERSITIES

An objective analysis of our knowledge enterprises undertaken with sufficient perspective — perhaps from the distance of the Oort Cloud, as suggested by James Duderstadt (2005) — discloses a number of fundamental design flaws. We face challenges of unimaginable complexity, but rather than learning to understand and manage complexity in the academy, we perpetuate existing organizational structures and restrict our focus with the entrenchment of disciplines and ever-greater impetus toward specialization. Our universities remain static if not entirely ossified, disinclined to evolve in pace with real time, and focused primarily on their advancement of abstract knowledge. The organizational frameworks we call universities — this thousand-year-old institutional form — have not evolved significantly beyond the configurations assumed in the late 19th century, nor have new designs come to the fore that accommodate change on the scale we are witnessing or address the challenges associated with the attendant increases in complexity. The problem of scale is an important dimension to analysis and endeavour that has not been sufficiently examined. I believe we do not understand either the implications of scale or how to shape questions at an appropriate scale in order to advance society and our institutions.

In order to conceptualize a model for the institutional design of knowledge enterprises, I extrapolate from a fundamental distinction explored by the polymath Herbert A. Simon in his 1969 book, *The Sciences of the Artificial*. Through his exploration of the categories of the natural and the artificial, Simon suggests the possibility for radical reconceptualization in our knowledge enterprises. His analysis underscores the distinction between the natural and artificial worlds, referring by the term “artificial” to objects and phenomena — artifacts — that are man-made as opposed to natural. He terms knowledge of such products and processes “artificial science” or the “sciences of design”. While artificial science more broadly refers to our use of symbols — the “artifacts” of written and spoken language — the most obvious “designers” of artifacts are engineers. But his usage of the term is broad and everyone is a designer who “devises courses of action aimed at changing existing situations into preferred ones”. The natural sciences are concerned with how things are, as he puts it, and the artificial sciences with how things ought to be. Artificial science — or design science — determines the form of that which we build — tools, farms or cities alike — but also our organizational and social structures (Simon, 1969). For our purposes we enlist Simon’s concept to underscore the potential for differentiation in the structure and organization of knowledge enterprises. The redesign of an institution represents a process as focused and deliberate and precise as the knowledge production of scientists, engineers,

and other scholars. From a design perspective and with the objective of optimal outcomes in mind, we may begin to assess the design flaws inherent in our existing knowledge enterprises and posit new models for their improvement, such as the New American University (Crow, 2008b).

The evolutionary trajectory of universities in the Western world can be modeled as a process visualized along two axes. The x-axis represents the scale of the institution, with scale meaning more than just size. Scale in this usage refers to the *breadth of functionality*, which measures more than just the number of disciplines studied. If the institution is a comprehensive knowledge enterprise such as the New American University, it will be committed to the traditional missions of teaching, research and public service, but in addition will advance innovation and entrepreneurship. Scale thus refers to both the intellectual, or pedagogical, and functional breadth. The y-axis, meanwhile, reflects the institution's *conception of itself* as an evolving, entrepreneurial entity. At the low end of the y-axis, we have what organizational theorists call conserving institutions, those that are inwardly focused, risk-averse and concerned primarily with self-preservation. At the upper end are entrepreneurial institutions, those willing to adapt, innovate and take risks in rethinking their identities and roles. On a chart the New American University would thus appear in the curve in the upper-right quadrant reserved for leading-edge institutions designed to accommodate innovation, rapid decision-making and entrepreneurial behaviour (Crow, 2008a).

A CASE STUDY FOR THE NEW AMERICAN UNIVERSITY

With the implementation of the New American University model, beginning in 2002, Arizona State University has often been characterized as a “case study” in American higher education. Not only is ASU a new university, it is competing in an arena dominated by some of the most well-established and influential institutions in the world. Some institutions might perceive such case study status as problematic, but for us the designation is not only appropriate but entirely welcome because through our reconceptualization we have deliberately positioned ourselves as an experiment in higher education at scale. *Newsweek* termed our reconceptualization “one of the most radical redesigns in higher learning since the modern research university took shape in nineteenth-century Germany” (Theil, 2008). And according to an editorial from the journal *Nature*, questions about the future of the contemporary research university are being examined “nowhere more searchingly than at Arizona State University” (26 April 2007). While the reinvention of the American research university has generated recommendations found scattered across the relevant specialized literature, the New American University model we are advancing was generally shaped through trial and error and our

efforts at the application of common sense, in some measure initially inspired by the call for a “new university” articulated by Frank Rhodes (2001).

Differentiation through a process of design

The designation of Arizona State University as a case study in higher education derives in part from the intensive and ongoing process of perpetual institutional self-assessment and reconceptualization that we often refer to as the “design process”. As set forth in the white paper “One University in Many Places: Transitional Design to Twenty-First Century Excellence” (2004), the objective of the design process is to build a comprehensive metropolitan research university that is an “unparalleled combination of academic excellence and commitment to its social, economic, cultural, and environmental setting”. An interrelated formulation that we have developed is the expression of our intent to build an institution “committed to the topmost echelons of academic excellence, inclusiveness to a broad demographic, and maximum societal impact”, with the associated tagline “Excellence, Access, Impact.”

Guided by a number of working drafts of comprehensive strategic plans to guide the development of the institution, we deem ourselves in the midst of a decade of unprecedented reorganization and decisive maturation (2002-2012), expanding and intensifying the capacity of the university for teaching and discovery in all disciplines while addressing the challenges of burgeoning enrolment with a distributed model. The evolving strategic plan centers on four basic university goals, all of which are interdependent but critical to achieving a set of eight “design aspirations”, considered in the following section. The goal of “access and quality for all” recognizes our responsibility to provide opportunities in higher education to all qualified citizens of the State of Arizona without impacting the highest levels of quality. A second goal is the establishment of “national standing for colleges and schools in every field”. “Becoming a national comprehensive university by 2012” will build regional competitiveness and national and global distinction to the state and region. The fourth goal recognizes the university’s responsibility towards the region it serves, and focuses on “enhancing our local impact and social embeddedness”.

‘Design aspirations’ for a New American University

There are many ways to parse the concept of the New American University, but, in brief, its objectives are inherent in the following “design aspirations” that, reduced to their essential terms, enjoin academic communities to: (1) embrace the cultural, socioeconomic and physical setting of their institutions; (2) become a force for societal transformation; (3) pursue a culture of academic enterprise and knowledge entrepreneurship; (4) conduct use-inspired

research; (5) focus on the individual in a milieu of intellectual and cultural diversity; (6) transcend disciplinary limitations in pursuit of intellectual fusion; (7) socially embed the university, thereby advancing social enterprise development through direct engagement; and (8) advance global engagement. Taken together, these tenets comprise a new paradigm for academic institutions, both public and private, that I advocate without reservation (Crow, 2002).

The design aspirations should be considered guiding principles rather than hard-and-fast imperatives — the complex academic operations of a research university do not correspond neatly to a single design aspiration but generally embrace many. And not all design aspirations could possibly be relevant to any given student or scholar or team of researchers. For example, the unique challenges associated with the location of the university and the demographics of metropolitan Phoenix and the American Southwest engage a majority of the design aspirations, especially the recommendations that we leverage our place; transform society; enable student success; and advance social embeddedness. Similarly, the design aspiration to value entrepreneurship refers to academic enterprise as the creative expression of intellectual capital and knowledge-centric change. Perhaps the most obvious dimension of academic enterprise is the process of innovation from the research laboratory to the marketplace, but our conception transcends the commercialization of university research (Slate & Crow, 2007). At ASU we consider entrepreneurship the process of innovation and spirit of creative risk-taking through which the knowledge and ideas within the university are brought to scale to spur social development and economic competitiveness. ASU is committed to embedding the paradigm of entrepreneurship into the fabric of our institutional culture through a supportive infrastructure of resources to inspire students, faculty and staff, and provide them with the necessary skills to turn their ideas into reality (Crow, 2008c).

A federation of schools (the ‘school-centric’ model)

In its present form Arizona State University is the youngest of the roughly 100 major research institutions in the United States, both public and private, and, with an enrolment approaching 70,000 undergraduate, graduate and professional students, the largest American university governed by a single administration. To promote access to excellence despite the challenges of burgeoning enrolment we have adopted a distributed model, operating from four differentiated campuses of equally high aspiration, with each campus representing a planned clustering of related but academically distinct colleges and schools. We term this empowerment of colleges and schools “school-centrism”. Predicated on devolving intellectual and entrepreneurial responsibility to the level of the college or school, the model calls for each school to

compete for status, not with other schools within the university, but with peer schools around the country and around the world. Schools are encouraged to grow and prosper to the extent of their individual intellectual and market limits (“One University in Many Places,” 2004).

The reconceptualized “school-centric” organization has produced a federation of unique interdisciplinary colleges and schools that, together with departments and research institutes and centers, comprise close-knit but diverse academic communities that are international in scope. Consistent with this school-centric model we have conceptualized and launched 22 new interdisciplinary schools, including the School of Human Evolution and Social Change, and the School of Earth and Space Exploration. Although we are first and foremost committed to educating the students of Arizona, we are equally a cutting-edge discovery organization, dedicated to contributing to regional economic development through enhanced research and academic programs, including major interdisciplinary research initiatives such as the Biodesign Institute, focused on innovation in healthcare, energy and the environment, and national security; the Global Institute of Sustainability (GIOS), incorporating the world’s first School of Sustainability; and the Center for the Study of Religion and Conflict. In the process we have eliminated a number of traditional academic departments, including biology, sociology, anthropology and geology (Capaldi, 2009). We consider such academic entities arbitrary constructs that may once have served certain social or administrative purposes but are no longer useful as we prepare to tackle global challenges (Committee on Facilitating Interdisciplinary Research [U.S.], 2005).

Unprecedented demographic challenges to higher education in Arizona

Situated in the heart of an emerging megapolitan area that stretches from the Prescott region southward to the border with Mexico, ASU is the sole comprehensive university in a metropolitan region of four million projected to increase to eight million — a metropolitan region the size of Chicago. Demographic projections suggest that this emerging megapolitan — the so-called Sun Corridor — will become one of perhaps 20 significant economic, technological and cultural agglomerations in the United States (Crow, 2008d; Gamage *et al.*, 2008; Lang, Muro & Sarzynski, 2008). Yet the higher education infrastructure of Arizona remains under-built and undifferentiated. In other metropolitan regions, responsibility for higher education is shared by a number of institutions. Major research universities in the metropolitan Los Angeles region, for example, include UCLA, USC, and Caltech, with UC Santa Barbara, UC Irvine, UC Riverside, and UC San Diego within close proximity. A host of other institutions — public (several California State University

campuses) and private (Occidental College and the prestigious Claremont Colleges and Claremont Graduate University) — complement these research universities.

Because we wish to move beyond the conventional model of the research university as preoccupied with the discovery of new knowledge to the exclusion of concern with the social outcomes of its research, we actively seek to imbue metropolitan Phoenix with the quality-of-life and quality-of-place characteristics that attract the intellectual capital and competitive advantage that accompanies the influx of “knowledge workers” (Kotkin & DeVol, 2001) and the “creative class” (Florida, 2002). If the university does not envision and guide such outcomes, we face the prospect of the sort of decline witnessed in such cities as Cleveland and Detroit, both of which have not been able to adapt to changing economic circumstances rapidly enough. The university models of the past are similarly as stagnant and irrelevant as the most dated and discarded concepts of urban planning. If our universities remain hide-bound and regard change and evolution as recourses of last resort, then we can dismiss the adaptive capability of this important mechanism of capital creation and societal advancement.

Access to excellence: Towards egalitarian admissions practices

While the direct correlation between educational attainment and standard-of-living and quality-of-life indicators has been widely documented (Mortenson, 1999), leading institutions of higher education have almost without exception during the course of the past half-century become increasingly *exclusive* — that is to say, they have chosen to define their excellence through admissions practices of exclusion. It is generally taken for granted that there are two types of universities: the small cadre of elite institutions that focus on academic excellence and discovery, and the majority of less selective schools that offer access yet often provide no more than a rudimentary level of higher education. Institutions that focus on academic excellence generally admit only a fraction of applicants, many of whom come from privileged socioeconomic backgrounds and have enjoyed undeniable advantages. All other students are expected to attend less competitive schools. In terms of societal outcomes, this implicit calculation is not only shortsighted, but may in the long run prove to be a fatal error. There is growing social and economic stratification between those with access to a quality higher education and those denied the opportunity. More and more students who would most benefit from access to this most obvious avenue of upward mobility — those whom we might categorize as “disadvantaged” or “underrepresented” — are denied access for lack of means or choose not to pursue for lack of understanding a high-quality university education (Bowen, Kurzweil & Tobin, 2006; Douglass, 2007; Haskins, 2008; Haskins, Holzer & Lerman, 2009).

If we continue to exclude a high proportion of the population from reaching their potential by excessive and sometimes arbitrary “culling”, we deprive countless individuals of opportunities to attain prosperity. We need to make more of an effort to understand how to educate greater numbers of individuals successfully, but we must also educate students to be successful. This economic dimension is intrinsic to the societal mission of colleges and universities. Individuals deprived of higher education through lack of funds represent not only personal opportunity lost, but also the loss of societal economic prosperity. Individuals deprived of college educations will likely earn lower wages and generate fewer jobs than they would have as graduates (Hill, Hoffman & Rex, 2005). A recent report on high school graduation rates in the 50 largest U.S. cities underscores the urgency of the problem: according to the study, 17 of the nation’s 50 largest cities had graduation rates lower than 50% (Swanson, 2009).

We believe that many public universities in the United States, particularly research-grade institutions, have abandoned core elements of their public mission and in some sense morphed into hybrid or semi-privatized institutions that operate on a narrow bandwidth of engagement. We reject the notion that excellence and access cannot be integrated within a single institution, and alone among American research universities have sought to redefine the notion of egalitarian admissions standards by offering access to as many students as are qualified to attend. Our approach has been to expand the capacity of the institution to meet enrolment demand and provide expanded educational opportunities to the many gifted and creative students who do not conform to a standard academic profile, as well as offering access to students who demonstrate every potential to succeed but lack the financial means to pursue a quality four-year undergraduate education.

When President Barack Obama spoke at our 2009 commencement exercises, he was especially excited about our newly established program to ensure that resident undergraduates from families with annual incomes below \$60,000 admitted as incoming freshmen would be able to graduate with baccalaureate degrees debt free. We estimate that for fall semester 2009, the President Barack Obama Scholars program will allow approximately 1,600 freshmen an opportunity to attain their educational objectives. The program epitomizes our pledge to Arizona that no qualified student will face a financial barrier to attend ASU and underscores the success of the longstanding efforts that have led to record levels of diversity in our student body. While the freshman class has increased in size by 42% since 2002, for example, enrolment of students of colour has increased by 100%, and the number of students enrolled from families below the poverty line has risen by roughly 500%. Our success in offering access regardless of financial need is easily one of the most significant achievements in the history of the institution.

Indicators of success in the reconceptualization process

An overview of the indicators of success in our experiment in institutional innovation may be justified. As evidence of our new stature and prominence, we note that during the past six years our research enterprise more than doubled its expenditures, surpassing the \$300 million level for the first time in FY 2009. ASU is one of only a handful of institutions without both an agricultural and medical school to have surpassed the \$200 million level in funding, with institutional peers in this category including Caltech, MIT and Princeton. According to the National Science Foundation, ASU now ranks among the top 20 leading research universities in the nation without a medical school, and for the third year ASU has been ranked as one of the top 100 universities globally in the international assessment of the Institute of Higher Education, Shanghai Jiao Tong University, placing 93rd in their 2008 “Academic Ranking of World Universities”. To provide some perspective on the momentum of the trajectory, ASU conducted no funded research whatsoever in 1980.

A short list of accomplishments during the past six years would also include the following: We have increased enrolment by more than 9,000 net new students and added 500 new faculty members. We have attained record graduation and retention rates and all academic indicators similarly track record quality. We now enrol more freshman National Merit Scholars than almost any public university in the nation. More members of the National Academies have joined our faculty during the past six years than have served on the faculty during the past five decades. More than 50 new interdisciplinary research centers and institutes have been established. Seven million square feet of new academic space has been added, including one million square feet of world-class research infrastructure. We have developed a master plan to guide the build-out of our campuses and restructured the institution by clustering our colleges and schools by their academic focus on four campuses distributed across the Valley.

For ASU self-determination as the foundational model for the New American University has meant embracing fundamental change: we have confronted the complexities associated with advancing robust institutional innovation at scale. We took the bold step of asking ourselves how we might best combine excellence with access while through a focus on regional challenges seeking solutions to the problems that confront global society. While all public research universities must be inherently committed to teaching and discovery, there is no reason why each cannot advance unique and differentiated research and learning environments that address the needs of their particular region. In our case this reconceptualized vision calls for inclusivity rather than exclusivity, an emphasis on outcomes rather than inputs, and an attempt to recover the egalitarian tenets of the true public university once envisioned in our society.

TOWARD MORE DIFFERENTIATED AND RESPONSIBLE INSTITUTIONS

In the rapidly changing and highly competitive global knowledge economy, the importance of higher education both to the individual and the collective has never been greater. Education is the means by which a skilled workforce is produced and the source of new knowledge capital and thus economic growth and advances in society, for the benefit of both the individual and the collective. Even as the wage gap between those with education and skills and those without continues to widen, more and more knowledge inputs are increasingly required to perform almost any job. The economic success of individuals contributes to the success of a society — in fact, it is the main driver (Hill, Hoffman & Rex, 2005). Without it, the United States and nations of Western Europe may face a reduction in our quality of life in the next generation, something unheard of in the past. In order for any nation to remain competitive, it is imperative that its universities prepare students to learn rapidly, and make them capable of integrating a broad range of disciplines in a rapidly changing world. But we must recognize that the institutional models we inherited from the 19th century will not instill in our graduates the drive and innovation required to meet the challenges of tomorrow. Nor do these institutions necessarily have the capacity to mount responses commensurate with the scale and complexity of the challenges that confront us as well as those yet to come in ensuing decades.

To anyone who has looked at the role of innovation as a driver of economic development during the past half-century, the most obvious mechanism to enhance the long-term economic competitiveness of any nation is through investment in research universities. Research universities educate students in a milieu that advances discovery and innovation while contributing to the development of a highly skilled workforce and the diversification of the economy. Yet across the globe our educational infrastructure remains dangerously under-built and undifferentiated. In the United States as elsewhere, we need new institutions, new designs and new models for higher education. Our colleges and universities remain little changed from the mid-20th century and are unable to accommodate projected enrolment demands at scale. America's colleges and universities require greater and not less diversification. While our nation urgently needs more research-intensive and research-active institutions, both public and private, it also needs more liberal arts colleges, four-year regional colleges, community colleges and technical institutes. The challenge, as I have argued, is about institutional design, about designing knowledge-producing enterprises that understand and respond to their constituents as well as the needs of global humanity.

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Smart Leadership for Higher Education in Difficult Times / 2011

Beyond the “New Normal” in American Higher Education: Toward Perpetual Innovation

Smart Leadership for Higher Education in Difficult Times

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4. Beyond the “new normal” in American higher education: toward perpetual innovation

Michael M. Crow

As the United States negotiates its recovery from the near meltdown of global economic markets, most institutions of higher education are engaged in some form of damage control and reassessment. Confronted by continuing fallout from the repercussions of the fiscal crisis, many colleges and universities are retrenching as if under siege while others are focused on restoring equilibrium. Still others are determined to seize the moment as an opportunity to restructure their academic organization or administrative mechanisms, generally with the intent of becoming more “efficient.” Much of the discussion surrounding the implications of the downturn for the academy has been couched in terms of a desire to attain to some condition of “new normalcy” in higher education.

I would maintain that any intent to seek a new normalcy in higher education is inherently misguided because such an objective suggests that conditions were tenable prior to their disruption by the economic dislocation. Indeed, I would argue that we must strike the notion of “normal” from the lexicon of American higher education because for decades the status quo has been characterized by progressive ossification and disinvestment. In my usage of the term, “ossification” refers to the lack of innovation in the organization and practices of our colleges and universities, and “disinvestment” refers to the progressive decline in investment, particularly from the public sector, in the infrastructure of higher education. It is the lack of innovation, however, even more than lack of investment that perpetuates existing “design flaws” and encourages the formation of new ones. Unless we come to some more lucid understanding of the design flaws in our academic institutions and the shortcomings in our overall model of higher education, our best efforts to turn crisis into opportunity will prove insufficient.

Perhaps the chief consequence of the confluence of ossification and disinvestment is lack of access to higher education. The momentum of

increased access to higher education by a wider demographic that marked the course of the past century has faltered in the past several decades, with the result that more and more students who would most benefit from access to this most obvious avenue of upward mobility – those whom we might categorize as “disadvantaged” or “underrepresented” – choose not to pursue, or are not aware that the option exists to pursue, a high-quality four-year university education (Bowen, Chingos, and McPherson, 2009). Inasmuch as our quality of life, standard of living, and economic competitiveness are intrinsically interrelated to the contributions of our universities, for the first time in our national history we risk broad decline as a consequence of the insufficient evolution of our institutions and the disinvestment that characterizes our policies toward higher education (Adams, 2009; Cole, 2009; Crow, 2008a).

Despite America’s success during the past century in establishing what is justifiably regarded as the world’s leading system of higher education – a decentralized system that led to the formation of a plurality of institutional types engaged in what has been described as a highly competitive but extremely productive “academic marketplace” (Graham and Diamond, 1997) – the nation’s educational infrastructure remains dangerously underbuilt and undifferentiated. And despite our success at establishing the gold standard for academic institutions, our colleges and universities, both public and private, have not evolved sufficiently in response to the progressively accelerating complexity across all sectors of global society that we must now regard as a permanent condition.

The status quo in American higher education was inadequate long before the economy proved that our sense of mastery over the course of events was not fully justified. While the present recession is symptomatic of what I perceive to be a growing complacency in American society, academic institutions have generally been similarly content to base their self-esteem on the accomplishments of the past. The many indicators of inadequacies in higher education have been well documented in any number of specialized reports replete with recommendations for incremental improvement or even drastic reforms. In a keynote address to the American Council on Education, for example, Gordon Gee, president of Ohio State University, expressed with particular eloquence the imperative for “radical reformation” for our colleges and universities: “The choice, it seems to me, is this: reinvention or extinction” (Gee, 2009). No one would argue that some measure of change is not essential, but we are nowhere near the sort of broad consensus or collective sense of urgency that would transform analysis into action.

In the following, I largely confine my focus to American research universities, which, I contend, should be understood as *comprehensive knowledge*

enterprises committed to discovery, creativity, and innovation (Crow, 2010). While there are approximately five thousand institutions of higher education in the United States, no more than one hundred or so, both public and private, are categorized as major research universities in the classification established by the Carnegie Foundation for Higher Education. I argue that the only antidote to the gradual erosion of our standard of living and quality of life is what in the more restricted context of technological innovation and economic competitiveness has been termed “perpetual innovation,” referring to innovation in ideas, products, and processes (Kash, 1989; Crow, 2007). More broadly, I maintain that the concept of perpetual innovation should guide the evolution of organizations and institutions, especially colleges and universities. As a case study in institutional innovation in higher education, the following also offers a summary account of selected aspects of the reconceptualization of Arizona State University (ASU), initiated in 2002. As president of ASU, I have guided the task of pioneering the foundational model for what we term the “New American University” – an egalitarian institution committed to academic excellence, inclusiveness to a broad demographic, and maximum societal impact (Crow, 2002, 2010; “A New American University,” 2008).

A LACK OF INSTITUTIONAL INNOVATION: DESIGN FLAWS IN THE AMERICAN RESEARCH UNIVERSITY

The American research university assumed its present form in the final decades of the nineteenth century. With the consolidation during this period of the discipline-based departmental organization we take for granted as the norm, significant further development in the organizational structure of the institutional form largely stagnated (Crow, 2008a; Atkinson and Blanpied, 2008). Undergirding the strict disciplinary organization of knowledge is a social organization hidebound by behavioral norms of astonishing orthodoxy. Along with entrenchment in disciplinary silos has come a fixation on abstract knowledge for its own sake as well as the proliferation of increasingly specialized knowledge, which comes to produce diminishing returns on investment as its impact on the world is measured in smaller and smaller ratios. Rather than exploring new paradigms for inquiry, academic culture too often restricts its focus to existing models of academic organization (Committee on Facilitating Interdisciplinary Research (U.S.), 2005).

Following the Second World War, American research universities assumed a leadership position in the discovery and dissemination of the

new knowledge that drives the global economy and provides those of us in advanced nations with the standard of living and quality of life we have come to take for granted (Graham and Diamond, 1997). While research universities are comprehensive in scope and the magnitude of their impact transforms nearly every aspect of our lives, their contribution to economic development is most closely associated with scientific discovery and technological innovation (Atkinson and Blanpied, 2008; Cole, 2009).

The quality of life and standard of living Americans take for granted has in fact been shaped by a trajectory of economic competitiveness that to a remarkable extent has been the product of scientific discovery and technological innovation (Blakemore and Herrendorf, 2009). Such discovery and innovation is primarily the product of the teaching and research that takes place in our colleges and universities. Public sector investment in the infrastructure of higher education – and thus investment in human capital – during the twentieth century produced a level of educational attainment that served as a catalyst to innovation and thus American competitiveness in the global knowledge economy (Goldin and Katz, 2008). Yet with our success, public investment in higher education has progressively declined (Heller, 2006; Hossler et al., 1997; McPherson and Shulenberg, 2008). American higher education cannot assume that its competitive position in the world is unassailable (Douglass, 2006). This erosion corresponds to a slackening in the pace of innovation and diminishment of our national competitiveness (Committee on Prospering in the Global Economy of the Twenty-First Century (U.S.), 2007).

The lack of innovation in the organizational structures of our colleges and universities is matched by insufficient differentiation between distinct categories of institutions as well as a stultifying homogeneity among institutions of the same type. The elite universities and colleges in our nation, both public and private, have established and maintained a gold standard for higher education that all others feel compelled to emulate, but institutions today must overcome their identification with this historical model of elitism and isolation from society. While conventional wisdom suggests that all great universities must function equally as centers for humanistic and social scientific scholarship as well as world-class science, engineering, and medical research, not every institution can support a comprehensive spectrum of programs and should instead seek differentiation and adapt to be of greater value to its constituents. Research-grade universities are but one of a number of institutional types in American higher education, but even such institutions must develop distinctly different competencies if our national innovation system is to remain robust. Our nation requires variation and not replication in all types of institutions – public universities, private universities, liberal arts colleges, regional colleges,

community colleges, professional schools, technical institutes, as well as for-profit enterprises focused primarily on workforce training. Institutions must advance unique and differentiated research and learning environments that address the needs of students with different levels of academic preparation and differing types of potential. Moreover, with the advent of ubiquitous information technology as an enabler of universal customized education, the monopoly on higher learning once held by universities is vanishing (Crow, 2006). Distance learning provides an important complement or for some an alternative to the traditional undergraduate experience.

While the intrinsic impetus to advance innovation distinguishes the research university from other institutional forms in higher education, institutions committed thus primarily to innovation restrict the potential of their contribution unless they explicitly embrace a broader societal role (Crow, 2010). We are daily confronted by urgent challenges of unimaginable complexity, yet our academic culture remains equivocal regarding the outcomes of its teaching and research. If research universities are to create knowledge that responds to the grand challenges of our epoch – social justice, poverty alleviation, access to clean water, sustainable development – these institutions must integrate their quest to advance discovery, creativity, and innovation with an explicit mandate to assume responsibility for the societies they serve. If our universities are to understand and respond to their multiple constituencies and advance broader social and economic outcomes, the continued evolution of our knowledge-producing enterprises becomes imperative (Bok, 1982; Duderstadt, 2000; Kerr, 2001; Kitcher, 2001; Rhodes, 2001; Sarewitz, 1996).

A LACK OF ACCESS AND THE PROBLEM OF SCALE

No national leader before President Barack Obama has so fully understood the transformational role of higher education in realizing both individual success and our collective societal ideals. But in order for the United States to achieve the ambitious objectives for educational attainment he specifies – the president envisions an America where all children graduate from high school and most go on to college – we must first build a higher education infrastructure adequate to the task. Unfortunately, our colleges and universities, both public and private, lack the capacity to offer access to the number of qualified applicants seeking admission. The issue of access is far more urgent than most realize, even those on the national stage charged with advancing higher education policy. More to the point, however, mere access is in itself inadequate and will not produce desired

results unless we educate greater numbers of individuals successfully and also educate at higher levels of attainment. Concomitant with building access, thus, we must also unleash evolutionary change in our institutions. What is required is a new model for our colleges and universities, a new set of assumptions that encourage institutions to innovate and differentiate and become useful to their local communities and regions while at the same time seeking solutions to global challenges.

America’s educational infrastructure remains little changed from the mid-twentieth century and is unable to accommodate projected enrollment demands in real time and at scale. More and more Americans of all ages, socioeconomic backgrounds, levels of academic preparation, and differing types of intelligence and creativity are seeking enrollment in our colleges and universities, overwhelming a set of institutions built to accommodate the needs of the United States prior to the Second World War. More and more students who would most benefit from access to higher education – those whom we might categorize as “disadvantaged” or “underrepresented” – are denied access for lack of means or choose not to pursue a baccalaureate degree for lack of understanding the implications associated with the decision (Bowen, Kurzweil, and Tobin, 2006; Douglass, 2007; Goldin and Katz, 2008; Haskins, 2008; Haskins, Holzer, and Lerman, 2009).

While the direct correlation between educational attainment and standard-of-living and quality-of-life indicators has been widely documented (Mortenson, 1999), leading American institutions of higher education have almost without exception during the course of the past half-century become increasingly *exclusive* – that is to say, they have chosen to define their excellence through admissions practices of exclusion. While our leading universities, both public and private, consistently dominate global rankings, our success in establishing excellence in a relative handful of elite institutions does little to ensure continued national competitiveness, especially when one considers the disproportionately few students fortunate enough to attend our top schools. In this sense, academic elitism has become a defensive posture and abdication of implicit responsibility.

It is generally taken for granted that there are two types of universities: the small cadre of elite institutions that focus on academic excellence and discovery, and the majority of less selective schools that offer access yet often provide little more than the most standardized instruction. Institutions that focus on academic excellence generally admit only a fraction of applicants, many of whom come from privileged socioeconomic backgrounds and have enjoyed undeniable advantages. The majority of students are thus expected to attend less competitive schools (Bowen,

Kurzweil, and Tobin, 2006; Golden, 2006). In terms of the growing social and economic stratification between those with access to a quality higher education and those denied opportunity, this implicit calculation is not only shortsighted but is certain in the long run to exacerbate inequality and injustice in our society (Bowen, Chingos, and McPherson, 2009).

If we continue to exclude a high proportion of qualified applicants from access to quality education by the excessive and sometimes arbitrary “culling” of the admissions processes of elite universities, we deprive individuals with immense promise of opportunities to attain their potential. Individuals thus deprived, whether through lack of funds or available seats represent not only personal opportunity lost but also the diminishment of societal economic prosperity. Such individuals will most likely earn lower wages and generate fewer jobs than they would have as graduates (Hill, Hoffman, and Rex, 2005). And because untold numbers of high school students lack the necessary qualifications even to submit applications to top universities and colleges, institutions have no recourse but to assume the additional responsibility to improve K-12 schools in their communities. A recent report on high school graduation rates in the fifty largest cities in the United States underscores the urgency of the problem: according to the study, seventeen of the nation’s fifty largest cities had graduation rates lower than 50 percent (Swanson, 2009). Not only must we make more of an effort to understand how to educate greater numbers of individuals successfully, but we must also endeavor to instill in students the potential to become productive citizens. A willingness to assume responsibility for the development of this socioeconomic dimension in undergraduates should become intrinsic to the societal mission of colleges and universities.

The problem of scale is an important dimension to analysis and endeavor in higher education that has not been sufficiently examined. I believe we do not understand either the implications of scale or how to shape questions at an appropriate scale in order to advance society and our institutions. With the population of the United States exceeding 308 million and projected to soar to 440 million within the present planning horizon, it is remarkable that no new universities of any significant scale are being conceptualized and built to meet enrollment demand, nor have existing institutions undertaken plans for significant expansion. Relative to the scale of our nation, the entire cadre of elite institutions, both public and private, operate on a limited bandwidth of engagement. Their lack of impact derives in part from their lack of capacity to adapt in response to the needs of society at scale. All of the engineers, scientists, doctors, and teachers that our nation will require in the decades ahead will inevitably come from the rank and file of American citizenry across all classes. Yet

where will so many students attend college in the numbers this nation urgently requires? Unless benefactors unexpectedly come forth to endow new private universities of international stature and scope, with current trends there is little hope that state legislatures will allocate sufficient investments to build new institutions or expand existing schools at sufficient scale.

Public policy throughout the nation perpetuates a tiered system that determines the lives of students according to arbitrary admissions criteria like class rankings and standardized test scores. The University of California is perhaps the nation's leading system of higher education and in some cases limits its freshman applicant pool to the top four percent of graduating high school classes. As a consequence of the enactment of Proposition 209, which prohibited consideration of race, ethnicity, and gender in admissions, UCLA admitted only 249 African American applicants to its 2006 freshman class of more than 4,800, of whom only about one hundred enrolled. While UCLA had historically maintained among the highest levels of minority enrollment in the UC system, and has since redoubled efforts to boost enrollment of ethnic minority students, given the ethnic and racial diversity of California and especially Los Angeles, such admissions practices represent a demographic distortion. Current constraints in admissions to UC system campuses attributable to the economic downturn have made recent headlines, but the progressive exclusion of more and more applicants has been ongoing for decades. According to enrollment reports from the California Postsecondary Education Commission cited by John Aubrey Douglass (2007, p. 127), the ratio of admits to freshman applicants to UC Berkeley from 1975 to 1995 declined from 77 percent to 39 percent. Since higher education is the means by which a skilled workforce is produced and the source of economic growth and advances in society both for the benefit of the individual and the collective, such trends augur a reduction in our quality of life in the next generation.

TOWARD ACADEMIC ENTERPRISE AND ECOLOGIES OF INNOVATION

Most of us correlate innovation primarily with the scientific discovery and technological advancement springing from the research enterprises of our colleges and universities, but innovation must also be understood to take place at the organizational or institutional level. If research universities seek only to recover normalcy and regard change and evolution as recourses of last resort, then we ignore the potential inherent in institutional innovation. In their quest for recovery and advancement in the

wake of the downturn, research universities face increased competition in their effort to secure limited resources. While the most important competition takes place for the best ideas, competition is ongoing for research dollars and private investment and also the best students, faculty, and administrators. In this fiercely competitive milieu, colleges and universities must embrace “real-world” entrepreneurial speed, resilience, and ingenuity. A change in institutional mindset such as I describe represents an evolutionary process or a process of institutional innovation. With my formulation of the research university as a “comprehensive knowledge enterprise,” I seek to underscore the potential inherent in the concepts of “enterprise” and “entrepreneurship,” which through some elitist logic have been marginalized in the discourse of the academy. Generally associated with the private sector, entrepreneurship is critical to the advancement of innovation (Schramm, 2006).

While the capital that business and industry produce is measured in economic terms, our task in academia is to produce both knowledge capital and human capital. All of these concepts are closely interrelated because knowledge capital actually produces human capital through a process of “academic enterprise.” If universities are to sustain their contributions to the development of new ideas, new products, and new services that yield substantial economic value, they must maintain their levels of investment in research infrastructure and R&D despite the downturn, guided by the resiliency required to negotiate ongoing technological change. In our accustomed effort to focus on discovery and the production of increasingly specialized knowledge, many research universities underestimate their capacity to advance desired outcomes or to create useful products and processes and ideas with entrepreneurial potential (Geiger, 2004). While the commercialization of university research is the most obvious avenue to move academic research at the “edge of newness” from the laboratory to the marketplace, our expansive usage of the concept of academic enterprise embraces all creative expression of intellectual capital and knowledge-centric change. Entrepreneurship is the process of innovation and spirit of creative risk-taking through which the knowledge and ideas generated within universities are brought to scale to spur social development and economic competitiveness. Academic enterprise thus inspires discovery, creativity, and innovation – the intellectual capital that is the principal asset of every college and university.

In order to maximize the potential for innovation, institutions must organize to exploit complementarities and establish new degrees of connectivity, both internally and externally, with stakeholders in the public and private sectors. Consistent with Gordon Gee’s call for universities to become “transinstitutional” (2009), entrepreneurial universities must

become highly networked, with contacts and working alliances with business, industry, and government, as well as individuals and organizations concerned with innovation and economic development. Participation in such an ecosystem of networked connectivity and cooperation creates many pathways for innovators to move ideas from conception to reality. When the organizational arrangements of an institution are conducive to innovation and a network of relevant collaborative relationships has been established, one perceives a well-rounded innovation infrastructure and the university becomes part of a larger ecology of innovation (Crow, 1998; Kash, 1989). Through such collaboration national systems of innovation integrate with global knowledge exchanges (Niosi, Saviotti, and Crow, 1993).

A PROTOTYPE FOR INSTITUTIONAL EVOLUTION: A NEW AMERICAN UNIVERSITY

As president of Arizona State University since July 2002, I have guided an effort to pioneer a foundational model for a New American University. Such self-determination has meant embracing fundamental change: we have confronted the complexities associated with advancing robust institutional innovation in real time and at scale. The operationalization of the vision represents an effort to compress a process of institutional evolution that might otherwise have taken more than a quarter of a century into a single decade (2002–12). The challenge was considerable since in its present form ASU is the youngest of the roughly one hundred major research institutions in the United States, both public and private, and, with an enrollment approaching seventy thousand undergraduate, graduate, and professional students, the largest American university governed by a single administration. An organization as large and complex as a major research university operating in one of the most rapidly growing metropolitan regions in the nation would face daunting challenges during the implementation of any large-scale planning adjustment but a comprehensive top-to-bottom reconceptualization of an institution such as we have accomplished is without precedent.

Our efforts to operationalize the vision of a New American University in Arizona were shaped by the imperative to accommodate the demands and requirements of the unique setting and demographic profile of the institution. As one of the fastest-growing states in the nation, Arizona will continue to experience large increases in its college-age population but boasts an insufficient four-year college infrastructure to accommodate that growth. Arizona’s economy is insufficiently diverse to accommodate

its population expansion, and the state is confronted with major challenges associated with its environment, health care, social services, immigration, and the performance of K-12 education. As is already the case in California, where minorities already constitute a majority, within the near term no single demographic category will comprise a majority of the population in Arizona. The rapid population growth is accompanied by rapid cultural diversification, and the unprecedented transformation of the regional demographic profile requires ASU to offer access, promote diversity, and meet the special needs of underserved populations.

Situated in the heart of an emerging megapolitan area that stretches from the Prescott region of central Arizona southward to the border with Mexico, ASU is the sole comprehensive baccalaureate-granting university in a metropolitan region of four million projected to increase to eight million. Demographic projections suggest that the so-called Sun Corridor will become one of perhaps twenty significant economic, technological, and cultural agglomerations in the United States (Crow, 2008b; Lang, Muro, and Sarzynski, 2008). Responsibility for higher education in other large metropolitan regions is shared by a number of institutions. Metropolitan Los Angeles, for example, boasts major research institutions such as UCLA, USC, and Caltech, with four additional UC campuses – Santa Barbara, Irvine, San Diego, and Riverside – within close proximity. A number of California State University campuses and private institutions such as Occidental College, the Claremont Colleges, and Claremont Graduate University complement these research universities. And while Maricopa County has the same population as the state of Colorado, the latter by contrast boasts the University of Colorado at Boulder; the University of Colorado at Denver, consolidated now with the medical school; the University of Colorado at Colorado Springs; Colorado State University; the University of Northern Colorado; a number of regional institutions, and some noted private institutions such as the University of Denver and Colorado College.

In the face of such challenges, the response of most institutions would have been to retreat and rely on the elite historical models of the past. ASU instead operationalized the vision of a New American University while continuing its existing operations. As set forth in the white paper “One University in Many Places: Transitional Design to Twenty-First Century Excellence” (2004, rev. 2009), the objective of what we term the “design process” has been to build a comprehensive metropolitan research university that is an “unparalleled combination of commitment to academic excellence and major responsibility for the economic, social, and cultural wellbeing of its community.” An interrelated formulation that we have developed is the expression of our intent to build an institution

"committed to the topmost echelons of academic excellence, inclusiveness to a broad demographic, and maximum societal impact," with the associated tagline "Excellence, Access, Impact." *Newsweek* has termed our experiment at scale "one of the most radical redesigns in higher learning since the modern research university took shape in nineteenth-century Germany" (Theil, 2008). An editorial from the journal *Nature* observes that questions about the future of the contemporary research university are being examined "nowhere more searchingly than at Arizona State University" (April 26, 2007). Accordingly, we invite scrutiny and encourage critique of the process since we consider our effort a definitive prototype or case study in the potential for institutional innovation in higher education.

While in some measure the initiation of our efforts was inspired by the call for a "new university" issued by Frank Rhodes (2001), the implementation of the New American University model we are advancing has in practice been shaped through exhaustive trial and error, a number of course corrections, and our best efforts at the application of common sense. Guided by a series of working drafts of comprehensive strategic plans, our intent has been to expand and intensify the capacity of the university for teaching and discovery in all disciplines while addressing the challenges of burgeoning enrollment with a distributed model. The evolving strategic plan centers on four basic university goals, all of which are interdependent but critical to achieving a set of eight "design aspirations," considered in the following paragraph. The goal of "access and quality for all" recognizes our responsibility to provide opportunities in higher education to all qualified citizens of the State of Arizona without impacting the highest levels of quality. A second goal is the establishment of "national standing for colleges and schools in every field." "Becoming a national comprehensive university by 2012" will build regional competitiveness and national and global distinction to the state and region. The fourth goal recognizes the university's responsibility towards the region it serves, and focuses on "enhancing our local impact and social embeddedness." While the advancement of the university will necessarily always remain a perpetual process, as of early 2010 – more than two years ahead of schedule – we announced that we have not only made demonstrable progress but have in fact accomplished these four basic goals.

The design aspirations guiding the process, applicable to all universities, both public and private, enjoin the academic community to (1) embrace the cultural, socioeconomic, and physical setting of their institutions; (2) become a force for societal transformation; (3) pursue a culture of academic enterprise and knowledge entrepreneurship; (4) conduct use-inspired research; (5) focus on the individual in a milieu of intellectual

and cultural diversity; (6) transcend disciplinary limitations in pursuit of intellectual fusion; (7) socially embed the university, thereby advancing social enterprise development through direct engagement; and (8) advance global engagement (Crow, 2002).

ASU has sought to promote access to excellence despite the challenges of burgeoning enrollment with a distributed model, operating from four differentiated campuses of equally high aspiration, with each campus representing a planned clustering of related but academically distinct colleges and schools. “School-centrism” has produced a federation of unique interdisciplinary colleges and schools that are expected to compete for status with peer entities worldwide. Schools are encouraged to grow and prosper to the extent of their individual intellectual and market limits (“One University in Many Places,” 2004, 2009).

Traditional academic organization reinforces disciplinary “silo mentality,” isolating faculty members from intellectual interaction with those in other departments. The “school-centric” reconceptualization has produced more than two dozen new transdisciplinary schools, including the School of Human Evolution and Social Change; the School of Historical, Philosophical, and Religious Studies; the School of Computing, Informatics, and Decision Systems Engineering; and the School of Earth and Space Exploration. New schools are complemented by major transdisciplinary research initiatives such as the Biodesign Institute, focused on innovation in health care, energy and the environment, and national security; the Global Institute of Sustainability (GIOS), incorporating the world’s first School of Sustainability; and the Center for the Study of Religion and Conflict. In the process we have eliminated a number of traditional academic departments, including biology, sociology, anthropology, and geology (Capaldi, 2009). Transdisciplinarity has trumped arbitrary constructs that may once have served certain social or administrative purposes but are no longer useful as we prepare to tackle global challenges (Committee on Facilitating Interdisciplinary Research (U.S.), 2005).

Operationalization of the New American University vision is shaping a unique academic profile at ASU to such an extent that consideration of major dimensions lies outside the scope of the present discussion. In recognition of the immense variability in types of intelligence and creativity that we champion in our student body, for example, ASU has established differentiated learning platforms within given disciplines to provide multiple pathways to a degree. Consistent with our design aspiration to focus on the individual, we have charted one of our campuses, for example, on a course to emerge as one of the nation’s leading polytechnics, with programs that provide both theoretical perspective and practical learning

experience, preparing graduates for direct entry into the workforce. We are advancing two differentiated schools of engineering, one focused on research and the theoretical aspects of technology and the other on practical application. Tens of thousands of students want to become engineers, yet the average math score on the SAT for students admitted to our traditional research-intensive engineering school is 765, which is to say a score in the 95th percentile. The program on our polytechnic campus responds to the needs of the thousands of students who possess spatial and tactile intelligence and every potential to enter the profession but would ordinarily never be admitted to conventional engineering programs because of their math scores. Similarly, we are advancing differentiated learning platforms through multiple schools of management or business, each with different learning modalities.

To consider a further example, to advance our institutional culture of academic enterprise we have reconceptualized a number of policies and processes associated with the commercialization of university research. Beginning with the establishment of Arizona Technology Enterprises (AzTE) in 2003 as our exclusive intellectual property management and technology transfer organization, we have boosted innovative output with new approaches to technology evaluation, product development, technology marketing, capital formation, operations and management, IP protection, industry relationships, and licensing and commercialization.

But our conception of academic enterprise transcends the commercialization of university research. ASU is building an innovation ecosystem infused with the intent not only to generate new enterprises but also to contribute solutions to the global challenges before us. We have not limited our entrepreneurial education to business and engineering but extended it across our campuses and throughout the disciplines and new interdisciplinary schools and centers. More than one hundred entrepreneurship-related courses are to be found throughout our curriculum, but instead of just teaching relevant courses we embed dynamic mechanisms for entrepreneurial innovation throughout schools and departments. The College of Nursing and Healthcare Innovation, for example, now boasts an innovation and entrepreneurship center, and a major industry-funded center for innovation in news media enhances teaching and research in the Walter Cronkite School of Journalism.

For students who are beginning to formulate a plan of action there are experiential learning opportunities and starter grants available through the Entrepreneur Advantage Project. For student teams ready to launch a venture there is the Edson Student Entrepreneur Initiative, which offers grants in addition to office space, training and mentorship. ASU Technopolis provides fledgling technology and life sciences entrepreneurs

with skills and strategies necessary to convert ideas into commercially viable businesses. Guidance is available for product development, business infrastructure development, proof-of-concept capital formation, revenue development, and access to funding. And while it is not uncommon for universities to establish research parks, ASU conceptualized and designed SkySong, the ASU Scottsdale Innovation Center, named for an iconic shade structure that is its signature architectural element. SkySong integrates academia with commerce in a state-of-the-art mixed-use complex for knowledge and technology research and commerce.

At Arizona State University we reject the notion that excellence and access cannot be integrated within a single institution, and alone among American research universities have sought to redefine the notion of egalitarian admissions standards by offering access to as many students as are qualified to attend. Our approach has been to expand the capacity of the institution to meet enrollment demand and provide expanded educational opportunities to the many gifted and creative students who do not conform to a standard academic profile, as well as offering access to students who demonstrate every potential to succeed but lack the financial means to pursue a quality four-year undergraduate education. Socioeconomic disadvantage based on low levels of family income and educational attainment of parents is a barrier to access that should occasion more widespread concern among the general public: According to research conducted by William Bowen and colleagues, the percentage of first generation college students from families with incomes in the bottom quartile of distribution represent no more than 3.1 percent of university enrollment nationwide (Bowen, Kurzweil, and Tobin, 2006, p. 98–99, figure 5.2). In an era when the importance of higher education both to the individual and the collective has never been greater, such lack of representation precisely by those who might most benefit from this obvious avenue of upward mobility is a sad comment on our society.

When President Obama spoke at our 2009 commencement exercises, he was especially excited about our newly established program to ensure that resident undergraduates from families with annual incomes below \$60,000 admitted as incoming freshmen would be able to graduate with baccalaureate degrees debt free. During fall semester 2009, the President Barack Obama Scholars program allowed more than 1,700 freshmen an opportunity to pursue their educational objectives. The program epitomizes our pledge to Arizona that no qualified student will face a financial barrier to attend ASU and underscores the success of the longstanding efforts that have led to record levels of diversity in our student body. While the freshman class has increased in size by 42 percent since 2002, for example,

enrollment of ethnic minority students has increased by 100 percent, and the number of students enrolled from families below the poverty line has risen by roughly 500 percent. Our success in offering access regardless of financial need is easily one of the most significant achievements in the history of the institution.

CONCLUSION: RECOVERING CORE VALUES OF OUR NATION THROUGH INSTITUTIONAL INNOVATION

Efforts to define a “new normalcy” in higher education in the wake of the recession are misguided because they represent the perpetuation of the ossification that has increasingly marked a sector of society that should be characterized by perpetual innovation. Any further recourse to the business-as-usual approach that has become the norm in higher education is counterproductive to efforts the academic sector must undertake to meet the challenges that confront humanity in the twenty-first century. Any such effort represents not a judicious recalibration but rather a step backwards, both for individuals and the collective. What is required instead is discussion regarding how best to operationalize perpetual innovation. What will be required are new institutional models that offer access to excellence to a broad demographic. But even such access is insufficient unless institutions have the resolve and resources to adequately guide student outcomes. Without sufficient public investment, our schools cannot hope to offer the curricula, programs, student services, and facilities that will produce the graduation rates called for by the president.

President Barack Obama has called on our universities to take on a national agenda: To provide every American with the opportunity to pursue a quality higher education. To help guide our nation through its current crisis. To ensure continued American leadership across all sectors, aided by a renewed focus on science and technology. It is the same agenda we are advancing at Arizona State University with the model of the New American University. This new model for the American research university seeks to recover the egalitarian values of a national university envisioned by the framers of the Constitution.

During the summer of 1787, a nascent republic was just completing its earliest aspirational blueprint, the Constitution of the United States of America. At this watershed moment in the history of the democratic process, delegates from the thirteen colonies considered the possibility of establishing a national university. While the vision for a single preeminent national institution dedicated to the advancement of knowledge and

discovery for the collective good was never realized, I would contend that such an institution evolved and flourishes to this day.

Our great public universities collectively comprise a de facto national university. Taken together all public universities produce more than 70 percent of all baccalaureate degree recipients in our nation as well as conducting nearly two-thirds of all federally funded research (McPherson, et al., 2009). It is these institutions that educate the majority of our students in a milieu that advances discovery and innovation and creativity while contributing to the development of a highly skilled workforce and the prosperity of our economy.

There was a time in the life of our nation when average citizens could reasonably hope for access to our great public universities. Following the Second World War, for example, returning veterans could expect to be admitted to institutions like the University of Michigan or the University of California, Berkeley, based on the B-plus average they had earned in high school. With elite universities now limiting enrollment to the very topmost few percent of graduating high school classes, the broad access to the best possible education that could once be taken for granted is now denied. While some may argue on behalf of this putative meritocracy and yet others justifiably challenge its assumptions (McNamee and Miller, 2004), I contend that the real imperative is for higher education to recover the egalitarian tenets inherent in the intentions of the founders of this nation. Since no national university was in fact ever established and higher education in America has instead thrived through the advancement of an astonishing array of diverse and heterogeneous institutions, each more at liberty to establish its own identity than most would even dare to contemplate, those of us in the academy are free to determine for ourselves the meaning of a true public university in all of its varied institutional forms. This, then, is a call for a New American University focused on perpetual innovation and for higher education to serve a higher purpose.

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The Future Of The Research University / 2008

Building an Entrepreneurial University



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THE FUTURE OF
THE RESEARCH UNIVERSITY

Meeting the Global Challenges of the 21st Century





Building an Entrepreneurial University

by Michael M. Crow
President, Arizona State University

Michael Crow is the president of Arizona State University. Prior to joining ASU in 2002, he was executive vice provost of Columbia University, where he also was professor of science and technology policy. As chief strategist of Columbia's research enterprise, he led technology and innovation transfer operations and the establishment of large-scale interdisciplinary research initiatives. A fellow of the National Academy of Public Administration, he is the author of books and articles on research organizations, technology transfer, and public policy as it relates to science and technology. He holds a BA from Iowa State University and a PhD in Public Administration from Syracuse University.

“Enterprise” is a concept sometimes wholly lacking in discussions about higher education and the American research university. “Academic enterprise” and the entrepreneurial academic culture that such an orientation instills encourage creativity and innovation with intellectual capital—the primary asset of every college and university.

Generally associated with the private sector, the spirit of enterprise is nonetheless highly relevant to the advancement of all of our nation's colleges and universities, but especially our research universities—institutions dedicated to both teaching and discovery. There are approximately 5,000 institutions of higher education in the United States and, of these, roughly 150, both public and private, are classified as “research extensive” in the classification established by the Carnegie Foundation for Higher Education. These are the institutions that increasingly fuel the national economy by producing leaders in all sectors of academia, business, industry, and government, and through perpetual innovation in products and processes.

a view from the united states

Since becoming the president of Arizona State University in July 2002, I have been leading an effort to reconceptualize a large public university as an academic enterprise—agile, competitive, adaptable, and responsive to the changing needs both of our constituencies and global society alike. The speed with which we now make and implement decisions and establish collaborative relationships with other academic institutions, and with business and industry, is characteristic of private enterprise. As an enterprise, we acknowledge and embrace the fact that we operate in a competitive arena. We are competing not only for research dollars and private investment, but also for the very best students, faculty, and administrators, and above all, for the very best ideas.

Instilling the spirit of enterprise into the institutional culture of a public university is only one of my objectives as the president of an emerging research institution. The larger task we have taken on is to redefine public higher education through the creation of a prototype solution-focused institution that combines the highest level of academic excellence, maximum societal impact, and inclusiveness to as broad a demographic as possible. Predicated thus on excellence, access, and impact, the paradigm is conceptually framed as the “New American University.”

The spirit of enterprise I endorse therefore must be integrated into a larger context. Academic enterprise is only one of eight “design aspirations” for the New American University. There are many ways to parse the concept of the New American

We are competing not only for research dollars and private investment, but also for the very best students, faculty, and administrators, and above all, for the very best ideas.

University, but, in brief, its objectives are inherent in the following guidelines that, reduced to their essential terms, enjoin the academic community to (1) embrace the cultural, socioeconomic, and physical setting of the institution; (2) become a force for societal transformation; (3) pursue a culture of academic enterprise and knowledge entrepreneurship; (4) conduct use-inspired research; (5) focus on the individual in a milieu of intellectual and cultural diversity; (6) transcend disciplinary limitations in pursuit of intellectual fusion; (7) socially embed the university, thereby advancing social enterprise development through direct engagement; and (8) advance global engagement. Taken together, these comprise a paradigm for academic institutions, both public and private, that I advocate without reservation. All of the design aspirations are interrelated, but in the following I will focus primarily on academic enterprise. Before we consider our efforts to rethink the contemporary

American research university, the following brief historical overview of the institutional form will set the context for a discussion of its present design flaws and the imperative for its reconceptualization.

The Evolutionary Trajectory of the American Research University

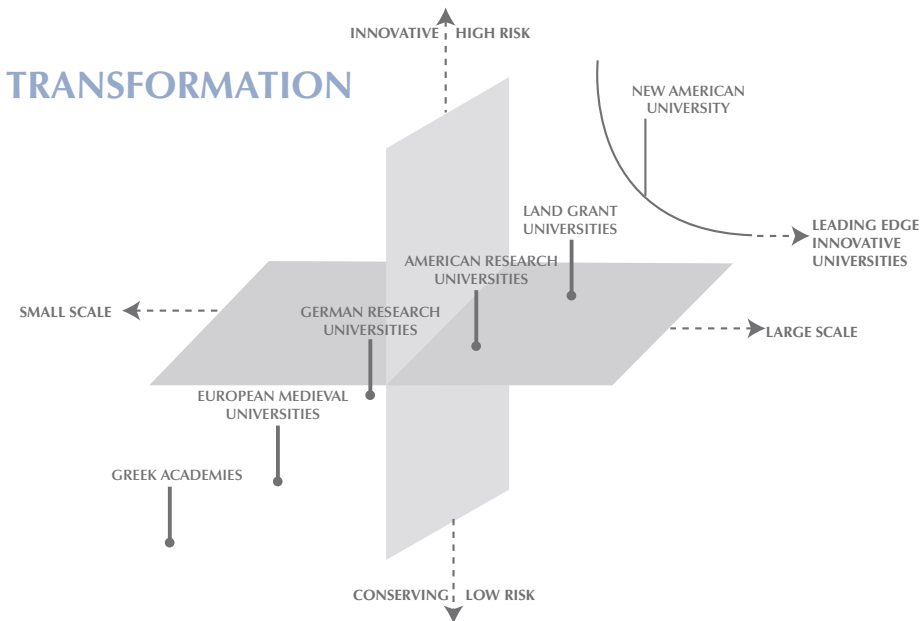
With a global population of 6.5 billion projected to increase to 8.5 billion by mid-century, we face challenges of unimaginable complexity, both as a species and, more narrowly, in terms of our standard of living and quality of life as a nation. But we strive to deny complexity in our national policymaking and planning, and, rather than learning to understand and manage complexity in the academy, we restrict our focus with ever-greater specialization and the narrowing of disciplines. Our universities remain highly static, resistant to change, unwilling to evolve in pace with real time, and focused primarily on their advancement of abstract knowledge. The organizational frameworks we call universities—this thousand-year-old institutional form—have not been designed to accommodate change on the scale we are witnessing or the attendant increases in complexity. Moreover, organizational constraints derived from the flawed institutional design of our colleges and universities prevent them from realizing their entrepreneurial potential. In order for our universities to overcome their ossification, academic enterprise must become a new organizing principle, both organizationally and conceptually. American research universities need not remain static, monolithic behemoths, unwilling or unable to advance their own institutional evolution or to catalyze positive societal transformation.

With a global population of 6.5 billion projected to increase to 8.5 billion by mid-century, we face challenges of unimaginable complexity, both as a species and, more narrowly, in terms of our standard of living and quality of life as a nation.

The evolutionary trajectory of universities in the Western world can be modeled as a process visualized along two axes. The x-axis represents the scale of the institution, with scale meaning more than just size. Scale in this usage refers to the *breadth of functionality*, which measures more than just the number of disciplines studied. If the institution is a comprehensive knowledge enterprise such as the New American University, it will be committed to the traditional missions of teaching, research, and public service, but, in addition, will advance innovation and entrepreneurship. Scale thus refers to both the intellectual, or pedagogical, and

a view from the united states

functional breadth. The y-axis, meanwhile, reflects the institution's *conception of itself* as an evolving, entrepreneurial entity. At the low end of the y-axis, we have what organizational theorists call conserving institutions, those that are inwardly focused, risk-averse, and concerned primarily with self-preservation. At the upper end are entrepreneurial institutions, those willing to adapt, innovate, and take risks in rethinking their identities and roles. In the following chart, the New American University appears in the curve in the upper-right quadrant reserved for leading-edge institutions designed to accommodate innovation, rapid decision-making, and entrepreneurial behavior.



A brief historical overview of the lineage of our universities—in a sense, our institutional genetic code—demonstrates the dynamics between scale and innovation. On the hills around Athens in Greece, academies formed more than 2,400 years ago when individuals of astonishing intellect like Socrates and Plato and Aristotle assembled and began to conceptualize and advance the core pedagogical methodology that we still use to the present day. The ancient Greek academies developed the capacity to understand nature and society in complex terms, but they were tiny in scale and exclusively “conservative,” in the sense of entrusting themselves to conserve

a view from the united states

knowledge. The ancient academies had little impetus to disseminate knowledge beyond their small circles and no conception of the notion of risk and reward.

Fast-forward 1,500 years: The first universities begin to emerge. Bologna, probably the oldest university in the Western world, was established in the eleventh century, followed by the University of Paris and, soon thereafter, Oxford and Cambridge; institutions like Uppsala University, in Sweden, and Jagiellonian University, in Krakow, become great centers of learning. Within this ethos, universities emerged as organizations focused on discovery. Our very understanding of who we are as a species and our place in the universe is the product of scholars and scientists working in these great institutions. In the office of the rector of Jagiellonian University, an institution established in 1364, one can find the instruments that Copernicus used to determine that the Earth was not the center of the universe. The medieval European universities were slightly larger in scale and only slightly more focused on disseminating knowledge. These institutions had only the most limited concept of risk and reward.

Fast-forward again to the late eighteenth century: Industrialization in Europe begins to transform the socioeconomic and cultural landscape, spreading from Great Britain throughout Western Europe, and especially into central and northern Germany. Driven largely by industrial competition and the emergence of the notion of efficient technology-driven competitiveness, the German universities that arose in the eighteenth century focused on specialized scientific research and were thus the predecessors of American research universities, but, with few exceptions, entrepreneurship was still little in evidence.

The prototype for the American research university was established in 1876 by Johns Hopkins University, which combined the traditional American undergraduate liberal arts college with the German model of the elite scientific research institute offering specialized graduate training. The American research university thus came into being in the decades between 1876 and 1915. During this formative period, existing mature universities redefined themselves as research-grade institutions and new institutions were established on the Hopkins prototype. The roster includes institutions that set the standard for the American research university, including Harvard, Columbia, Michigan, Illinois, California, Stanford, Chicago, MIT, and others. Some of these were land-grant universities established under the Morrill Act. With their connection to large-scale agricultural research, these were among the first universities to explicitly take on a broader functional mission, that of advancing the “agricultural and mechanical arts” for the growth of the country. Rather than focus on teaching the classics to the privileged,

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the land-grant institutions became involved in production agriculture and thus further advanced the model of the entrepreneurial university. The land-grant schools had the capacity to create products and processes and other forms of capital that could be sold and used by consumers outside the university system, and entrepreneurship came to the forefront. Following the example of these pioneering institutions, universities like Stanford and MIT committed themselves to entrepreneurial risk-taking and prospered.

The establishment of the prototype of the American research university was a critical evolutionary step in the growth and development of universities, setting the pattern for intense and focused discovery across all disciplines, the emergence of American-style graduate study leading to advanced degrees, including the PhD, and the emergence of the professoriate as both teachers and practitioners. The important point in this sketchy historical overview is that institutions of higher learning, like all organizations, are evolving entities. To the extent that they can adapt to a changing environment or, better yet, lead the change, they survive and flourish. Like other organizations, they also must be wary of institutional inertia, the resistance to change that almost certainly would bring about their demise.

Institutional inertia is nowhere more evident than in the academic valorization of increasingly specialized knowledge. In our effort to produce abstract knowledge without regard for its impact, many universities have lost sight of the fact that they are also institutions with the capacity to create products and processes and ideas with entrepreneurial potential. Prestige always will attach to the pursuit of the unknown, but I would argue that we must reprioritize our practices and rethink our assumptions if we are not to minimize the potential contributions of academic enterprise. Through some

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strange elitist logic, the concept of entrepreneurship has been eradicated from institutions of higher education in this nation. I would argue that we have been excessively attached to our lineage from the academies of ancient Greece and the medieval European universities. We must instead design some of our institutions to allow us to be competitive and address the challenges that will confront global society in the decades ahead. Our universities must

recover an entrepreneurial edge if they are to be relevant and useful on a global scale. Yet, however significant the potential of their contributions to societal advancement, entrepreneurial universities must first expand access to a broader demographic if their impact is not to be diminished.

Dilemma: Excellence or Access?

Research universities both in the United States and around the world are the primary sources of the knowledge and innovation that have driven the global economy and provided those of us in advanced nations with the standard of living that we have come to take for granted. But in America and elsewhere, leading institutions tend to be *exclusive*—that is to say, they define their excellence based on exclusion. It generally is taken for granted that there are two types of universities: those that focus on academic excellence and discovery, and those that focus on access—providing a base level of higher education. Institutions that focus on academic excellence generally admit only the finest students, most of whom come from privileged socioeconomic backgrounds and have enjoyed undeniable advantages. All others are expected to attend less competitive schools. In terms of societal outcomes, this implicit calculation not only is shortsighted, but also may, in the long run, be a fatal error. There is growing social and economic stratification between those with access to a quality higher education and those without. More and more students who would most benefit from access to this most obvious avenue of upward mobility—those whom we might categorize as “disadvantaged” or “underrepresented”—are denied access for lack of means or choose not to pursue for lack of understanding of a high-quality university education.

Higher education is the means by which a skilled workforce is produced and the source of new knowledge capital and, thus, economic growth and advances in society, for the benefit of both the individual and the collective. The global economy requires skilled workers, and the wage gap between those with education and skills and those without continues to widen. More and more knowledge inputs are increasingly required to perform almost any job in the new global knowledge economy. The economic success of individuals contributes to the success of a society—in fact, it is the main driver.

If we continue to exclude a high proportion of the population from reaching their prosperity potential by excessive and sometimes arbitrary “culling,” we deprive countless individuals of opportunities to attain prosperity. We need to make more of an effort to understand how to educate greater numbers of individuals successfully, but we also must educate people to be successful. This economic dimension is intrinsic to the societal mission of colleges and universities. Individuals deprived of higher education through lack of funds represent not only personal opportunity lost, but also the loss of societal economic prosperity. Individuals deprived of college educations likely will earn lower wages and generate fewer jobs than they would have as graduates. A lack of

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higher education is not only a personal loss; it is a loss for all of society and the global economy.

We reject the conventional wisdom that excellence and access cannot be achieved in a single institution and have committed ourselves to building a university that combines the highest levels of academic excellence with access to a broad demographic, and to accomplish this at scale. Such an institution seeks to provide the best possible education to the broadest possible spectrum of society, embracing the educational needs of the entire population—not only a select group, and not only the verbally or mathematically gifted. Its success will be measured not by whom the university *excludes*, but rather by whom the university *includes*, and from this inclusion will come the diversity necessary for the advancement of society.

Our mission, as we have conceived it, is to build a comprehensive metropolitan research university that is an unparalleled combination of academic excellence and commitment to its social, economic, cultural, and environmental setting. Excellence, access, and impact are thus integral to our mission and integrated in a single institution. Of the 150 major research institutions in our nation, both public and private, ASU alone has sought to redefine the notion of egalitarian admissions standards. Our approach has been to expand the capacity of the institution to meet burgeoning enrollment demand, and provide expanded educational opportunities to the many gifted and creative students who do not conform to a standard academic profile, as well as offering access to students who demonstrate every potential to succeed but lack the financial means to pursue a quality four-year undergraduate education. Our admissions standards are determined by our assessment of a potential student's ability to do university-level work, not by test scores or some other arbitrary indicator.

In the rapidly changing and highly competitive global knowledge economy, the value of a university education has never been greater. Higher education is the means by which a skilled workforce is produced, and is the source of economic growth and advances in our society, for the benefit of both the individual and the collective. Our colleges and universities play a key role in ensuring that, as a nation, we will continue to lead the world in innovation, maintain our competitive advantage, and weave the fabric of our economic prosperity. Without an increasingly highly educated citizenry, we as a nation may face a reduction in our quality of life in the next generation, something unheard of in the past. In order for America to remain competitive, it is imperative that our universities prepare our students to learn rapidly, and make them capable of integrating a broad range of disciplines in a rapidly changing world. But the institutional

design of our universities may itself represent an inherent obstacle. Our reconceptualization of ASU has been undertaken to correct a number of inherent design flaws in American research universities.

Demographic Challenges to Excellence, Access, and Impact

Arizona State University is at once the youngest and largest and fastest growing of all major American research institutions, enrolling more than 64,000 undergraduate, graduate, and professional students in twenty-one colleges of equally high aspiration configured across metropolitan Phoenix. ASU is the only comprehensive university in a metropolitan region with a population that already exceeds four million and is projected to merge into a megapolitan corridor with a population that could approach ten million in the coming few decades. As one of the fastest-growing states in the nation, Arizona will continue to experience large increases in its college-age population but lacks a sufficient four-year college infrastructure to accommodate that growth. Arizona's economy is insufficiently diverse to accommodate its population expansion, and the state has major challenges associated with its environment, health care, social services, immigration, and the performance of P-12 education. As is the case in California, where minorities already constitute a majority, within the near term, no single demographic category will comprise a majority of the population in Arizona. The rapid population growth is accompanied by rapid cultural diversification, and the unprecedented transformation of the regional demographic profile requires ASU to offer access, promote diversity, and meet the special needs of underserved populations.

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At the same time that the greater Phoenix metropolitan region matures and becomes the heart of a vast megapolitan region, ASU has set a course to evolve from a regional university to a national research institution of top rank. In response to demographic pressures, and because we believe that the university can best accommodate the needs of the region by facilitating the broadest possible distribution of its teaching, research, and community service, we plan to increase enrollment from the current level of 64,000 students to approximately 100,000 by 2020, thus providing expanded educational opportunities—both on-campus and online—to qualified students. To accommodate enrollment increases from 35,000 students in 1975 to 100,000 in 2020 is no small feat. In terms of resources and infrastructure, during the past five years we have added nearly seven million square feet of new academic space,

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including more than one million square feet of new research space. The infrastructure required to accommodate such growth requires billions of dollars in capital investment and, in the past five years, we have invested \$1.5 billion in new facilities. There remain \$3.5 billion of additional facilities yet to come, and the government will finance less than one-third of those. Investment has come from private sector partners, donors, and multiple municipal governments. A master plan is redefining the relationships between the four ASU campuses, the clusters of colleges and schools that comprise each campus, the university community and its academic programs, and the university and surrounding metropolitan region. The intent of the master plan is to create campuses whose buildings and grounds reflect the scope and stature of a world-class institution and provide for our students a vibrant living and learning environment. Among the most important planning principles we observe is the integration of the campus into the community, which is consistent with our design aspiration of “social embeddedness.”

Consistent with our design aspirations to focus on the individual and transform society, ASU proudly champions diversity, and the enrollment of students of color since 1996 has increased by 81 percent. And, while the freshman class has increased in size by 36 percent during the past five years, enrollment of students of color has increased by 40 percent, with students from Hispanic backgrounds now comprising more than 14 percent of undergraduate enrollment. And, in addition to our Latino students, ASU enrolls roughly 1,500 students from Native American backgrounds, one of the largest such enrollments in the nation. In Arizona, our twenty-two Native American tribes speak different dialects that often are correlated with one another, but have no correlation with either English or Spanish.

Demographic diversification among ASU students is accompanied by differentiation in wealth. The average family income of the upper quintile of our students exceeds \$200,000 per year. The bottom quintile has a tenfold lower level of income, less than \$20,000 per year. Our institution thus enrolls students from families that are wealthy, even by American standards, and others from families that have virtually no income. The current level of investment in undergraduates through scholarship and gift support is approaching \$100 million annually and, for graduate students, exceeds \$50 million. We have greatly expanded both our investments in general financial aid, and in specific programs designed to help low-income Arizona students attend and graduate. The number of students enrolled from families below the poverty line has risen by roughly 500 percent, a number we expect will continue to grow, and we have increased the number of Pell Grant recipients by one-third, from

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9,200 to 12,300 recipients. A program called ASU Advantage provides tuition, fees, room, board, and books (via merit- and need-based grants and scholarships, and work-study) for students who meet all normal admissions standards and whose family incomes do not exceed \$25,000. And all other students at all income levels pay only about 2 percent of the cost of tuition after merit-based scholarships and need-based grants. Although we expend university resources for programs like ASU Advantage and receive no support from the state, we are overcoming financial barriers to access.

As a public metropolitan research university, the profile of the student body, the character of the research enterprise, and the scope of community engagement differ from that of other institutions. ASU is a public asset that belongs to all the citizens of Arizona, and is an active partner with the private sector in initiatives to enhance the social well-being, economic competitiveness, cultural depth, and quality of life of metropolitan Phoenix and statewide. Consistent with our design aspirations associated with community engagement and societal transformation, ASU offers more than 1,000 outreach opportunities in partnership with more than 500 community organizations across Arizona. ASU is investing in the future of the many diverse communities beyond our campuses.

Institutional Redesign to Facilitate Access to Excellence and Academic Enterprise

Arizona State University is mid-point in a decade of unprecedented change and decisive maturation, positioning itself to emerge as a prominent global university and comprehensive knowledge enterprise committed to teaching, discovery, creativity, and innovation. To promote access to excellence despite the challenges of burgeoning enrollment, we have adopted a distributed model, operating from four differentiated campuses of equally high aspiration, with each campus representing a planned clustering of related but academically distinct colleges and schools. We term this empowerment of colleges and schools “school-centrism.” The school-centric model produces a *federation* of unique colleges, schools, academic departments, and interdisciplinary institutes and centers (“schools”), and a deliberate and planned clustering of programs on each campus around a related theme and mission. Predicated on devolving intellectual and entrepreneurial responsibility to the level of the college or school, the model calls for each school to compete for status, not with other schools within the university, but with peer schools around the country and around the world. Consistent with the design aspiration of academic enterprise, schools are encouraged to grow and prosper to the extent of their individual intellectual and market limits.

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The reconceptualized school-centric organization has produced a federation of twenty-one unique interdisciplinary colleges and schools that, together with departments and research institutes and centers, comprise close-knit but diverse academic communities that are international in scope. Consistent with this school-centric model, we have conceptualized and launched sixteen new interdisciplinary schools, including the School of Global Studies, the School of Human Evolution and Social Change, the School of Materials, and the School of Earth and Space Exploration. Although we are first and foremost committed to educating the students of Arizona, we are equally a cutting-edge discovery organization, focused on contributing to regional economic development through enhanced research and academic programs, including major interdisciplinary research initiatives such as the Biodesign Institute, focused on innovation in health care, energy and the environment, and national security; the Global Institute of Sustainability (GIOS), incorporating the world's first School of Sustainability; and the Center for the Study of Religion and Conflict.

Consistent with our objective of creating differentiated learning environments that address the needs of individual students, we have designated one of our campuses, for example, to emerge as one of the nation's leading polytechnics, with programs that provide both a theoretical and practical learning experience, preparing graduates for direct entry into the workforce. We are advancing two differentiated schools of engineering, one focused on research and the theoretical aspects of technology, and the other on practical application. Similarly, we have established three schools of education and three schools of management or business, each of which is built on a different learning platform. Some are focused on research, some on cultivating leadership skills, and some on practical application through learning-by-doing. We are overlapping and merging these programs to achieve maximum leverage.

At our four campuses, we have instituted a model with no campus-level governance—neither chancellors nor provosts, but only deans heading colleges and schools. Deans are responsible for the emergence of individualized learning environments. We also have made efforts to eliminate the hierarchization or “tiering” of campuses. We do not observe a distinction between a “good” campus, a “not-so-good” campus, and a “still-lesser” campus. Although not always explicit, that tiering process is very common in American universities, and perhaps in some European institutions, and it is a pernicious structural obstacle to student success. The historic Tempe campus used to be known as the “Main Campus,” but now we simply refer to it as Arizona State University at the Tempe campus.

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To fill out the picture of our organizational reconceptualization to maximize academic enterprise, I would like to consider some more complex and even radical modes of innovation. The first is an example of what we call “system innovation.” The goal is to have impact on a major social system through innovation in multiple yet interrelated ways, and the system we are targeting is the P-20 education system. This is a term used in the United States to refer to the whole spectrum of formal education, with the “P” standing for pre-kindergarten and the “20” standing for the last year of formal instruction in graduate school. However, I will summarize what we are doing as an institution to transform education through the twelfth grade.

First, we are building up our institutional capacity to deal with education. For instance, we now have not one but three schools of education, each with a different learning platform for the teachers and prospective teachers who enroll. One school has a focus on preparing leaders in education, another has a focus on technology and innovation, and the third is our more traditional school, the highly ranked Fulton College of Education. At the same time, we are building new collaborative partnerships with entities outside the university. These range from independent, nonprofit groups concerned with education to public school districts in Arizona. We also are becoming more active in education policy, working with public policy makers in our state government and with national organizations.

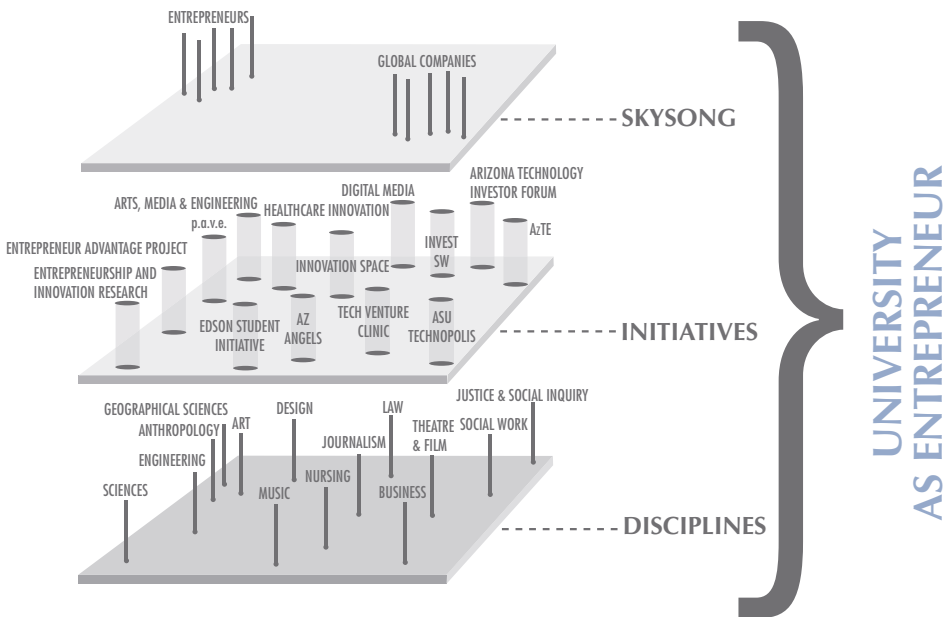
Finally, we are launching a number of strategic initiatives. One is a nonprofit enterprise called University Public Schools, Inc., through which we will operate our own schools to implement new ideas in education. Our first prototype, an elementary school, opened in August 2008. Our schools will not be elite schools for the children of professors, by the way. They will be for students from all backgrounds, including low-income families and immigrant households where the primary language is not English. We want to demonstrate how education can work for every student. We believe that, when education falls short, the main obstacle is not resource constraint, but, rather, idea constraint. So we are working across multiple dimensions—from redesigning the structure of our own university to starting actual new schools in the field—in order to create an entire system of innovation for transforming this social system.

Fostering an Entrepreneurial University: Toward an Ecology of Innovation

To foster the entrepreneurial potential of our institution, ASU also is trying to innovate more effectively by improving core processes that lead to innovative output. The obvious example here is technology transfer or intellectual property

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commercialization. A good bit of what we are doing in this area draws on the work of the Ewing Marion Kauffman Foundation, which has studied the issues extensively. At ASU, we are experimenting with several new approaches at once. To simplify the licensing process, for example, we have introduced the use of licensing templates and master sponsored research agreements, which can reduce the need to negotiate over terms and conditions. In terms of strategic objectives, we are managing our IP for deal flow density rather than for revenue—in other words, to maximize the number of inventions and discoveries actually moved into use, instead of trying to maximize near-term income from fewer and bigger deals. We also are experimenting with faculty entrepreneurship incentives, allocating the income so as to give faculty inventors a greater incentive for starting companies.



A systems innovation approach is reflected in our institution-wide campaign, called “University as Entrepreneur.” The overarching objective of this initiative is perpetual institutional innovation. Toward this end, we seek to inspire and enable both students and faculty members to innovate. In practice, we actually generate new enterprises—whether for-profit startup companies or new ventures in research or education, or useful new projects of any kind. As you can see from the chart, creating

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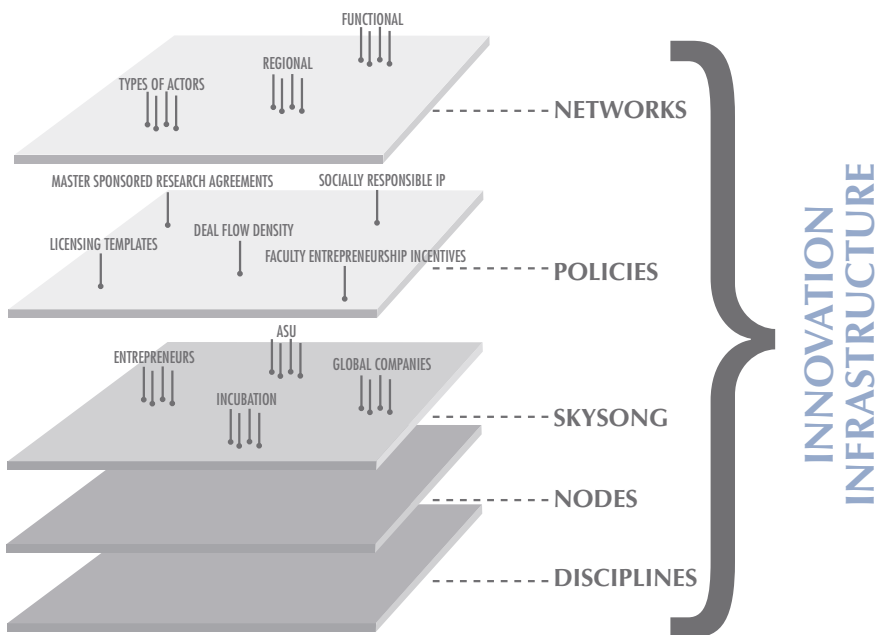
an entrepreneurial university is a multi-level task. We start at the foundation with our academic disciplines. We want to engage all of them, from the arts and humanities and social sciences, to the natural sciences and engineering and the professional schools. Instead of just teaching courses in entrepreneurship that would reach all of the disciplines, we have decided to embed entrepreneurial opportunities and learning environments within each of them. So our nursing college now has an innovation and entrepreneurship center. Our journalism school has a major industry-funded center for innovation in the news media. In every school and discipline, there is now a set of dynamic mechanisms for making innovation something that lives habitually within the context of the discipline.

At the next level up, we launch and facilitate a series of initiatives geared to assisting entrepreneurial ventures that come out of work in the disciplines. We believe there is value in fostering large numbers of initiatives because, inevitably, some will fail. In this manner, we allow natural selection to demonstrate which have merit. One that has shown particular merit is the Edson Student Initiative. Here we have raised an endowed fund to finance companies started by students. The students own the companies and the university expects no return other than seeing the companies take off. This is an idea we picked up from Tec de Monterrey in Mexico, and it is working well in metropolitan Phoenix: We are incubating about eighty student-led companies right now. Another initiative that has worked well is ASU Technopolis, which brings together entrepreneurs, venture capitalists, and creative thinkers in the Phoenix region. ASU Technopolis encourages innovation and economic development by providing fledgling technology and life sciences entrepreneurs with skills and strategies necessary to convert ideas into commercially viable businesses. Guidance is available for product development, business infrastructure development, proof-of-concept capital formation, revenue development, and access to funding. Technopolis stimulates economic development by offering a series of rigorous programs that educate, coach, and network local entrepreneurs. Through this program, approximately 500 early-stage companies have received coaching and mentoring, and they have raised about \$75 million in private investment capital.

The top level in the chart is labeled "SkySong," which requires some clarification. It is not uncommon for universities to establish research parks, which begin as entrepreneurial ventures but often turn out to be more about real estate. We decided to make our enterprise more than the typical real estate project by expanding the vision. To position metropolitan Phoenix and the state of Arizona as competitive in

a view from the united states

the global knowledge economy, ASU conceptualized and designed a hub for knowledge-driven industries, technology innovation, and commercial activity. In collaboration with the City of Scottsdale and the ASU Foundation, ASU established SkySong, named for an iconic shade structure that is the signature architectural element of the complex. We enlisted a public-sector partner and a private-sector partner and, instead of just providing space for locally grown companies, decided also to recruit large global and foreign-based companies that could engage in beneficial exchange with the university and its startups. SkySong is a \$500 million world-class assembly point for knowledge and technology research and commerce. With 1.5 million square feet of densely packed and creative educational, research, cultural, retail, and residential space, SkySong will be the nucleus for an entire open-ended community of entrepreneurs dedicated to innovation and learning.



We have instituted a number of institutional policies that promote entrepreneurship and make it easy to move ideas into action, consistent with the policies mentioned earlier relating to intellectual property commercialization. Conversely, policies that discourage entrepreneurial behavior should be minimized. Unfortunately, many

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universities have a wide range of such constraints—the kinds of policies that can inhibit decision-making, deaden creative thinking, and turn deans into paper-pushers. Changing the policy structure of the institution is an ongoing project that goes hand in hand with changing institutional culture. There have certainly been individuals who have disagreed with the objective of fostering an entrepreneurial university, or who did not see the value in it, and we have resolved the issue in a number of ways. We have conducted meetings and discussions to resolve concerns, and, as we advance, we attract new faculty and staff who are aligned with the vision and want to be part of it. In my six years as president, we have been able to move forward significantly.

Finally—and this is very important—an entrepreneurial university is highly *networked*. It has contacts and working alliances with entrepreneurs and industries, and with all sorts of individuals and groups concerned with innovation and growth. Along with cutting-edge research, universities that aspire to have broad impact are marked by a very high degree of connectivity, both internal and external. Such an ecosystem of networked connectivity creates many pathways for people to move ideas from conception to reality. When all of the elements are working together, one perceives a well-rounded *innovation infrastructure*, and the university becomes part of a larger *ecology of innovation*.

An Investment Model for Academic Enterprises

Along with organizational redesign comes the need for reconceptualization of the institutional mindset. Like other public institutions, ASU derives the majority of its operating budget from the State of Arizona, which has led it in the past to conceive of itself as an agency of the state government. But as universities reinvent themselves as academic enterprises navigating in the competitive academic marketplace, it is imperative that they assume responsibility for their advancement consistent with the paradigm of an investment model. With the investment model at ASU, we make the case that if either the private sector or the public is willing to lend us financial or political support, we promise to work to deliver a specified return on investment. The simple argument for investment of taxpayer dollars in a public university proceeds according to the following logic: If the appropriations committee of the state legislature invests specified resources, the university promises to work to deliver an agreed-upon return. Without such an investment, there can be no return on investment. Here is the negative impact from not making that investment. Here is the impact of that non-return on the overall enterprise—the state—that is in your charge. The same argument can be made for investment from the federal government, business and industry, and foundations and individuals.

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When we have made requests for tuition adjustments, we present it as an argument for investment. This past year, we published a sixty-page white paper on the return on investment to a family making investments in tuition for their children, or students making investment in themselves, and we calculated the annual rate of return to the individual over his or her lifetime at 12 percent. A college education is the most significant investment that anyone can make over that time frame. When we requested \$233 million from the City of Phoenix to establish an ASU campus downtown, we made it on an investment basis. We went to the city with our vision of what we want the university to become, and said, "If you make this investment in us, we will be able to start a campus on twenty-two acres of land in downtown Phoenix. Here is what we will commit and what our schools will be able to achieve with these new facilities." It is difficult to refute such sound logic.

When one considers the effort required to build this new kind of university, one perfectly reasonable question that may arise is: How do you pay for it? The answer to that question has several parts. We have had to rethink and make adjustments to our overall financial structure, as one would with any major program of reconceptualization. In some cases, new initiatives have been launched on an entrepreneurial basis—that is to say, they receive initial seed funding, but beyond that they must raise or generate their own funds. But here is the best part: We have found that this model of the entrepreneurial university *attracts investment* from others. It is a model that invites wide-ranging participation and promises and delivers wide-ranging benefits. If an institution can put forth an entrepreneurial model of this type, individuals and corporations and foundations and governments will validate it by investing in the vision.

To summarize a few major investments: The Kauffman Foundation has given us a \$5 million grant for our effort, which we leveraged to attract another \$25 million in matching funds. Entities of regional government, with whom we had no financial relationship in the past, have put in significant funding: the \$233 million grant from the City of Phoenix and a \$100 million grant from the city of Scottsdale. Private individuals have invested hundreds of millions of dollars to create endowments for venture funds, for other initiatives, or for particular schools and colleges at the university. Altogether, in advancing this model, we have been able to generate about \$1.2 billion per year of new resources for the institution in the last six years.

This model puts us in a much better position to compete for major research funding because, in addition to basic research capability, we can demonstrate the *entrepreneurial* capability to move the research forward and develop it for application.

This is valuable to sponsors who want to see not only the discovery of new knowledge but also real-world results. Recently, for example, we have attracted significant investment for new approaches to attacking cancer. The government of the Duchy of Luxembourg is partnering with us on a \$200 million effort targeted to lung cancer, and we were one of three institutions to win highly competitive grants for new cancer research authorized by the U.S. Congress. Also, the U.S. Army has funded a \$110 million project to develop a thin-film flexible display that would be wearable on the body or disposable like paper. Again, they chose ASU because they believe that our faculty—working with the thirteen companies that we have brought into our facility with us—will be able not only to determine the scientific pathway to this technology but also be able to actually develop it.

Toward Entrepreneurial Universities Capable of Perpetual Innovation

The very identity of the university is at stake today and each institution must focus on establishing its own unique and differentiated identity. The question, “What is a university?” is one that every speaker at this conference is in some respect addressing. What are these institutions called universities, and how are they different from other institutions and organizations in our society? And, more to the point, why do universities need to assert their difference from other institutions and insist on their status as enterprises? The greatest universities that exist on the planet have emerged in America during the past several hundred years, and especially during the past century. All of these institutions share a set of characteristics that are consistent with the great universities that have emerged in the past. A principal characteristic of great universities is that not one of these institutions conceives of itself as either a corporation or an agency, by which I mean a standardized unit of government. All of them have emerged as enterprises. Some are public and owned by collectives such as the State of California or the State of Michigan. And some are private and self-perpetuated by groups of committed stewards who, over the course of centuries, have guided their institutions to greatness.

A number of environmental forces are, or should be, influencing how each of us redesigns our universities going forward. Different institutions may succeed by responding differently, but there are some strategies that are almost sure to fail. One is to rely on existing approaches, trying to advance the university as it has been advanced in the past. Another is the insular approach, simply perpetuating the university as if it is a remote monastery immune to outside forces. The temptation is great for universities to isolate themselves in abstractions, perpetuating their institutional cultures with their own sociologies and vocabularies, focused primarily on their own dynamics and their own

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constraints. It is incumbent on universities as never before to help solve the pressing global issues of our time: population growth, climate change, national and international security. The scale of knowledge transfer must increase as the demand for new knowledge increases. It is essential to realize that continued economic growth depends upon innovation and that the global economy operates according to the forces of “creative destruction,” described by the economist Joseph Schumpeter nearly a century ago. The only way to move forward is to replace what you have with something better—to innovate and to create new technologies and products and processes that replace those that already exist. We must accelerate the pace of our academic culture to move in sync with the needs of the world. And the ultimate driver is competition. The globalization of American universities is accelerating because of the rise of global competition. Globalization is the outcome of hundreds of years of connectivity through trade and the transfer of knowledge between cultures, and, as the nations of the world become more deeply entrenched in the process of globalization, universities have no alternative but to embrace it.

The industrialized nations peaked some time ago in their capacity to continue to enhance capital creation, both in terms of raw numbers and access to that capital creation process by all segments of our society. Several decades ago, the United States was the world’s dominant economic force. But now we face a challenge to our identity because we must look toward the future as only one of a number of major economic powers, each interrelated and cooperating with others, but, at the same time, competing in completely new ways. Continued economic growth must remain an overarching objective, because if we stop growing economically the social outcomes will be dire. If we do not embrace perpetual innovation—and by this I mean innovation in university design itself—not just the products of the university but also our collective standard of living will decline, our way of life will be threatened, and opportunities for the success of future generations will be diminished. The scale and speed of knowledge transfer is unprecedented, but we must ask ourselves where the new entrepreneurial institutions are that will teach our students how to thrive in this new environment. Where is the next great entrepreneurial university that will prepare the next generation for perpetual innovation?

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Enterprise: The Path to Transformation for Emerging Public Universities

ENTERPRISE

The Path to

In my career as a faculty member and academic administrator, I have always focused on understanding, designing, and building knowledge organizations. I have been driven by a desire to understand the fundamental organizational forces—economic, political, and societal—within which academic institutions operate. My approach has been to act very much like an architect and, in many ways, a general contractor for new intellectual enterprises. I deliberately speak of academic institutions in terms of “enterprise” because, since becoming the president of Arizona State University (ASU) in July 2002, I have been leading an effort to reconceptualize a large public university as an enterprise—agile, competitive, adaptable, and responsive to the changing needs of both our constituencies and global society alike.

MICHAEL M. CROW is president of Arizona State University.

ISE :

Transformation for Emerging Public Universities

By Michael M. Crow

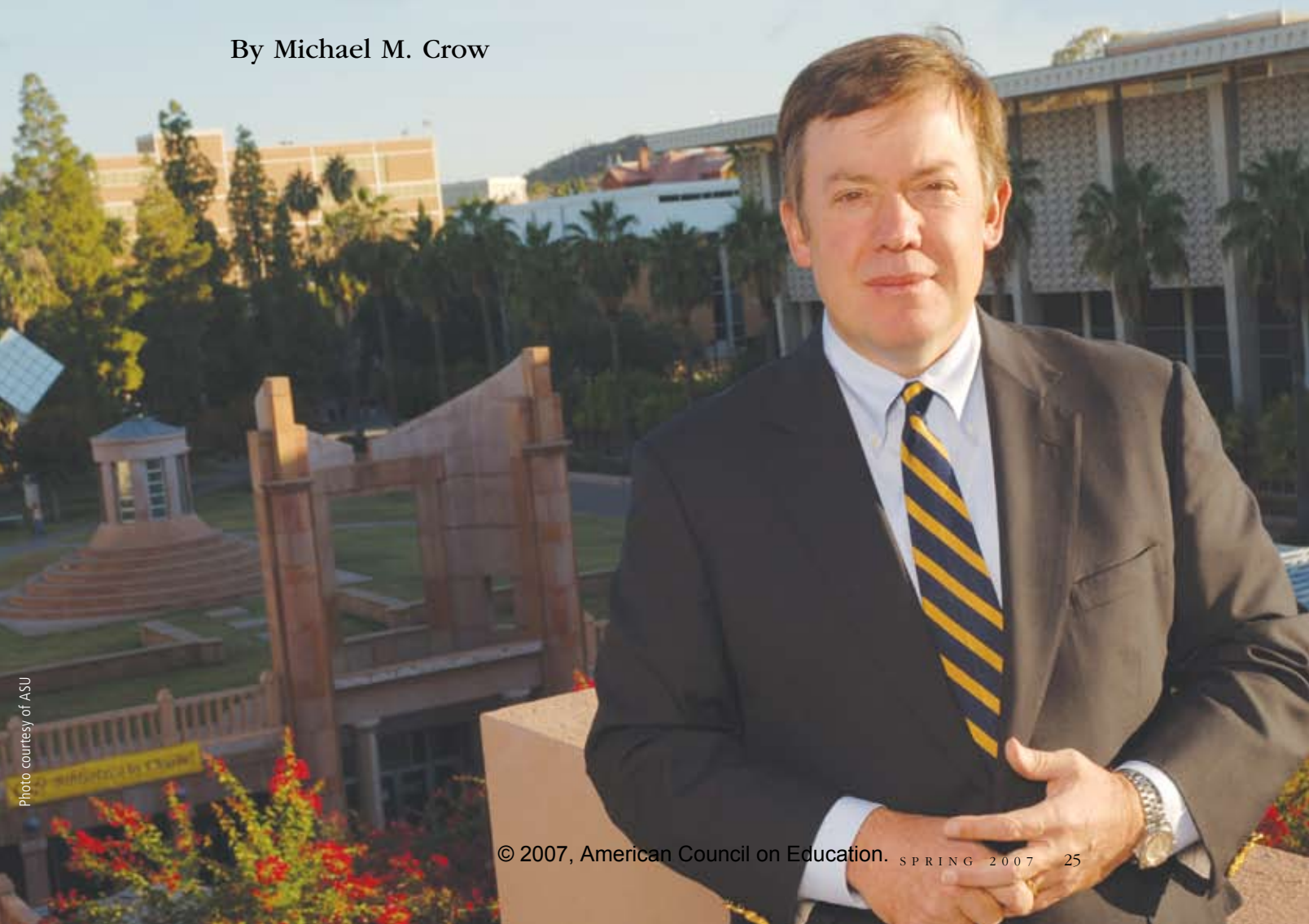


Photo courtesy of ASU

Like other public institutions, ASU has historically derived much of its core investment from the state (approximately 28 percent for 2006). This has led the university in the past to conceive of itself as an agency of state government, with all associated inherent limits and constraints. As a means of overcoming such constraint, I have sought to instill into institutional culture a sense of enterprise—an academic enterprise with the state of Arizona being its primary investor. With this new identity, we have become entrepreneurial in raising funds, both public (from multiple sources, including more than \$350 million in capital from municipal government partners) and private (including more than \$900 million in public/private partnerships).

The speed with which we now make and implement decisions and establish collaborative relationships with other academic institutions and with business and industry is characteristic of private enterprise. As an enterprise, we acknowledge and embrace the fact that that we operate in a competitive arena. We are competing not only for research dollars and private investment but also for the best students, faculty, and administrators, and above all, for the best ideas.

Defining the New American University

Enterprise is a concept sometimes wholly lacking from discussions about higher education and the American research university. Enterprise and the entrepreneurial academic culture that such an orientation instills encourage creativity and innovation with intellectual capital—the primary asset of every college and university. Generally associated with the private sector, the spirit of enterprise is nonetheless highly relevant to the advancement of all of our

nation's colleges and universities, but it is with research universities in mind—institutions dedicated to both teaching and discovery—that I make most of the following recommendations.

Instilling the spirit of enterprise into the institutional culture of a public university is only one of my objectives as the president of an emerging research institution. At ASU, I am leading an effort both to reconceptualize a public metropolitan research university *and* to redefine public higher education by creating a prototype solution-focused institution that combines the highest level of academic excellence, maximum societal impact, and inclusiveness to as broad a demographic as possible. Predicated on excellence, access, and impact, the paradigm is conceptually framed as the “New American University” (www.asu.edu/president/newamericanuniversity) and I believe that it has relevance for public and private colleges and universities nationwide.

At the end of the day, universities are teaching and discovery organizations. There are few organizations assigned such complex functions as their core objective. And the core culture of American research universities comprises various markers or parameters. Chief among these is the notion of free and open discourse—argument and debate advancing logic to arrive at solutions and foster new knowledge. Other parameters include the system of tenure; the traditional organizational structure of universities and colleges, with academic departments as the basic unit; and of course, that most sacrosanct of academic practices, scientific method. All of these parameters serve to advance the central element of the university: teaching.

Public Universities and Their Self-imposed Paralysis

Given the apparent soundness of this robust genetic code, what could possibly threaten our public universities? I would argue that our institutions are under serious attack by what I have designated “the virus of the



agency.” Bureaucracies, or agencies, are admirable social constructs that accomplish much, delivering goods and services. I do not enlist the concept in any pejorative sense, but the principle mission of universities lies beyond the “service” they deliver, that is, the basic task of educating undergraduates. But universities have begun to act like service agencies, focused only on providing efficient educational service. In organizational or ecological parlance, universities have varied their routines and adjusted their behavior and allowed something harmful to infect their organizational structure, something that runs contrary to their genetic heritage.

The primary symptom of the virus is a fixation with efficiency and “make-do logic”: “We have only so much to work with, so let us make do. Let us be sensible and not dare to dream of that which we could attain only with great struggle.” Such make-do logic leads to a self-imposed lack of vision and initiative and encourages preoccupations with

efficiency. Most of the processes and outcomes that define greatness in academic culture are by their very nature contrary to standardization and efficiency. Scholars and researchers cannot be efficient when following a path that has not already been marked. The hierarchical relationship that allows agencies like the local division of motor vehicles to perform repetitive tasks in a standardized and relatively efficient manner is ill-suited to the famously circuitous pursuit of discovery. I can say with absolute certainty that efficiency is not the means by which one determines the origin of the universe.

A secondary symptom, closely related, is an obsession with the external political environment. When universities behave like units of government, they obsessively focus on factors largely irrelevant to their success as academic institutions. The task of university leaders is to focus on the learning environment and to advance discovery. Administrators instead hobble their aspirations and vision to navigate the perceived intricacies and uncertainties of the external legislative environment.

A third symptom is operation in “conserver mode.” In a 1967 study of the politics of bureaucracy, policy scholar Anthony Downs examined how bureaucrats run “agencies.”¹ The agency virus has infected so many universities that they have shifted into what Downs would call the conserver mode, becoming risk averse, lacking innovative and adaptive capacity, and failing to develop and implement a clear strategy for advancing their mission.

The intellectual agenda of each institution must be self-determined, but in their weakened state, universities have fallen prey to attempts at outside influence. At the national level, the

U.S. Congress issues instructions to agencies, but great universities must operate with autonomy from centralized control. Such inappropriate control reduces the inherent autonomy of the institution, which is critical to its mission, and diminishes the significance of faculty governance. Self-governance is further undermined by exclusive reliance on a single source of revenue, such as annual state appropriations, because with that revenue comes constraint, sometimes including expectations regarding who should be admitted and what is permissible in the curriculum.

A Treatment for the Virus

The treatment for the virus is to *reconceptualize the university as an enterprise*. Accepting the status of an agency is a matter of mindset and more profound than a mere assessment of funding sources. Such complacency leads to lack of initiative and anticipatory self-censorship that is contrary to the genetic code of an institution predicated on freedom of thought. Constraints are everywhere and inevitable and some may be insurmountable, but reconceptualization as an enterprise fosters a sense of autonomy and independence that allows institutions to leverage every possible advantage. An enterprise is responsible for its own future.

Treating this virus entails taking several steps:

1. Recapture the identity of the university. First, strive to establish a unique identity for the institution. Why does this particular university exist in the first place and what is it attempting to achieve? What are its principles and values that supersede all else? Answers to some of these questions are contained in the genetic code, and some are unique to given universities in their particular locations with their own faculty assemblages,

institutional cultures, and student bodies.

2. Encourage innovation, adaptation, and differentiation. The logic and rhetoric for the New American University model that we discuss at ASU is all about differentiation. We have taken the genetic code of the academy and are commingling that historic tradition with eight new design parameters—areas of aspirational design differentiation—with which we hope to produce a unique genetic code. Because we are not in medieval Europe or 19th-century New England, we embrace our setting in 21st-century Arizona to address the needs of our region as well as the global society.

We are competing not only for research dollars and private investment but also for the best students, faculty, and administrators, and above all, for the best ideas.

Generic public universities that behave like government agencies operate efficiently in a manner just like all the other generic public universities, with standard-issue, cookie-cutter departments replicated on models that have gone unquestioned for years. All of these departments tend to look the same, act the same, and think the same. When problems are encountered, such institutions just look to see what others have done when encountering the same problem. This is the path to mediocrity.

Differentiation is the process by which nature prospers, allowing species to evolve and offering new prospects for evolution to organisms. Institutional differentiation could take the form of new schools bringing together scholars from diverse disciplines to tackle large-scale obstacles that confront us. In this manner, universities realize more optimal adaptation to the environment.

The environment in which universities navigate has shifted. Residents of many states confronting population growth and competing demands for resources balk at funding higher education at past levels. The \$15 per \$1,000 of personal income that were available in Arizona in 1974 to fund the state universities, for example, has now been reduced to a mere \$6. This represents an environmental shift of great magnitude—similar to a 60 percent reduction in rainfall—and an institution will face problems if it has not varied its routines. Any organization confronted by a comparable level of environmental change without any change in its own routine would suffer.

Most organizations believe that they change their routines through coping mechanisms. They cope with resource decline as a cactus copes with drought, but a cactus is a life form suitable only for a narrowband environment, as opposed to an adaptive, changing life form like the coyotes I often see in my driveway. The coyote is an adaptive life form that can vary its routine and prosper in spite of environmental change.

3. Accept total responsibility.

A third aspect of the treatment for the agency virus is for the institution to accept total responsibility for its destiny and future. Period. When operating in this manner, all other organizations become potential partners with which you may choose to interact, and from

which you may strive to obtain resources and other valuable assets. Other organizations may wish to become allies, but the fate of your institution is sealed only by its status as either an agency or an enterprise.

We must
accelerate
the pace of
our academic
culture to move
in sync with the
needs of the
world.

4. Shift to an investment model. Under an investment model, we make the case that if either the private sector or the public is willing to lend us financial or political support, we promise to work to deliver a specified return on investment. Here is the simple argument for investment of taxpayer dollars in a public university: “If the appropriations committee of the state legislature invests specified resources, the university promises a given return. Without such an investment, there can be no return on investment. Here is the impact of that non-return on the overall enterprise (the state). . . .” The same argument can be made for investment from the federal government, business and industry, and foundations and individuals.

When we made requests for tuition adjustments, we presented them as an argument for investment. This past year, we published a 60-page white paper on the return on investment to

a family making investments in tuition for their children, or students making investments in themselves, and we calculated the annual rate of return to the individual over their lifetime at 12 percent. A college education is the most significant investment that anyone can make over that timeframe.

When we made a request to the City of Phoenix for \$233 million to establish an ASU campus downtown, we made it on an investment basis. We went to the city with our vision of what we want the university to become, and said, “If you make this investment in us, we will be able to start a campus on 22 acres of land in downtown Phoenix with three renovated and three brand new facilities. Here is what we will commit and what our schools will be able to achieve with these new facilities. . . .” It is difficult to argue with such sound logic.

5. Recognize the need for speed. An academic wristwatch moves slowly because it is marked in increments of semesters. We must accelerate the pace of our academic culture to move in sync with the needs of the world. If you think and move at the pace of semesters, new competitive institutions will outpace you. With the advent of new information technologies as enablers of universal customized learning, new institutions for learning are springing up in unpredictable places, and the monopoly on higher learning once held by universities is vanishing. For-profit institutions like the University of Phoenix offer new styles of engagement, new styles of pedagogy, and new ways of learning. Worldwide, China has set out to build 100 new universities from scratch, and Singapore is encouraging foreign institutions to build campuses in that nation.

continued on page 30

continued from page 28

Universities operating in con-server mode slow everything down to avoid all risk, to analyze the complexities of the political environment, and to wait for the perfect moment in time to advance. Institutions with this mindset will not be able to adapt in a manner that allows them to successfully compete for new resources or to serve the changing needs of their constituencies.

University as Enterprise

Not every university that is here today is going to make it over the next hundred years. Those that do make it will be the ones that attack and defeat the virus of the agency by reconceptualizing themselves as enterprises: taking control of their identities; focusing on innovation, adaptation, and differentiation; assuming responsibility for their destinies; operating at an accelerated pace; and shifting to an investment model.

Returning to a public university following a decade at a private institution offered me some perspective. Private universities cannot rely on state legislatures as sources of funding, thus lending to such institutions an intrinsic sense of enterprise sometimes lacking in public institutions excessively reliant on taxpayer dollars. A successful institution will diversify its revenue sources, seeking long-term investment in the enterprise by multiple sources, generally with no single long-term dominant source.

Yet for public institutions, state funding provides bedrock support comparable to an endowment. A comparison of legislative appropriations with returns from endowments plotted against the stock market reveals that both perform about the same. If we treat legislative appropriations as if drawn from an endowment, the rate of return will move up sometimes and down at other times, but the movement is negligible over the long run.

There are many perspectives from which to parse institutional progress, and the enterprise model is not a panacea for all institutional ills. For public institutions, much undeniably depends on a supportive legislative environment. Enterprise will advance an institution, but differentiation is key. Conventional wisdom suggests that all great universities must function both as centers for humanist scholarship and world-class science, engineering, and medical research. But each institution simply cannot accomplish all of these objectives, and must seek differentiation. Each must adapt to be of the greatest value to its constituents. Differentiation rather than replication enhances both individual institutions and systems of higher education, allowing us to transcend arbitrary hierarchies. With new and multifaceted metrics, each institution must account for its contributions—economically, culturally, environmentally, and socially. The question is whether our universities can adapt and change fast enough to meet the challenges of the global economy in the 21st century. ■

Note:

1. Downs, A. (1967). *Inside bureaucracy*, A RAND Corporation Research Study. Boston: Little Brown, 96–101.

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University Business Magazine / June 2007

Sustainability: An Organizing Principle for Colleges and Universities

WE ARE APPROACHING WHAT I would term a critical inflection point in the evolution of global society. Such inflection points occur when new advances in our understanding converge in some meaningful way with our existing social, cultural, economic, and historical circumstances and practices, allowing us to glimpse new opportunities. Sustainability is a term that is easily applied to so many things that we constantly risk diluting its power as a concept, but without doubt it represents nothing less than a reconceptualization of our relationship with both the planet and the community.

The task for scholars and administrators in our nation's colleges and universities is to register the significance of this inflection point and to consider how best to refigure institutions to accommodate and advance the new transdisciplinary teaching and research critical to our collective well-being.

New Challenges, New Solutions

With a global population of 6.5 billion that is projected to increase to 8.5 billion by mid-century, we face challenges of unimaginable complexity, both as a species and, more narrowly, in terms of our American standard of living and quality of life as a nation. The increasing interconnectedness and integration of societies and economies worldwide makes us interdependent, but we are all wholly dependent on the dynamic and interactive system of complex biogeochemical cycles that makes life on earth possible in the first place.

Yet despite our efforts to advance our understanding, there remain both incomprehension and complacency regarding the extent to which the Earth is falling increasingly under our influence as the dominant life-form.

As we impinge more and more on natural systems—with our planet falling increasingly under the domination of a single species with the capacity to modify natural systems, extract and consume resources, and generate waste on a scale that even in the recent past would have been unimaginable—we must assume challenges that remain beyond our historic and present capacity to solve.

We are at a critical juncture in the evolution of our relationship to the environment, and universities must take the lead in addressing issues of sustainability.

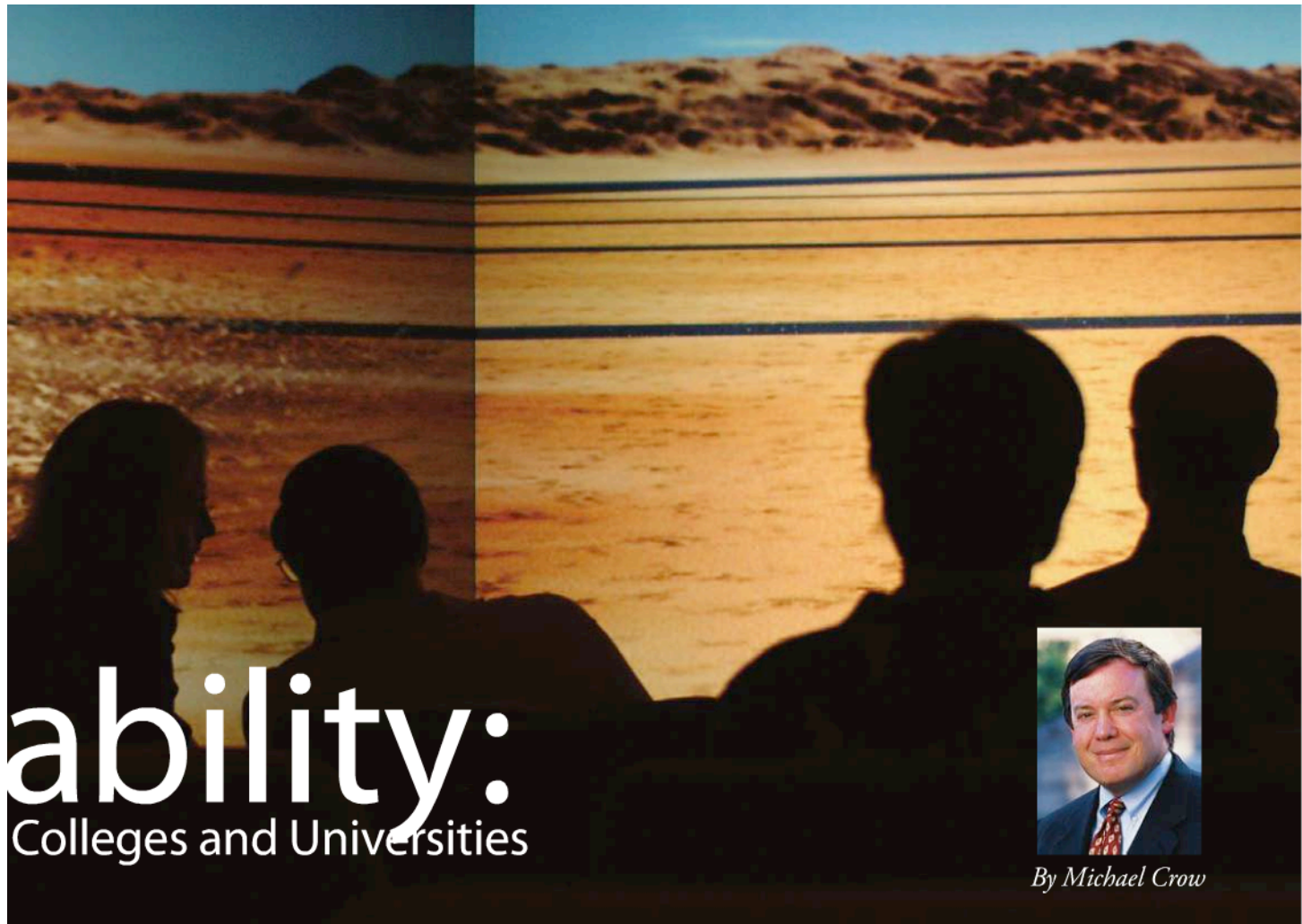
Nations are falling further behind, both in terms of developing the basic infrastructure necessary to maintain quality of life and an adequate standard of living for all citizens, and in balancing the needs of humanity with the long-term consequences of human



impact on environmental systems.

The concept of sustainability, sometimes mistakenly equated with an exclusive focus on the environment, is at once straightforward and far more complex than one might suspect. Sustainability embraces environmental concerns, certainly, but its implications are far richer, spanning issues intrinsic to economic development, health care, environmental planning and urbanization, energy, chemicals, materials, agriculture, national security, business, industry, and government—in short, all the concerns of daily life in societies around the globe. Sustainability acknowledges the needs of human societies but in its framing seeks a balance between social values, including equity and justice, and the environment.

We are at a critical juncture in the evolution of our relationship to the environment—the long-term sustainability of our nation and even our planet remains in doubt—and universities must take the lead in addressing issues of sustainability. Academic communities cannot be removed from the front lines of social change, and our universities must serve as a forum for cultural, economic, political, and social reform. Universities are transformational catalysts for societal change and perform functions essential to our collective survival, but we must confront the fact that we do not fully understand the implications of human impact on the environment and are not adequately prepared to advance policies



ability:

Colleges and Universities



By Michael Crow

Arizona State University's president.

In the Decision Theater at ASU, scientists, students, and others can see alternate future environmental scenarios through 3-D visualizations.

regarding the optimal intersection of human and natural systems.

The central question that confronts us is whether we will be able to choose wisely among alternative future trajectories, and in this sense our academic institutions are the keepers of the keys. Our colleges and universities generate the knowledge necessary both in terms of scientific and technological knowledge and the ability to wisely govern the world that we have made.

But universities are a thousand-year-old institutional form and change very slowly, maintaining their existing organizational structures and core cultures unaltered whenever possible. While we do not understand the long-term effects of our impact on the planet, we have even less knowledge about how to organize our academic institutions to confront this challenge.

A New American University

At Arizona State University we are in the midst of an effort both to reconceptualize a public metropolitan research university *and* to redefine public higher education through the creation of a prototype solution-focused institution that combines the highest level of academic excellence, maximum societal impact, and inclusiveness to as broad a demographic as possible.

The paradigm is conceptually framed as the "New American

University," and because the institution is predicated on *excellence*, *access*, and *impact*, I believe that it has relevance for colleges and universities both in this nation and abroad. Sustainability is at the core of this conception, not simply because interdisciplinary research on human-dominated environmental systems has long been one of the strengths of the university, but because we made an explicit institutional commitment to sustainability.

The problems that we face require multiple approaches and an integration of disciplines. Thus, as our front line of engagement in sustainability, we conceived an academic entity construed across disciplinary boundaries, bringing together scientists, engineers, and scholars from a broad community of disciplines, engaging the expertise and influence of leaders from business, industry, and government to develop solutions to pressing real-world problems.

With a planning gift of \$25 million from Julie Ann Wrigley, president and CEO of the Julie Ann Wrigley Foundation (a philanthropic foundation committed to the environment, health care, and education), the Global Institute of Sustainability (GIOS) was launched in November 2004 to catalyze and advance interdisciplinary research on environmental, economic, and social sustainability.

If academic institutions are to succeed, each must leverage its strengths. ASU was already uniquely positioned to play a central ►

SUSTAINABILITY:
AN ORGANIZING PRINCIPLE FOR COLLEGES AND UNIVERSITIES



The ASU campuses boast a number of LEED-certified buildings, including this interdisciplinary science and technology facility (left). Research facilities include the Biodesign Institute (middle); an alternative fuels project in its laser lab helps explain how plants turn light into energy (right).

role in providing science-based solutions to address the challenges of sustainable development, especially as these bear on the burgeoning Phoenix megalopolis, including:

- the impacts of rapid growth on a semiarid ecosystem;
- water-resource management;
- human health and well-being;
- ecosystem viability; and
- biological diversity.

Leveraging our growing prominence in earth-system sciences, we decided to deploy our capacity to apply authoritative insight, prototype decision-support tools, and institutional mechanisms to improve the relationship between social and ecological systems through a continuum of understanding, prediction, adjustment, and adaptation. Together with resource managers, industry leaders, and local, regional, and state policymakers, ASU has positioned itself to tackle complex issues associated with sustainability.

Our sustainability initiative also provides a framework to connect the university to institutions similarly interested in collaborat-

ASU's sustainability initiative provides a framework to connect the university to institutions similarly interested in collaborating on applications relevant to the global community.

ing on applications relevant to the global community. GIOS thus has developed productive partnerships with a number of premier institutions around the world, including **Stanford University**, **Harvard University**, **MIT**, the **University of Washington**, the **Instituto Tecnológico de Monterrey** (Mexico), **Cambridge University** (U.K.), the **University of Cape Town** (South Africa), and the **Indian Institute of Technology** in Delhi.

To prepare students capable of integrating a broad range of disciplines in a rapidly changing world, we have conceptualized and launched the School of Sustainability, the first of its kind anywhere in the world. With both undergraduate and graduate degree programs, the school is educating a new generation of leaders through

collaborative, transdisciplinary, and problem-oriented training that addresses the environmental, economic, and social challenges of the twenty-first century. Teaching and research in the school seeks adaptive solutions to such issues as rapid urbanization, water quality and scarcity, habitat transformations and the loss of biodiversity, and the development of sustainable energy, materials, and technologies.

Time for Commitment

There is much at stake, and now is the time for academic leaders to commit their institutions to advancing what is nothing less than an evolutionary transformation in our collective consciousness. The world is not yet on a trajectory that is sustainable, and thus it is incumbent on academic communities to demonstrate persuasively that the advancement of social interests is wholly compatible with sound environmental stewardship.

If we are to harness our knowledge to address the complex challenges we face in reconciling development goals with the environmental limits of the planet, academic leaders must be willing to rethink and reconfigure their institutions to foster teaching and research that seek to guide a conscious transition towards a more sustainable relationship with the Earth.

Sustainability has every potential to become a new principle for organizing knowledge production and application and for reorganizing our institutions. Sustainability is a concept with as much transformative potential as justice, liberty, and equality, and we must foster its discourse and implementation in our academic institutions.

Inflection points such as this are rare, and given what is at stake we must not hesitate to make the necessary investment. We are in the critical early stages of the advancement of a sector critical to the well-being of human society and ultimately crucial to our continued economic development. At this stage there is everything to win and everything to lose in the effort to advance sustainability, and we must maintain our focus if we are not to lose our way. **U**

Michael Crow is president of Arizona State University.

Arizona Policy Choices: Sustainability For Arizona / June 2007

Sustainability: A New Organizing Principle

ARIZONA'S SUSTAINABLE FUTURE

The main thing history can teach us is that human actions have consequences and that certain choices, once made, cannot be undone. They foreclose the possibility of making other choices and thus they determine future events.

Gerda Lerner, Emerita Professor of History at University of Wisconsin
and World War II Refugee.

SUSTAINABILITY: A NEW ORGANIZING PRINCIPLE

Michael M. Crow, President, Arizona State University

The need for action is urgent: demand for energy and transportation is growing rapidly in many developing countries, and many developed countries are also due to renew a significant proportion of capital stock. The investments made in the next 10-20 years could lock in very high emissions for the next half-century, or present an opportunity to move the world onto a more sustainable path.

Nicholas Stern, former Chief Economist to the World Bank from "The Economics of Climate Change."

With a global population of 6.5 billion projected to increase to 8.5 billion by mid-century, we face challenges of unimaginable complexity as a species and as a society. The continuing integration of nations and economies worldwide is making us increasingly interdependent, while at the same time we all are wholly dependent on the dynamic, interactive biogeochemical cycles that make life on earth possible in the first place. Yet though the challenges that confront us are global in scale, we must address many of their impacts locally because Arizona represents a microcosm of the larger scenario.

Nevertheless, as we impinge more and more on natural systems – and as the environment of our planet falls increasingly under the domination of a single species with the capacity to modify natural systems, consume resources, and generate waste on a scale that even in the recent past would have been unimaginable – we face problems seemingly beyond our historic capacity to solve. The world's nations have fallen behind in developing the infrastructure necessary to create and maintain prosperity for all citizens, and they have not yet determined how to balance the needs of humanity with the long-term consequences of human impact on environmental systems. Similarly Arizona simultaneously benefits from and is stressed by a rapidly growing population urbanizing a fragile desert environment.

We must, therefore, realize we are at a critical juncture in the evolution of our relationship to our life system. The long-term sustainability of our state, our nation, and even our planet remains in doubt. The evidence of Hurricane Katrina brought home the notion that things really are far more complex and interconnected than we ever suspected, and that at present we seem to operate beyond our ability to plan and implement effectively, or even conceive what needs to be done in certain circumstances. Among the lessons we should have learned from the disaster on the Gulf Coast is that we must incorporate sustainability into our policies and planning because our lives depend on it.

The concept of sustainability is sometimes mistakenly equated with an exclusive focus on the environment. This report, however, demonstrates that sustainability is much more than that. Sustainability embraces environmental concerns, certainly, but its implications are far broader, spanning issues essential to economic development, healthcare, urbanization, energy, materials, agriculture, business practices, social services and government – in short, all the concerns of daily life in societies around the globe. Sustainability acknowledges the economic needs of human societies, but in its framing seeks a balance with social values, justice, and the environment.

While we must consider that being able to mount an effective response to a disaster the magnitude of Hurricane Katrina could be mere child's play compared with addressing such issues as global climate change and ecosystem collapse, we should also understand that we have more knowledge at our disposal than we realize. The descriptions of activities and prac-

tices by local, national, and international organizations that appear throughout this report show that a variety of strategies and technologies can improve the human condition, protect the environment, and make companies more profitable. For example:

- A commercial carpet company in Georgia captures methane emissions from public landfills to help convert its manufacturing plants to 100% renewable energy, thereby giving it a significant competitive advantage.
- A small community in Connecticut works with a developer to clean up a toxic abandoned industrial site and convert it to a revenue-producing center that helps create businesses, homes, jobs, and public amenities.
- An Arizona company uses a 19th-century invention to develop an emission-free engine that converts the sun's heat to utility-scale electric power.
- A Bangladeshi bank pioneers micro-lending in struggling communities to launch businesses and reduce poverty.

These are just a few examples of initiatives that, at scale, could have profound positive effects on our capacity for sustainability. Thus, we must vastly improve our ability to communicate the knowledge and ideas we already possess, so that we can readily deploy it to improve the quality of our lives, our state, and our planet.

Our universities play a unique and powerful role in ideas and information for sustainability. But neither academic research nor even the best collaborative efforts of scholars can in isolation create a sustainable future. Sustainability will require the application of enormous amounts of capital – political, intellectual, and financial – to develop the leadership, consensus, integrative science, and technology that will enable society to achieve sustainability. To advance solutions, scholars and researchers must be committed to solving real-world problems and efficiently channeling science-based solutions to state, community, and industry leaders. In turn, decision makers must become more knowledgeable about sustainability and its economic, environmental, social, cultural, and geographic implications so they can thoughtfully engage universities and other research institutions in addressing the critical issues that confront us.

As Sustainability for Arizona points out, the communities that will enjoy sustained prosperity in the 21st century will be those that create resilient local economies by making the unique strengths of their places, institutions, and people sources of competitive advantage. So too our institutions, whether in the public or private sector, must each leverage their potential.

Together, Arizona's local, regional, and state policymakers, resource managers, industry leaders, and scholars must coordinate their efforts to tackle issues associated with sustain-

Many environmentalists take it for granted that rich countries will have to cut their consumption sharply to stave off ecological disaster. There is another approach. Global public policies and market institutions can promote new technologies that raise living standards yet reduce human impact on the environment.

Jeffrey D. Sachs, director of Earth Institute, Columbia University, from "The Promise of the Blue Revolution." *Scientific American*, July 2007.

ability, including the impacts of rapid growth, human health, economic well-being, ecosystem viability, and biological diversity. Arizona must make the difficult but powerful policy choices to reduce natural resource consumption, waste production, traffic congestion, air pollution, and energy use. We should embrace innovative policies that promote renewable energy, disease prevention, water conservation, affordable housing, infrastructure investment, cultural development, equitable opportunity, and an innovation economy that will deliver the knowledge and technologies we need to address contemporary and future sustainability issues. We must invest in people and institutions to put creative policies into effective practice and devise “scorecards” to track how we are doing.

ADAPT OR PERISH, NOW AS EVER, IS NATURE’S INEXORABLE IMPERATIVE.

H.G. Wells (1866-1946), author, from
“Mind at the End of Its Tether,” 1945.

Furthermore, whether in terms of new discoveries, technologies, services, or products, the results must be exportable, and in this regard Arizona is in a strong position. As Jonathan Fink, Julie A. Wrigley Director of Arizona State University’s Global Institute of Sustainability and ASU’s chief sustainability officer observes in his essay, “Figuring out how cities can expand economically while avoiding unsupportable stresses on the ecosystem and social fabric is one of the most important challenges the world faces. The region where these things are being most aggressively studied is metropolitan Phoenix.” In fact, this is precisely why ASU created the Global Institute of Sustainability and why prominent leaders, such as Julie Wrigley, are supporting its mission.

Neither the world nor Arizona is now on a trajectory that is ultimately sustainable. Thus, it is incumbent on academic, business, and government leaders to demonstrate persuasively that the advancement of social and economic interests is wholly compatible with sound environmental stewardship. Now is the time for those at the helm to commit their organizations and institutions to transforming our collective consciousness.

In order to reconcile Arizona’s historic development practices with its environmental limits – and to do so in a socially just way – our leaders must be willing to rethink and reconfigure their institutions to foster scientific and public policy solutions that can guide a conscious transition toward a more sustainable future. In this regard, Arizona leaders should start by answering some tough questions:

- How can public and private institutions best collaborate to create solutions to our most pressing environmental, economic, and social problems?
- How can we depoliticize the public decisions needed to get Arizona on a sustainable trajectory?
- How can we monitor our progress toward sustainability?
- How can we encourage and enable Arizona businesses to adopt sustainable operating and production practices without impinging on profitability?
- How can public sector services and activities become more efficient?
- How can we tap into the passion many residents’ and visitors’ already have for a sustainable Arizona?
- How can we communicate the sustainability message to positively influence the behavior of all individuals?
- How can we design or redesign efficient new developments and existing communities?

This report began with the notion that the 20th century was about “raising Arizona,” while the 21st will be about sustaining it. We are at the beginning of a long-term journey to becoming a more sustainable state. Far more than the latest trend or fleeting concern, sustainability is truly the issue of our age. As such, it demands our commitment both to step-by-step progress and to embracing bold policy ideas that will bring about rapid and efficient systemic changes.

Authors and contributors to this report have recommended numerous policy changes that fit both descriptions and together could be taken as Arizona’s first sustainability agenda. Their recommendations include:

- Expand access to 21st century education and job skills for adults
- Ensure equity and quality in Arizona’s P-20 education systems
- Develop programs for sustainability transfer just as universities have for technology transfer
- Require regional planning that integrates water use, and mobility options in existing and new communities
- Enhance dedicated funding mechanisms, such as the Heritage Fund, that are available for environmental restoration and community rehabilitation
- Update groundwater management policies throughout Arizona
- Provide incentives and information to Arizona businesses to support industrial recycling facilities and more technologies for sustainability
- Create a sustainability scorecard and use it for consistent monitoring, feedback, and planning
- Embrace sustainable goods, services, and knowledge as a focus for economic development

To make good on this sustainability agenda, Arizonans must consider and respond to some important issues: How can we encourage and help residents and visitors to make smart choices for reducing wasteful consumption, building community, and fostering sustainability? How can we make the investments that are needed now and over time to support sustainability?

A concept like sustainability has every potential to become a new principle for organizing knowledge production and application, and for reorganizing our institutions. Sustainability is a concept with as much transformative potential as justice, liberty, and equality, and we must foster its discourse and implementation both in our academic institutions and broadly across business, industry, and government. Because turning points like this are rare in the evolution of our consciousness, and the stakes are so high, we must not hesitate to take the right steps and make the necessary investments. The central question that confronts us is whether we will be able to choose wisely among alternative trajectories. This report should convince us that we are now at the stage where there is everything to win and everything to lose.

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If we don’t act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever... In contrast, the costs of action – reducing greenhouse gas emissions to avoid the worst impacts of climate change – can be limited to around 1% of global GDP each year.”

Nicholas Stern, former Chief Economist to the World Bank from “The Economics of Climate Change.”

Bioscience Magazine / July 2010

Organizing Teaching and Research to Address the Grand Challenges of Sustainable Development

Organizing Teaching and Research to Address the Grand Challenges of Sustainable Development

MICHAEL M. CROW

Academic culture has not evolved sufficiently in its ability to mount adequate responses at scale and in real time to the progressively accelerating complexity that marks contemporary life. This lack of adaptive capacity is nowhere more evident than in the institutional posture of our research universities when they are confronted by the need to address grand challenges—one need only think of global climate change, air and water pollution, overpopulation, hunger and poverty, extinction of species, exhaustion of natural resources, and destruction of ecosystems. A response commensurate to these problems will require that we advance research on sustainable development, by which I mean the efforts we must undertake to balance the generation of wealth with continuously enhanced environmental quality and social well-being. Building the capacity of our colleges and universities to respond to the challenges of sustainable development thus requires that we rethink our academic institutions.

Even before the advent of organized science and the formation of the modern research university, our intellectual progenitors understood the need to think at scale and across time. Four centuries of scientific focus on the ever-narrower and more fundamental secrets of nature have seemingly impaired our ability to do so. Our narrowing focus has also diminished our ability to construe teaching and research between and among the disciplines. Meanwhile, through our increasingly sophisticated manipulation of limited knowledge, coupled with brute force and an astonishing measure of hubris, our species has shaped a world that in all likelihood cannot sustain our collective standard of living.

Our potential to attain a conception of research sufficiently expansive

to address the challenges of sustainability requires that we recalibrate the structure and practices of our academic institutions. Although American research universities retain their global dominance in discovery, innovation, and creativity, their adaptive capacity is threatened by progressive ossification. As I use the term, “ossification” refers to the preponderant lack of innovation in the organization and practices of our colleges and universities. This structural ossification perpetuates longstanding “design flaws” and encourages the institutionalization of new organizational impediments to institutional evolution.

Rather than exploring new paradigms for inquiry, academic culture too often restricts its focus to existing organizational models. Perhaps the most obvious symptom of ossification is the perpetuation of the discipline-based departmental structure that we now take for granted. Entrenchment in disciplinary silos undermines our drive to develop formal languages comprehensible to practitioners of other disciplines. The lack of innovation in the configurations of our colleges and universities is matched by insufficient differentiation between distinct categories of institutions. Research-grade universities are one of many institutional types in American higher education, but even such institutions must develop distinctly different competencies if we are to have a robust national system of innovation.

Academic culture assumes that our research enterprises are somehow inherently calibrated to not only promote discovery but also to seek knowledge with purpose, and to link that useful knowledge with action for the common good. Instead, our universities too often perpetuate an inwardly focused academic culture that privileges the pursuit of new

knowledge, with little concern for its purpose and application. While we valorize the discovery of the unknown by individual scientists, we attach less prestige to collaborative endeavors that target real-world problems, and to team participation in projects that accomplish assessment, assimilation, synthesis, implementation, and application. Scientific research conducted with application and social context in mind—outcome-driven science, or science with purpose—should be granted equal accord with fundamental research.

As president of Arizona State University (ASU), I have led an effort to reconceptualize the youngest of the roughly one hundred major research institutions in the United States through a comprehensive “design process.” This reconceptualization represents an effort to pioneer the foundational model for what we term the “New American University”—an egalitarian institution committed to academic excellence, inclusiveness to a broad demographic, and maximum societal impact—but also constitutes a reexamination of academic operations and organization. Our objective has been to accelerate a process of institutional evolution that might otherwise have taken more than a quarter-century and compress it into a single decade (2002–2012). Sustainability is at the core of this conception, not simply because interdisciplinary research on human-dominated environmental systems has long been one of the strengths of the university, but because we deemed it an implicit institutional commitment.

With the establishment of the Global Institute of Sustainability (GIOS) in 2004 and the first-of-its-kind School of Sustainability three years later, ASU has positioned itself in the vanguard of interdisciplinary research

on environmental, economic, and social sustainability. The institute brings scientists and engineers together with government policymakers and industry leaders to share knowledge and develop solutions to pressing real-world problems. With research in areas as diverse as agriculture, air quality, marine ecology, materials design, nanotechnology, policy and governance, renewable energy, risk assessment, transportation, and urban infrastructure, the faculty members affiliated with GIOS are addressing some of the most critical challenges of our time, as well as training future generations of scholars, scientists, and practitioners. Our sustainability initiatives also provide a framework to develop productive partnerships with a number of premier institutions around the world, including Stanford, Harvard, Massachusetts Institute of Technology, the University of Washington, Tec de Monterrey, and Cambridge.

To prepare students to integrate a broad range of disciplines in a rapidly changing knowledge economy, the School of Sustainability offers both undergraduate and graduate degree programs. The school is educating a new generation of leaders through collaborative, transdisciplinary, and problem-oriented training that addresses environmental, economic, and social challenges. Teaching and research seek adaptive solutions to such issues as rapid urbanization; water quality; habitat transformation; the loss of biodiversity; and the development of sustainable energy, materials, and technologies.

The impetus to reorganize and recombine discipline-based academic departments had already gained a foothold at ASU even before the design process was under way. An ambitious reorganization of the biology faculties to overcome disciplinary boundaries,

for example, epitomized the momentum. In July 2003, the departments of biology, microbiology, plant biology, and the program in molecular and cellular biology merged to form the new ASU School of Life Sciences. The school allows more than one hundred life scientists, engineers, philosophers, social scientists, and ethicists to self-organize around the great socially and environmentally relevant questions of the day.

Through the reorganization of the university, we have sought to produce a model of differentiation. Rather than advancing a trajectory model that would guide evolution according to linear extrapolation, or a replication model that would attempt to re-create the organizations of leading research universities, we chose to pursue a distinctive institutional profile by building on existing strengths to produce a federation of unique colleges, schools, interdisciplinary research centers, and departments, with a deliberate and complementary clustering of programs at each of our four campuses. With "school-centrism," schools compete for status not with other schools within the university but globally with peer entities.

More than a dozen new transdisciplinary schools, including the School of Human Evolution and Social Change, the School of Earth and Space Exploration, and the School of Sustainable Engineering and the Built Environment, complement large-scale initiatives such as GIOS and the Biodesign Institute, focused on innovation in health care, energy and the environment, and national security. In the process, we have eliminated a number of traditional academic departments, including biology, sociology, anthropology, and geology. Transdisciplinarity trumps arbitrary constructs that may once have

served certain social or administrative purposes but that are no longer useful.

While GIOS remains our front line of engagement in sustainability, we are engendering an institutional culture of sustainability. Arizona State University offered sustainability-themed courses in more than two-dozen subject areas during the past academic year, such as anthropology, architecture, biology, economics, engineering, industrial design, law, philosophy, nonprofit leadership, and urban planning. A further objective is to engage the community in supporting sustainability initiatives, including widespread reductions in greenhouse gas emissions. In terms of operational sustainability, ASU has made major investments in energy-efficiency infrastructure. These efforts helped advance the university's carbon-neutral goal and reaffirmed its leadership position in the American College and University Presidents Climate Commitment.

Along with guiding principles of modern societies such as human rights, sustainability is an epochal issue that must be addressed by the citizens of a planet whose population already exceeds 6 billion and that is projected to approach 10 billion. Organizing research and teaching efforts to seek solutions to the grand challenges associated with sustainability represents an important dimension of such an imperative. Through research and teaching associated with sustainability, ASU has sought to design a prototype both for deliberate institutional evolution and large-scale academic reorganization to tackle some of the most intractable challenges of our era.

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Moral Ground: Ethical Action for a Planet in Peril / 2010

Sustainability as a Founding Principle of the United States

MORAL GROUND

Ethical Action for a Planet in Peril

Edited by
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Sustainability as a Founding Principle of the United States

Michael M. Crow

In the summer of 1787, two watershed processes in world history were in their earliest stages of development. First, the Industrial Revolution was gathering momentum in Europe and ultimately exerting its impact on the burgeoning American economy. Second, at this same pivotal moment, the nascent republic known as the United States was just completing its earliest aspirational blueprint, the Constitution. The coincidence of these revolutionary processes and products—one economic and the other political—is significant because, however defining for future generations each may have been, both are in one sense only the result of merely incremental progress in human consciousness. Both represent crude and inchoate forms of social and economic redesign that could have been inestimably more successful had the processes of redesign been undertaken with some awareness of the context and content of the natural world.

The American Constitution is an extraordinary articulation of the design of a state that at once establishes democratic governance, liberty, and justice, as well as other core personal and social aspirations intended to be realized around bedrock political institutions. The Industrial Revolution, resulting from the evolution of fundamental

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principles of capitalism and cultural reorganization, consolidated the formats and structures through which society could be reorganized around new kinds of economic institutions.

In neither the Constitution nor the basic principles of capitalism, as best represented by Adam Smith in *The Wealth of Nations*, is there evidence of any meaningful awareness of the fact that the natural systems of the Earth and our constructs and designs as humans must advance in sustainable ways. An appreciation of the interrelationship between natural processes and human design is a prerequisite for any adequate conception of sustainability. This hybrid concept can be summarily defined as the stewardship of natural capital for future generations, but its implications are far broader than any of these terms, embracing not only the environment and economic development, but also health care, urbanization, energy, materials, agriculture, business practices, social services, and government. While sustainable development means balancing wealth generation with continuously enhanced environmental quality and social well-being, it is a concept of a complexity, richness, and significance comparable to other guiding principles of modern societies, such as human rights, justice, liberty, capital, property, governance, and equality.

While even this list of the implications of sustainability is incomplete on its face, any such tally is the product of hindsight derived from our twenty-first-century intellectual culture. Any notion regarding our responsibility to maintain natural capital for future generations or to advance economic and technological progress with a sense of stewardship was not present in the eighteenth-century designs that still drive so much of our economic thinking. While we may parse the deliberations and discussions of the era for evidence of some incipient appreciation of our predicament, we only know with certainty that the understandings we derive from John Muir, Aldo Leopold, and Rachel Carson had yet to be formulated, much less realized. At the time we were still held captive by a millennia-old Malthusian-style constraint model in which each advance in population resulted in a series of negative constraints greatly limiting our collective quality of life by constantly cycling in ways in which personal income could not be enhanced. Not surprisingly, then, the new economic order of the eighteenth century and the new political order being realized in the

United States at the same time were so powerful in their transformative effect that only now can we look back in both awe and fear at what these revolutions have wrought.

Two-hundred-plus years into this new political and economic order, for all its vicissitudes the world has advanced in many positive and constructive ways. The pre-Industrial Revolution economies of subsistence agriculture and the long-term persistence of poverty endured by all but an elite handful have largely passed from the social order. The masses, formerly voiceless and without any political power, now speak loudly and often and can be heard in many new settings. Yet at the same time we sit on the edge of a precipice of a significant failing. Because neither our economic nor our political models have factored in the natural limits of the Earth, and because the Constitution outlines neither aspirations nor outcomes relative to man's relationship with the natural world, we are at this very moment in time on a path toward a condition where the natural rights of man and national laws of economics collide with the natural systems of the Earth, to the ruinous long-term detriment of us all.

As vigorous and dynamic a modern society as we are, and as hard-working and productive as we have been, one would expect our nation to have exerted an impact on the environment. Yet it is surprising to me that in only 250 years we have actually altered the natural patterns of the atmosphere and both land and ocean ecosystems to the extent that future natural capital inputs for our long-term well-being are actually at risk. It is almost beyond comprehension that the political and economic designs that have allowed most of us to leave behind the brutish world of our ancestors are the same designs that have brought us to the brink of environmental collapse.

Both our economic and political designs are at once too limited and too simplistic to address the complex problems intrinsic to the discourse of sustainability, such as intergenerational equity, biodesign, adaptive management, industrial ecology, and natural capital conservation—new principles for organizing knowledge production and application. These inherent limitations are a consequence of not only the relative immaturity of our economic and political tools but also, and more important, the implicit “aspiration of self” that the Constitution endorses. We all operate out of self-interest to some

extent, which is entirely rational, but the parameters that our foundational national document establishes in many ways simply constitute a justification for us to indulge in selfish, or let us say at least nakedly self-interested, pursuits and therefore might be just too simplistic to be a completely successful design for long-term societal success. As a consequence of our economic and political system, the individual perspective has inevitably outweighed the collective, with the result that adequate protection for the collective has lost out. In part because of the inevitable limitations of a document drafted in the eighteenth century—however brilliant and visionary it may have been—efforts to advance the long-term interests of the whole by controlling the short-term behavior of the individual are doomed to failure.

While we have pursued our aspirations of self, roughly 20 percent of the planet's bird species have been driven into extinction, 50 percent of all freshwater runoff has come to be consumed, seventy thousand synthetic chemicals have been introduced into the environment, the sediment load of rivers has increased fivefold, and more than two-thirds of the major marine fisheries on the planet have been fully exploited or depleted. What right do we have to eliminate the fishing stock of the oceans for generations or to alter the atmosphere of the planet? What rights of man or pursuit of happiness grants us the power to condemn future generations to the impact of human-induced sea level rise? Of course, the answer is we have no such rights. Likewise, what logic permits the extraction of such quantities of natural capital from the Earth in the ten to fifteen generations that will have presided between 1850 and 2150, leaving future generations with only a diminished basis to use the natural systems from which we have greatly benefited? No such logic can be found.

In an effort to redeem ourselves, let us at last reconsider our design, derived from the framers of the Constitution in the eighteenth century. However belatedly, it is at long last time to add one more value to the concept of the self as expressed by the Constitution. To provide for the common good we cannot only consider justice for those of us present; we must also conceptualize and enact into law provisions for justice for future generations. To ensure the equitable pursuit of happiness we cannot look only at the 40 or 50 years ahead of or behind us; individually we must come to terms with the realization that deci-

sions made during the past 250 years have put humanity during the next several thousand years at potential risk.

It is time for America to take yet another first step, just as we took a first step in 1789. In the twenty-first century we must at last declare sustainability a core aspirational value of the American people, on the same level as liberty and justice and equality. With such a declaration we would see changes in law, changes in behavior, changes in teaching and learning, and, yes, even changes in economics. With such a declaration we would fulfill the expectations of the visionary framers of the Constitution of the United States of America.

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None Dare Call It Hubris: The Limits of Knowledge

PERSPECTIVES

MICHAEL M. CROW

None Dare Call It Hubris: The Limits of Knowledge

During the past four decades, many of us have come to terms with an increasing realization that there may be a limit to what we as a species can plan or accomplish. The U.S. failure to protect against and respond to Hurricane Katrina in the summer of 2005 and the apparent futility of the plan to democratize and modernize Iraq provide particularly painful evidence that we seem to be operating beyond our ability to plan and implement effectively, or even to identify conditions where action is needed and can succeed.

Our disappointing performances in New Orleans and Iraq might be less disheartening if they were the most complex problems we need to address, but they are child's play compared to the looming problems of global terrorism, climate change, or possible ecosystem collapse; problems that are not only maddeningly complex but also potentially inconceivably destructive.

Our current approach to framing problems can be traced back to the 1972 publication of the Club of Rome's *The Limits to Growth*, which posed the still-unanswered question: How much population growth and development, how much modification of natural systems, how much resource extraction and consumption, and how much waste generation can Earth sustain without provoking regional or even global catastrophe? Since that time, the way we think about human activity and the environment and the way we translate this thinking into our science policy and subsequent R&D, public debate, and political action have been framed by the

idea of external limits—defining them, measuring them, seeking to overcome them, denying their existence, or insisting that they have already been exceeded.

For technological optimists these limits are ever-receding, perhaps even nonexistent, as science-based technologies allow progressive increases in productivity and efficiency that allow the billion and a half people living in industrialized and industrializing nations today to achieve a standard of living that was unimaginable at the beginning of the 20th century. For the pessimists, there is global climate change, the ozone hole, air and water pollution, overpopulation, natural and human-caused environmental disasters, widespread hunger and poverty, rampant extinction of species, exhaustion of natural resources, and destruction of ecosystems. In the face of these conflicting perceptions, it makes no sense to try to use external limits as a foundation for inquiry and action on the future of humans and the planet. It is time to look elsewhere.

All sides in the limits-to-growth debate would probably agree on the following two observations: First, the dynamic, interactive system of complex biogeochemical cycles that constitutes Earth's surface environment is falling increasingly under the influence of a single dominant life form: us. Second, this life form, notable for its ability to learn, reason, innovate, communicate, plan, predict, and organize its activities, nonetheless exhibits serious limitations in all these same areas.

During the past 150 years, scientific and technological innovation has facilitated enormous growth: The population of

Earth has increased approximately sixfold, the average life span of those living in the industrialized nations has doubled, agricultural productivity has increased by a factor of five, the size of the U.S. economy alone has increased more than 200-fold, the number of U.S. scientists has increased by more than 17 times, and the volume of globally retrievable information stored in analog and digital form has expanded by incalculable orders of magnitude. At the same time, 20% of the planet's bird species have been driven into extinction, 50% of all freshwater runoff has come to be consumed, 70,000 synthetic chemicals have been introduced into the environment, the sediment load of rivers has increased fivefold, and more than two-thirds of the major marine fisheries on the planet have been fully exploited or depleted.

As Joel Cohen has brilliantly illustrated in his book *How Many People Can the Earth Support?*, there are many possible futures available to us. The only certainty is that present trajectories of growth cannot, and therefore will not, be maintained indefinitely. (Thomas Malthus got this point right more than 200 years ago. He simply failed to appreciate the productivity gains that science and technology could deliver.) The central question that faces us is whether we will be able to position ourselves to choose wisely among alternative future trajectories or will simply blunder onward. The markets will indeed adjust to the eventual depletion of fossil-fuel reserves, for example, but will likely be too shortsighted to prevent global economic disruption on an unprecedented scale, a situation that could even lead to global war.

If we continue to define our problem as external to ourselves—as limits imposed by nature and the environment—then we consign ourselves to a future of blundering. The limits that matter are internal. They are the limits on our collective ability to acquire, integrate, and apply knowledge.

Although it is difficult to isolate these limits neatly from one another, it is helpful to separate them into six large categories: limits of the individual, of sociobiology, of socioeconomics, of technology, of knowledge, and of philosophy. Although these might at first seem to be insurmountable shortcomings, I believe that our best hope for finding our place in nature and on the planet resides in embracing our limits and recognizing them as explicit design criteria for moving forward with our knowledge production and organization. I see potential for progress in each.

Individual limits. We all operate out of self-interest, which is entirely rational. Community spirit and altruism may be motivating factors, but given that we cannot know the effects of our individual actions on the larger systems in which we are enmeshed, the only reasonable alternative

is for each of us to pursue our conception, however imperfect, of our own interests. Yet as social systems grow more and more complex and as they impinge more and more on natural systems, our individual vision inevitably captures less and less of the big picture. Our only option is to accept the limits of individual rationality and to take them into account in formulating public policy and collective action.

Sociobiological limits. During the course of our development, humanity's special capabilities in areas such as toolmaking, language, self-awareness, and abstract thought have rendered us extraordinarily fit to engage in the competitive business of individual and species survival. We compete among ourselves at every organizational level and with other species in virtually every ecological niche. Cooperation, therefore, most often occurs at one level (a tribe or a nation, for example) in order to compete at a higher level (a war between tribes or nations). But at the highest levels—the behavior of an entire species competing with or dominating billions of other species—we have run out of reasons to cooperate or structures to foster effective cooperation. We need to consciously search for ways to transcend our socio-biological limits on cooperation.

Socioeconomic limits. We have done our best to make a virtue out of our individual and sociobiological limits through market economics and democratic politics. Yet we are unable to integrate the long-term consequences of our competition-based society into our planning processes. Our competitive nature values the individual over the group, but the aggregation of individual actions constantly surprises us. Despite our best intentions, our actions are consistent with a global economy predicated on the expectation of continued growth and development derived from ever-increasing resource exploitation. Thus, for example, we all climb into our cars in the morning thinking only that this is the most convenient way to get to work. We are not deliberately choosing to waste time in traffic jams, exacerbate the trade deficit, and pump greenhouse gases into the atmosphere.

We find it extraordinarily difficult to anticipate or accurately account for the costs and risks incurred over the long term by such group behavior. Indeed, those costs and risks vary wildly from individual to individual and from group to group. An example of this is the cost/benefit calculation that must have been made regarding New Orleans, where the probability of catastrophic flooding is low and the cost of protecting the city is high. At every level of the political system, the individual perspective outweighed the collective, with the result that adequate protection for the whole community lost out. Because of these complexities, efforts to advance the long-term interests of the whole by controlling the short-term behav-

ior of the individual are doomed to failure, which is one of the lessons of the global collapse of communism.

Technological limits. To evade the behavioral limits of biology and economics, we have turned to technology. Indeed, technology, harnessed to the marketplace, has allowed industrialized societies to achieve amazingly high standards of living. In doing so, however, we have put our future into the hands of the lowest bidder. Cheap oil and coal, for example, ensure our continued dependence on the internal combustion engine and the coal-burning power plant. The problem we face is not a shortage of polluting hydrocarbon fuels, but an excess. History shows that we will develop increasingly efficient energy technologies but that gains in efficiency will be more than offset by the increased consumption that accompanies economic growth. The increased efficiency and cleanliness of today's cars when compared with those built in 1980 are an example. Technology has allowed us to pollute less per mile of driving, but pollution has declined little because we drive so many more miles. Too often we choose technologies that save us from today's predicament but add to the problems of tomorrow.

Knowledge limits. There is absolutely no a priori reason to expect that what we can know is what we most need to know. Science uses disciplinary organization to recognize and focus on questions that can be answered. Disciplines, in turn, are separated by methodology, terminology, sociology, and disparate bodies of fact that resist synthesis. Although disciplinary specialization has been the key to scientific success, such specialization simultaneously takes us away from any knowledge of the whole.

Today the whole encompasses six billion people with the collective capability of altering the biogeochemical cycles on which we depend for our survival. Can science generate the knowledge necessary to govern the world that science has made? Do we even know what such knowledge might be? Producing 70,000 synthetic chemicals is easy compared to the challenge of understanding and dealing with their effects. Despite the billions we have spent studying our interference with the planet's biogeochemical cycles, we really do not have a clue about what the long-term result will be. And we have even less knowledge about how to organize and govern ourselves to confront this challenge.

The intrinsic difficulties of creating a transdisciplinary synthesis are compounded dramatically by a dangerous scientific and technological illiteracy among senior policymakers and elected officials. An ironic effect of technology-created wealth is the growth of an affluent class that prizes individualism over civic engagement and that feels insulated from the need to understand and confront complex tech-

nology-related social issues.

Philosophical limits. The scientific and philosophical intellectuals of "the academy" remain focused on the relatively simple question of understanding nature. The much more complicated and challenging—and meaningful—quest is to understand nature with a purpose, with an objective, with an end. What is the purpose of our effort to understand nature: to learn how to live in harmony with nature or to exploit it more efficiently? For thousands of years, philosophical inquiry has been guided by such fundamental questions as "Why are we here?" and "How should we behave?" Such questions were difficult enough to confront meaningfully when our communities were small, our mobility limited, and our impact restricted. In today's hyperkinetic world, how can we possibly hope to find meaning? The literal answers provided by science amount to mockery: We are here because an expanding cloud of gas some 15 billion years ago eventually led to the accretion of planets, the formation of primordial nucleotides and amino acids, the evolution of complex organisms, the growth of complex social structures in primates, and the dramatic expansion of cognitive and analytical capabilities made possible by the rapid evolution of neocortical brain structures. Such explanation is entirely insufficient to promote the commonality of purpose necessary for planetary stewardship. We lack a unified or unifiable metaphysical basis for action, just when we need it most.

I list these limits—which no doubt could be parsed and defined in many different ways—not to bemoan them, but to acknowledge the boundary conditions that we face in learning how to manage our accelerating impact on Earth. How can we create knowledge and foster institutions that are sensitive to these boundary conditions? This is a sensitivity that we have hardly begun to develop and that will not be found in any of compartmentalized traditional disciplines that we nurture so earnestly.

Not only do we perpetuate traditional disciplines, we assign inordinate significance to distinctions in a strict hierarchy: Disciplines trump other disciplines based on their quantitative capacities. The academy remains unwilling to fully embrace the multiple ways of thinking, the different disciplinary cultures, orientations, and approaches to solving problems that have arisen through hundreds if not thousands of years of intellectual evolution. Our science remains culturally biased and isolated: Western science is derivative of a philosophical model of domination and the manipulation of nature, as opposed to the acceptance of natural systems and dynamics.

The problems that we face are not hierarchical, nor do they

fall within strict disciplinary categories. They require multiple approaches and an integration of disciplines; we cannot expect biologists alone to solve the problem of the loss of biodiversity. Because each academic discipline has a Darwinian focus on its own survival, none has the impetus or the capacity to develop a formal language to make itself comprehensible to other disciplines. We have not developed the means for chemists to talk to political scientists, and for political scientists to talk to earth scientists, and for earth scientists to talk to engineers. The debate must engage a broad community of disciplines, and not just the expertise found within the universities but also the wisdom and expertise developed in commerce, industry, and government.

We need new ways to conceive of the pursuit of knowledge and innovation, to understand and build political institutions, to endow philosophy with meaning for people other than philosophers. We trumpet the onset of the “knowledge society,” but we might be much better off if we accepted that, when it comes to our relations with nature, we are still pretty much an “ignorance society.” Our situation is reminiscent of Sherman McCoy, the protagonist of Tom Wolfe’s *Bonfire of the Vanities*, who fancies himself a “Master of the Universe” just as his life is taken over by events far beyond his control. We have the illusion of understanding and are not humbled by the fact that we do not understand. We refuse even to consider the possibility.

Hubris, exemplified in the demands we make on science, is a major obstacle to coming to grips with our situation. We are obsessed with trying to predict, manage, and control nature, and consequently we pour immense intellectual and fiscal resources into huge research programs—from the Human Genome Project to the U.S. Global Change Research Program—aimed at this unattainable goal. On the other hand, we devote little effort to the apparently modest yet absolutely essential question of how, given our unavoidable limits, we can manage to live in harmony with the world that we have inherited and are continually remaking.

Concepts such as sustainability, biodesign, adaptive management, industrial ecology, and intergenerational equity—new principles for organizing knowledge production and application—offer hints of an intellectual and philosophical framework for creating and using knowledge appropriate to our inherent limits. Sustainability is a concept as potentially rich as justice, liberty, and equality for guiding inquiry, discourse, and action. Biodesign seeks to mimic and harness natural processes to confront challenges in medicine, agriculture, environmental management, and national secu-

urity. Adaptive management acknowledges the limits of acquiring predictive understanding of complex systems, and although the prospect of their control is illusory, the genesis of increasingly sophisticated data sets should impart increasing “predictability” to the bandwidth in which systems may behave. Industrial ecology responds to our tendency to organize and innovate competitively, and looks to natural systems for a model of innovation that can enhance competitiveness while reducing our footprint on the planet. Intergenerational equity seeks to apply core societal values such as justice and liberty across boundaries of time as well as space. Of course, we will need many other new ways to think about and organize our actions, but these few indicate a beginning.

Common to all such approaches is the idea that more flexibility, resilience, and responsiveness must be built into all institutions and organizations—in academia, the private sector, and government—because society will never be able to control the large-scale consequences of its actions. In today’s ignorance society, we must define some measure of rationality and recognize that the only way to reduce uncertainty about the future is to take action and carefully observe the outcomes. We must establish threshold criteria for, or at least attempt to define, the range of potential scenarios for which some degree of planning either to promote or obstruct a given outcome should be contemplated. The latter is the more difficult, particularly if a major risk or disaster begins to emerge. Yet we should not succumb to the paralysis of the “precautionary principle,” which saps innovation and risk-taking. The more institutional and organizational innovation we conduct, the better the chances that we will learn how to deal with the implications of our own limits.

The ideological and institutional struggle between communism and market democracy can be viewed as one such set of competing innovations, albeit poorly planned and exceedingly costly. A key result of this innovation competition is the certain knowledge that rational self-interest cannot be successfully suppressed indefinitely and that legal systems that foster dissent and freedom of choice provide a fertile culture for innovation. We now urgently need to conceptualize a new series of innovations, at much lower cost and shorter run-time, to push this result further and apply it to the problem of ensuring that our global society can continue to be sustained by the web of biogeochemical cycles that makes life possible in the first place.

Michael M. Crow is president of Arizona State University.

Newsweek International / August 2007

The World Is Catching Up

Michael Crow: The World Is Catching Up

By Michael M. Crow

Newsweek International

Aug. 20-27, 2007 issue - The modern university is the ideal environment for the creation and transfer of knowledge that drives national competitiveness in an increasingly global era. Its most effective form is the American adaptation of the European model, in which teaching, learning and research are integrated into a single institution. Indeed, the American university has proved capable of almost anything, from developing advanced economic theories to creating new life forms. And that's in addition to providing basic liberal-arts training to millions of people who drive commerce, education, government and the arts around the world.

From the European Union to China, India to Mexico, many national leaders understand that the university is the critical catalyst for America's adaptability, economic robustness and emergence as a great power. And they are moving aggressively to catch up. In France, President Nicolas Sarkozy is outlining a total overhaul of the country's underperforming university system. In India, a private citizen is building a university for 100,000 students, while China is building or revamping hundreds of institutions. And the universities created by emerging economies beginning in the 1990s and through 2020 will likely play a decisive role in reshaping the global balance of economic power.

That is bad news for the United States. The past two decades of American university development have been characterized largely by self-satisfaction arising from steady progress by the top 20 or so research universities. And America as a nation has been coasting. Since 2000, the United States has lost its edge in the graduation of engineers and technologists. The country no longer dominates scientific discovery, innovation or exploration. Most important, the United States has not launched any effort to build new institutions to accommodate its increasingly diverse population of more than 300 million.

The result is that America's university system, despite its historical pre-eminence, has ceased to grow. Few new universities are being built, and only a handful of those in existence are undergoing meaningful expansion. Furthermore, America's university system has failed to adapt to the dramatic demographic shifts occurring as a result of social mobility and immigration.

America needs to realize that its universities face real competition from the rest of the world to attract the best and the brightest, to secure resources and to provide environments that educate and inspire. This is not to say that the best American universities are no longer the leaders in discovery and innovation. They are. Rather, it is

to say that the success of the higher-education system must be measured by more than just innovations. Its long-term performance depends on its ability to provide learning to a broad cross sections of citizens, to advance

national proficiency in math and science and to create an adaptable work force, as well as to develop a national appreciation for discovery, entrepreneurship and the creative process.

In China and elsewhere, these are the goals of the new universities being built. In the United States, we need to move from a national self-confidence based on past success to one built on the knowledge that we are advancing a system of higher education that will meet our future needs. This will require that policymakers, business leaders and universities rededicate themselves to creating comprehensive learning and discovery environments; design entirely new models and methods for teaching, and then take action to implement them. It is imperative that we get started now.

Crow is president of Arizona State University.

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McKinsey Quarterly / April 2011

Innovating US Higher Education: Arizona State University's Michael Crow

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McKinsey Quarterly

SOCIAL SECTOR PRACTICE

Innovating US higher education: Arizona State University's Michael Crow

A pace-setting university president explains why US universities need to become more productive, and how to advance reforms.



When Michael Crow became president of Arizona State University, in 2002, the former Columbia University vice provost had ambitious plans to turn the school into a new American university devoted to educating a wider swath of students and focused on higher productivity in cultivating competitive graduates who can succeed in today's volatile job market.

Nine years and a 25 percent increase in student enrollment later, Crow, 56, has delivered big changes in those areas and others at ASU and has garnered a growing reputation as a pace-setting thinker on higher education. He has made strides toward expanding ASU in areas such as ethnic and economic diversity, graduation rates, freshman retention rates, and in the number and intellectual reach of graduates. In fall 2010, ASU boasted an 83 percent first-year retention rate, up from 75 percent in the mid-2000s, and a record enrollment of more than 70,000 undergraduate and graduate students. A survey of recruiters by the *Wall Street Journal* in September 2010 ranked ASU as the fifth-best American university in terms of quality of graduates.

Crow has been outspoken on the topic of government support for schools, pushing for an output-based model that links funding with the ability of universities to produce large numbers of graduates with literacy across multiple disciplines. He has developed close working ties with businesses to develop a higher profile and value proposition for ASU in its surrounding community. In this video interview at his office in Tempe, Arizona, Crow sat down with McKinsey's Lenny Mendonca to discuss the challenges of restructuring the intellectual enterprise of today's public universities.

A global edge in higher ed?

You know, what's interesting about the global position of American universities is that people often think that it's only the rankings of who are the top research performers. It's that, and then some. And so [with] that, relative to research, I think American universities are well positioned to maintain their dominance, in terms of fundamental knowledge production and so forth.

Where American universities are having some difficulty is in educating the broader populace. We've got 310 million people. Our universities have difficulty scaling and innovating. And so that's where I think other universities in other places may have the opportunity to be more innovative. And that's where we've got to be alert to the competitive challenges. American universities are going to have to learn how to scale. They're going to have to learn to perform multiple missions and multiple functions with greater intensity.

It's clear to almost everyone that we're going to be going through multiple careers, and multiple jobs [with] lots of changes as we ebb and flow with the changes in the economy. Well, if that's the case, which it in all likelihood will be, then our job is not to produce the

history major or the civil-engineering major but to produce the history *graduate*, or the civil engineering *graduate* who is capable of learning across, basically, all disciplines. And so you have to change your logic of what you're actually producing. And we're not there yet. We're underperforming right now in our public institutions, particularly for a whole wide range of reasons—principally, I think, a lack of focus on innovation and a lack of focus on producing that as an important outcome.

Changing an institution's clock speed

When you think about change inside a university, I think the most fundamental thing that I've worked on in the last nine years is changing the focus from being an institution measuring itself based on its inputs—you know, what's the selectivity of the students? You certainly have to have students that are qualified. But somehow that's [become] the measure of success. That, of course, has nothing to do with what you do once students come to the university.

And so we've flipped it on its head, and we said, now the university will be measured by what we are able to achieve—what's the quality of the learner that we're producing, what's the speed capacity of the learner that we're producing. And so once you are able to focus on that, then change comes from this change in mission, change in direction. Once you have a change in mission and a change in direction, then you can focus on change in routine.

And you start tearing down the routines that are standing in the way of actually achieving the institution's actual goal. Well, when you look at a public university, and you think about a public university versus a private university, or you think about a university versus a corporation, or something else, are there differences when you think about efficiency or ineffectiveness?

The answer is yes, but not meaningfully so. When you think about efficiency and effectiveness, what you're really talking about is, how can you structure your learning environment to operate at the highest level of performance? And if you're a true public university, you're very committed to access. So therefore, at the lowest possible cost, what are the differences? The differences are in terms of mission.

So our mission is to educate as broad a cross section of students that we possibly can in large numbers in ways that they can be competitive in whatever field they happen to be in, and then more broadly they can be really educated as critical thinkers and as high-speed learners.

How do you do all of that and still be efficient? It means you have to fundamentally go back and look at the fundamental model of the curriculum, the nature of the semester, the clock speed of the institution—all of those things. And so right now, we have decided to look at everything. There are no sacred cows. We're looking at every single aspect of how the institution works.

Technology: 'Our dear and intimate friend'

When you think about technology and the role of technology, we believe that just in the last couple years, just since 2008 and 2009, we have been able to apply technology to our tremendous benefit. For instance, in teaching 10,000 [students] freshman English, we have found a way to lower the cost and improve the outcomes. And [we are] doing the same with freshman math.

Before, we had students who were fully capable—based on their SAT scores or their ACT scores—to do very well in freshman math who were still failing in freshman math. What we did is we restructured how we teach. We use new technologies, artificial-intelligence-based algorithms, and new platforms—new ways of learning. We not only improved our success rate dramatically, we also lowered our costs by 50 percent at the same time. So technology has been our dear and intimate friend.

Overcoming barriers to reform

The hardest part of actually accomplishing change either in a university or another institution—but I think particularly hard in universities—is to overcome an innate conservatism, which operates on the basis that what one needs to do is to protect the routine, protect the methodological content, protect the social constructs, in a sense not even remembering where most of those things came from. Or what they were derived from. Or that they themselves were innovations at one point.

And somehow the biggest challenge is getting people to realize that they *can* be courageous. They can advance change as an objective and actually attain a measurable and better outcome as a result of that. There never has been one way to do something. Universities have not operated the same way throughout the eons. They have changed. And they have adjusted. And they need to accelerate their change and their ability to adjust in moving forward.

Mastering the future

I think in the next five or so years, ASU will definitively master the performance of the immersion part of the university, the physical part of the university, where a broader cross-section of students than most research universities have will be performing at the same level in terms of retention, graduation, success of our students, and so forth.

So we will have mastered that through innovation. Then we'll be looking in that context to accelerate learning. So that you can either get in and get out quickly, if that's what you choose, or you can take not two majors or three majors or four, but four, five, or six. That is, you could master more subjects, not for the sake of mastering the subjects but for expanding your learning capability.

I think then beyond that, we've also figured out how to project the university with our content. And so we're looking in the next five years to have as many as 30,000 or 40,000

Related thinking

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online students who are not in the immersion part of the university but are connected to the immersion part of the university, getting an unbelievably technologically advanced access platform into fantastic degrees.

And so we’re going to be doing both of those things. That, by the way, is different than the model that most of the online purveyors of educational content are working in, because in this case that content will be derivative of the same faculty working in the immersion environment—in a sense doubling down their impact. And so, could we affect 100,000 students with a small, elite, highly compensated, high-performing, fantastic faculty rather than just growing the faculty and growing the faculty with each increment of growth at the University? That’s what I think that we will have mastered in that five-year time frame. ○

Nature Magazine / April 2007

The Arizona Experiment



Arizona State University's president Michael Crow wants to shake up the hierarchy of American universities.

THE ARIZONA EXPERIMENT

A shift in population, money and political influence to America's 'sunbelt states' is helping to reshape its research universities. The first of two features looks at the far-reaching ambitions of Arizona State University. The second asks whether a rush to create extra medical schools could spread the region's resources too thinly.

It is a hot February morning in the Arizona desert, and Walter Cronkite, the legendary American newscaster, is straining every muscle in his 90-year-old body to break the hard ground with a golden shovel.

Cronkite is in Phoenix to start construction on a new home for America's biggest journalism school, in America's largest university, in what will soon be its third-largest city. He has some generous words for his host, the president of Arizona State University (ASU). Michael Crow, Cronkite tells the crowd gathered for the ground-breaking, is "a true visionary of our time. He entered the city and took the reins of the university, and gave it direction and energy beyond what anyone could have imagined."

Strong words coming from the 'most trusted man in America'. But the energy is palpable across ASU, including its campus here in downtown Phoenix where construction cranes speak to Crow's ambition. In the past four years, since he left Columbia University in New York to take the reins in Arizona, Crow has had one goal in mind. Put simply, he wants to leave behind the Harvard template, and build a new American university for the twenty-first century.

The key to Crow's vision is to break away from the department-based model of most universi-

ties, and instead build up excellence at problem-focused, interdisciplinary research centres. US research universities, Crow argues, "are at a fork in the road: do you replicate what exists, or do you design what you actually need?" By his reckoning, centres that teach students to communicate with the public and to tackle real problems, such as water supply, are more relevant to today's needs than, say, a chemistry department.

Crow's ideas for ASU have some powerful supporters. "It has become a very different and very exciting institution," says Frank Rhodes, former president of Cornell University in New York and the one-time chair of the US National Science Board. "It is going to be a prototype for the rest of the country."

Not everyone is convinced. Some think that Crow has over-reached, attempting to turn a public university with a mixed reputation into a research hub of international repute. For instance, critics have attacked plans for a medical school in Phoenix — supported by Crow, but being built by Arizona State's erstwhile rival, the Tucson-based University of Arizona — as being extravagant and politically inspired (see page 971). In addition, Crow has been involved in noisy public disputes with ASU's student newspaper over allegations that he tried to censor

its content to please Ira Fuller, a Mormon construction magnate who has donated more than US\$160 million to various university projects.

Before arriving at ASU, Crow had a reputation as a talented but headstrong university leader. A political scientist who specialized in science and technology policy at Iowa State University, he entered full-time university administration as a vice-provost at Columbia University, one of the top private research universities in the United States. There he helped to establish the Earth Institute — now led by economist Jeffrey Sachs — to tackle interdisciplinary environmental problems. He also pursued a vainglorious effort to save Biosphere 2, the Earth-sciences experiment-cum-greenhouse built in the Arizona desert and funded by Texan billionaire Ed Bass. It was his sojourns to Biosphere 2 that first drew him to the youngest and, arguably, brashest of the contiguous United States. "I liked the attitude here," Crow recalls.

Talk to any academic who has accepted or rejected a position at ASU recently — and there are plenty of them — and this attitude invariably comes to the fore. For your typical American university professor from either coast, the idea of moving to Phoenix is about as appealing as a stint in the nineteenth-century wild-west community

C. CARLSON/AP

portrayed on HBO's series *Deadwood*. Yet the size and the sheer energy of the city and the project can overcome initial misgivings. A surprising number of top-flight individuals — from Nobel-prize-winning economist Edward Prescott to the biologist and former research chief of SmithKline Beecham George Poste — have taken the plunge.

ASU was already growing its research from a modest base, with an interdisciplinary bent, before Crow turned up. In 2002, the university was involved in setting up the Translational Genomics Research Institute (TGen), a genetics research centre run by Jeffrey Trent, former scientific director of the US National Human Genome Research Institute. Today TGen has about 300 researchers, an annual research income of \$60 million, and eight spin-off companies under its belt.

Crow's role has been to publicly raise the flag of bold reform, get politicians and philanthropists on board, sign up some star academics and build interdisciplinary centres to house them. Those established under his tenure include the physically spectacular, \$150-million Biodesign Institute led by Poste; a School of Earth and Space Exploration (SESE), headed by geologist Kip Hodges; and the Consortium for Science, Policy and Outcomes run by Dan Sarewitz, a former Democrat staff member of the House of Representatives.

Stylish approach

The Biodesign Institute, whose building won R&D magazine's award last year for the finest new laboratory in the United States, houses 700 staff, including 100 faculty members who are collaborating, drug-industry style, on new approaches to molecular biology and genetics. Biology, computing and engineering in particular, but also law, social sciences and other specialties, are brought into the mix. Last year, the institute attracted about \$60 million in public research funding. If all goes to plan, two additional laboratory buildings will be built by 2009, at a further total cost of \$300 million.

Poste has the air of someone more accustomed to giving orders than following them,



Arizona State University's Biodesign Institute is set up to foster collaborations between researchers.

but, like many of Crow's recruits, he speaks with an almost-childlike enthusiasm for the project. ASU is "singularly the most radical experiment going on in American higher education", he says. "This is the fastest-growing metropolitan area in the United States, and its largest constellation of undergraduates. This isn't just about the research; it is about the future of these young people."

Michael Tracy, deputy director of the institute, admits that he hesitated before coming to Arizona from his previous position at Stanford Research International, a contract research group in California. But he says that he has been impressed by the extent to which Arizona's residents have bought into the university's plans. "Local people realize that the area needs a high-value proposition," he says. "They have really embraced the idea."

Kip Hodges, who came from Massachusetts Institute of Technology (MIT) in Cambridge last July to lead ASU's new School of Earth and Space Exploration, shares this enthusiasm. "It is a wonderful thing to be part of a place that is becoming, rather than a place that has been," he says of Phoenix.

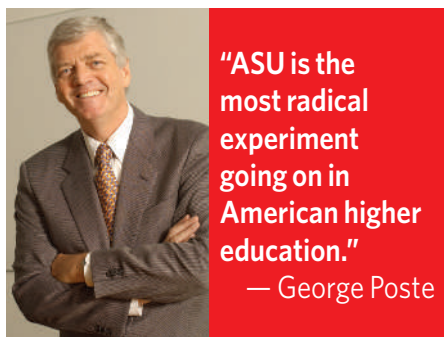
SESE, which has 36 faculty from many disciplines, hopes to be in a new, purpose-built building by 2009. It aims to pull together expertise in engineering, computation and Earth and space science (ASU is a leader in Mars exploration) to obtain a better understanding of problems on this planet and farther afield. At first, Hodges suspected that ASU's emphasis on serving Phoenix was parochial — "after all, what has MIT ever done for Boston?" he asks rhetorically. "But for SESE, it is a matter

of the relationships between the Earth and society." For example, the centre plans to study how society coevolves with changes in water resources. "It is obviously important for Phoenix, but it is important for the rest of the world, too," Hodges says. Addressing such problems requires a huge collection of skills, including archaeology, the physics and chemistry of water, evolution, anthropology, human ecology, climate and palaeoclimatology. The centre aims, for instance, to build a comprehensive model of the entire Colorado river basin.

Heat islands

Water issues are also to the fore at the Global Institute for Sustainability, an interdisciplinary centre led by Chuck Redman, an anthropologist and long-time ASU faculty member. The institute brings together about 50 faculty, all of whom also have departmental appointments, to study the relationship between people and the environment, especially in urban areas. A focus of interest, Redman says, is to develop building materials and coatings that are suited to 'heat island' cities such as Phoenix, where temperatures can exceed the surrounding area by as much as 8 °C.

Unlike these other centres, the Consortium for Science, Policy and Outcomes is a unit that Crow founded in Washington DC and brought with him to ASU. On Tuesday mornings, he even teaches class there, engaging in a double act with centre director Sarewitz in a three-hour seminar with about 30 undergraduate and graduate students. Crow's a talented teacher. He pulls students into Thomas Kuhn's ideas on how scientific paradigms change by



"ASU is the most radical experiment going on in American higher education."
— George Poste

ARIZONA STATE UNIV.

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P. EISENBERGER

alluding to a friend who died of the immune disease lupus, and illuminates policy questions by referring to people he knows, such as Jack Marburger, the US presidential science adviser, and Jim Collins, an ASU biologist who runs the National Science Foundation's biological-sciences directorate.

All of this is part of an overall picture that puts strong precedence on three things: high-quality, interdisciplinary research; access for large numbers of students from Phoenix's racially and socially diverse population; and relevance to the needs of the city and the region. Parts of the vision predate Crow's arrival, but the university has become very much Crow's project. "You have got to give him credit for attacking on multiple fronts simultaneously," says Trent.

Fast forward

Phoenix may be the ideal place to host the vision. "This is a university that is being built at the same time as the city is being built," says Crow. On a wall in his office, an aerial view displays the phenomenal growth of a city whose developed area already exceeds that of Los Angeles. The population of Phoenix and its suburbs has grown rapidly to nearly 4 million, and is projected to reach around 8 million within the next quarter century.

Yet for Crow and his disciples, this newness is the greatest part of the appeal. The city has no establishment to overthrow; even Los Angeles is an establishment town by comparison. Asked why people come here, Crow's answer is straightforward: "Quality of life," he says. For most of the city's youthful population that means space to live and drive, not opera or bookshops. That suits Crow, the son of an car mechanic, just fine: "Someone once said to me, 'some of you blue-collar PhDs are quite smart,'" he recalls with glee.

The question of what kind of university will best serve this new American university is yet to be answered. The model Crow mentions most frequently is that of the University of London which, although now fraying, includes everything from the elite Imperial College to stalwart specialized colleges such as Goldsmiths and



Path to success: ASU will provide resources for a diverse community.

Birkbeck, which provide vocational training and adult education.

Arizona, with its booming population and slim infrastructure, faces some of the same challenges as Victorian London — and it sees strong universities as part of the solution. The relationship between public universities and legislature in most American states is traditionally a difficult one. Universities are regarded by many state legislators as expensive and dangerous hotbeds of radicalism and free love (a relationship searingly portrayed by Jane Smiley — a friend and former Iowa State colleague of Crow's — in the comical novel *Moo*). But in Arizona, the free love is between the legislature and the state university system, of which ASU is the largest part.

Conservative lawmakers and the state's liberal governor, Janet Napolitano, are united in their support for the university's expansion. A state referendum in 2000 allocated \$1.5 billion in sales tax revenue over 20 years to research in the state university system. Two years later, the legislature gave \$400 million more.

And private money is flowing too. In a young city with a thin scholarly tradition, private philanthropy should be a hard sell. But the involvement of people like Fuller, who never attended the university but delivered newspapers near its main Tempe campus, and William Carey, a financier who gave \$50 million to ASU's business school in 2003, have shown that this door, too, can be prised open.

The programme still has its detractors. Academics who don't agree with the new interdisciplinary paradigm say that they have been

trampled underfoot. Take Robert Pettit — a chemist and long-time director of the Cancer Research Institute at ASU until he lost the position in 2005. Pettit had clashed with Crow over various issues, including the relationship between his lab and new, interdisciplinary centres at the university. Still a tenured professor at ASU, Pettit says that the arrival of the new institutes "has been very destructive to faculty and student morale and has placed ASU in serious financial jeopardy".

Richard Zare, head of chemistry at Stanford University and another former chair of the National Science Board is, like Rhodes, an authority on US research universities. But he thinks that ASU's emphasis on the interdisciplinary may come unstuck. "It will learn, as others have in the past, that you can't have strong interdisciplinary programmes without strong departments," Zare says.

But to Crow, the hierarchy among established US university departments is too rigid. "If you are the 25th-best geology department, you are trapped!" he says. "Your chances of getting to be fifth-best are zero." The interdisciplinary approach, he says, offers more promise.

Meaningful measures

Measuring achievement for the new ASU falls to the university provost, Betty Capaldi. A typical Crow hire, Capaldi was already co-leader of a project that collates detailed, comparative statistics between US universities. So no one is likely to accuse her of fudging the numbers. Capaldi, however, is rather coy about how the performance of the new ASU should be measured. The centres can "use anything they find meaningful," she suggests. "We are asking every unit to talk to us about how they would measure success. If you are unique — compare yourself to yourself," she says.

It will take years to determine whether the experiment has been a success. Senior ASU faculty assert that the commitment to interdisciplinary research and broad student access have already developed deep roots at the university. And the enthusiasm that it has rekindled in such diverse and seasoned characters as Walter Cronkite and George Poste is certainly infectious.

But the entire project undoubtedly hangs on Crow's unique style of leadership. The approach is unusual, as Rhodes notes, because presidents of US universities often have to content themselves with refining what they have already got. "The polishing of the status quo is much more comfortable," he says. At ASU, he says, "there is a kind of rugged individualism that says — we will just make this happen." ■
Colin Macilwain is a reporter and editor for *Nature* based in Edinburgh.

D. TEVIS/ARIZONA STATE UNIV.



"It is a wonderful thing to be part of a place that is becoming, rather than a place that has been."
— Kip Hodges

The university of the future

The traditional model of the US research university — based on the pre-eminence of the single-discipline department — needs to be stretched and challenged.

The American research university is a remarkable institution, long a source of admiration and wonder. The idyllic, wooded campuses, the diversity and energy of the student populations, and, most of all, the sheer volume of public and private resources available to run them, have made them the envy of the world.

Seen from the inside, however, everything is not quite so rosy. Setting aside the habitual complexity of medical schools, which have separate healthcare and finance issues, the structure of these institutions is straightforward and consistent. The bedrock of each university is a system of discipline-specific departments. The strength of these departments determines the success and prestige of the institution as a whole.

This structure raises a few obvious questions. One is the relevance of the department-based structure to the way scientific research is done. Many argue that in a host of areas — ranging from computational biology and materials science to pharmacology and climate science — much of the most important research is now interdisciplinary in nature. And there is a sense that, notwithstanding years of efforts to adapt to this change by encouraging interdisciplinary collaboration, the department-based structure of the university is essentially at odds with such collaboration.

A second set of issues surrounds the almost static nature of the departmental system. In a country where most things are highly fluid, the fields covered by departments, as well as the pecking order between them, have remained largely unchanged for many years. As people and money have flowed, particularly over the past twenty years, to the south and the southwest, the strongest US universities and departments remain embedded in the northeast and in California. League tables drawn up by the National Academy of Sciences and others show little movement in this pecking order, even over several decades.

Another, perhaps more contentious, issue concerns the relevance of the modern research university to the community it serves. The established model, whatever else its strengths and weaknesses, reflects the desire of the middle classes for undergraduate training that prepares their offspring for a stable career. But how does it serve a society in which people may have to retrain and recreate their careers throughout their adult lives?

These questions are being asked throughout American academia, but nowhere more searchingly than at Arizona State University (ASU), a huge public university that is expanding to meet the needs of the United States' fastest-growing major city (see page 968). Michael Crow, its president, is executing an ambitious plan to replace the traditional model with one in which both influence and research excellence are concentrated not in departments, but in large, broadly based interdisciplinary centres with clear commercial or societal goals.

Whatever its outcome, this experiment will not of itself uproot the traditional university system. Incremental change, notably the establishment of stronger multidisciplinary entities such as Bio-X at Stanford University in California, and several new centres at Harvard, may have a greater bearing on the overall development of the system.

But ASU's effort already tells us plenty about the likely direction of the research university in the up-and-coming regions of America. The university of the future will be inclusive of broad swaths of the population, actively engaged in issues that concern them, relatively open to commercial influence, and fundamentally interdisciplinary in its approach to both teaching and research. ■

“There is a sense that the department-based structure of universities is essentially at odds with collaboration.”

Taking the first step

China will join efforts to cut carbon emissions, but should not be expected to lead them.

With a new coal-fired plant coming online about once a week, China is on course to overtake the United States as the world's leading carbon dioxide emitter this year or next, an official at the International Energy Agency said last week (see page 954).

This means, of course, that unless China and other major nations such as India and Brazil join a global effort to mitigate the effects of climate change, tough targets and sophisticated carbon markets across the developed world will eventually pale into insignificance.

But the onus is still on the developed nations, who created the problem, to lead that effort.

China is now working on a national plan that will lay out the measures it intends to take to deal with climate change. Despite all the new power stations and the usual difficulty in discerning China's real intentions, there is one good reason to accept that its efforts are sincere: it is in China's self-interest to confront the problem. Assessments by both China and the Intergovernmental Panel on Climate Change have made clear that the nation is likely to be hit hard by climate change, which will increase pressure on water supplies and cut agricultural yields.

In the United States, momentum for domestic action on carbon emissions is growing. As it does so, the issue of how to ensure that China and other developing countries are on board — the issue that prevented the US Senate from ratifying the Kyoto Protocol in the

Change Magazine / July-August 2009

Intellectual Transformation and Budgetary Savings Through Academic Reorganization

Intellectual Transformation and Budgetary Savings Through Academic Reorganization

by *Elizabeth Capaldi*

When times are good, there is little urgency to evaluate fundamental assumptions, as investments can be made in new projects and structures while the old continue. Constrained resources do not allow this luxury. The current economic crisis and associated budget woes in universities requires us to be open to more radical and rapid change than we are used to. What follows is a description of a method to transform the academic organization of the university to fit the current mode of intellectual inquiry—which is broader, more individualistic, and more interdisciplinary than previous modes—and at the same time to conserve university resources.

Customarily, universities organize their academic operations into departments constructed around disciplines, whose standards and boundaries the departments patrol. In response to the growth of knowledge and the proliferation of disciplines as the sum total of knowledge has increased, the number of academic departments has risen dramatically since they were first introduced in the United States. Columbia University had 42 departments at the beginning of the 20th century and started the 21st century with more than 85 (Friedman, 2001), for instance, with traditional departments such as history and literature dividing into ones focused on specific areas: Asian Studies, African Studies, and so on.

However, the discipline-based mode of organization is no longer the optimal way to support the work of the contemporary faculty or accomplish the aims of graduate and undergraduate education, never mind to solve the problems facing the planet. The method described below offers an alternative: to reduce the number of academic departments by combining faculty and their related intellectual interests into larger multidisciplinary groups. Such a strategy, not incidentally, also conserves university resources in hard times.

Current Academic Organization

Departments typically have the following functions:

- undergraduate education, including advising students in the major, assigning faculty to courses, and designing the curriculum;
- graduate education, including admitting students to the graduate program, assigning teaching assistants to faculty and faculty to courses, evaluating graduate students, recommending faculty members for the graduate faculty, and certifying graduate student eligibility for degrees;
- hiring faculty;
- evaluating faculty for tenure, promotion, and raises; and
- assigning space to faculty and students.

Each department in a large research university typically has a chair, faculty, administrative help, a business office, and possibly a publications function and/or a personnel office. While some of the business operations may be centralized in a small liberal arts college or small department, the faculty and staff exist even there, as their functions are independent of size. Large departments (those with greater than 30 or so faculty) often subdivide into smaller academic units to run the graduate program, assign teaching, and perform support functions for the specialization.

Departmental status is a sign of maturity for a field. For example, biomedical engineering is sometimes a program and sometimes

a department. But between 1990 and 2006, the Whitaker Foundation funded universities to strengthen biomedical programs and encouraged them to form departments of biomedical engineering, in order to signal that it had become recognized as a separate discipline.

Because of the prestige associated with departmental status, there is continual pressure from new fields to become departments. Faculty feel, rightly, that this establishes their longevity and their ability to compete for resources within the university. The budget, the catalogue, the graduate faculty, and university buildings are all organized around academic departments. And large departments have more clout and prestige than small ones. So departments will resist any attempt to eliminate or shrink them in response to developments in the disciplines or to declining student interest.

Defects of Departments

While a program may garner prestige, longevity, visibility, and resources when it becomes a department, the generation of departments is expensive for the university. And even while the number of disciplines and of departments has grown, the boundaries between the disciplines have become weaker and their arbitrariness more obvious.

Studies of research practices in the digital environment by Houghton et al. (2003, 2004) found considerable evidence for a fundamental shift from researcher-driven, discipline-bound knowledge production to research that is funder- or problem-driven, highly interdisciplinary, and applied. Highlights from their survey findings:

- Fifty-six percent of respondents said that their research was becoming “increasingly interdisciplinary,” 22 percent that it was “more applied.”
- Research is being conducted in a wider range of settings: 60 percent of respondents reported an increase in the diversity of their collaborators’ locations.
- Collaboration is spreading into the humanities, arts, and social sciences, with more than half of respondents reporting an increase in team collaboration in order to access specialist skills, intellectual property, and equipment. Three-quarters said they now worked as part of a team.

Van Leeuwen and Tijssen (2000) identified how closely fields are related by looking at citations; in doing so they found an increase in interdisciplinarity—as did Herring (2002) when looking at electronic publications.

Rigid departmental structures can interfere with this kind of work. It is true that core disciplinary expertise is critical in order to have rigorous interdisciplinary scholarship, and many faculty still operate within a single discipline. But this can become a problem when faculty who publish in interdisciplinary journals find their scholarship disparaged by those who are not familiar with those journals. Faculty who teach outside the main lines of their own discipline are also frequently not valued by a home department that needs the disciplinary courses covered and the financial credit for its activities added to its budget. Students too may suffer from rigid educational silos, when too much depth within too many majors leaves them unaware of the nature of knowledge and broader perspectives.

A certain amount of inefficiency, unaffordable in times of budget stress, is inevitable within a rigid departmental structure. Departments often duplicate course offerings and compete for students, especially if funding follows credit hours. While these problems can be solved in part by crediting teaching hours to the unit that pays for them, challenges having to do with faculty commitment to building departmental strengths rather than optimizing the university’s investment in the instructional program are harder to address (Massey and Zemksy, 1994).

Analysts have suggested various ways to improve the administration of universities by minimizing the negative effects of departments. Edwards (1999) suggested that interdisciplinary work could be encouraged within the structure of the traditional academic department by creating new departments to straddle the traditional ones—a solution that would seem to exacerbate the problem. More viably, Edwards also suggested that research institutes and pooled teaching assignments could help replace the department. Gazzaniga (1998) suggested a totally flexible approach where faculty might arrange themselves in any configuration they want at any time.

At Arizona State University (ASU) we considered all of these approaches when we undertook the restructuring of our academic

operations.

A Transformed Academic Organization

Faculty groupings should reflect the composition and interests of the faculty at any particular time and place. Some administrator needs to assign faculty work and be responsible for managing the processes associated with hiring, promotion, and tenure. But assignments of faculty work do not need to be limited to one department or discipline.

What follows are some ways each of the functions traditionally performed via academic departments can be handled in a university with a more flexible administrative structure: graduate education, undergraduate education, and faculty work. These alternative forms of organization improve the delivery of education and research and, in addition, save the university administrative resources.

Graduate Education

There must be a graduate faculty certified as qualified to direct dissertations or master's theses and to serve on graduate committees. Traditionally these faculty members evaluate the credentials of their peers for these purposes and send these recommendations to a graduate dean or provost. But there is no need for them to be located within particular departments. Instead, the graduate faculty in, say, psychology, can be all those at the university qualified to supervise graduate work in psychology. Most basic science departments in medical schools went to this model years ago because of the interdisciplinary nature of biology.

At ASU we created graduate faculties comprised of all those qualified to supervise graduate work with a given field. This separates graduate education from departmental control and makes it a university-wide function. The graduate faculty establish fields that have a domain of some rigor and differentiation, justifying the awarding of a Ph.D. in that domain. These domains supplement the disciplinary doctorates.

The implementation of the university-wide ASU graduate faculty model in 2007 had several immediate effects. First, because faculty could be members of several graduate faculty groups at once, there was a 72 percent increase in the listings of faculty in doctoral programs across the university. Second, whereas only a few faculty members had served on multiple doctoral committees previously, the reorganization led to over 620 faculty members' officially being recognized as members of multiple graduate programs—over half the doctoral faculty. Third, as ASU launched new interdisciplinary Ph.D.s, the graduate faculty model became central to their structure and success. New Ph.D. programs in sustainability, biological design, neuroscience, media arts and sciences, social science and health, social science and the environment, and applied linguistics have as many as 70 graduate faculty members from as many as eight departments. This model has broadened faculty thinking about degree programs and has also increased the intellectual capacity and experience available to our students.

Institutions can get help in making this transformation. The National Science Foundation has funded the Integrative Graduate Education and Research Traineeship Program (IGERT) to help institutions produce graduate students who can bridge more than one discipline. The foundation did this in recognition of the fact that increasingly, research is shaped by problems—or, as the National Academy of Engineering terms them, “grand challenges”—that are solved by researchers working in teams organized around problems, not disciplines.

Undergraduate Education

Undergraduate education requires a curriculum designed by faculty whose expertise is relevant to the degree program. But here too there is no necessary tie between degree programs and departments, and many academic units can and do administer a number of undergraduate degree programs. Once the relevant faculty design the curriculum, the administration of undergraduate education requires advisors, course schedulers, and enrollment managers, all of whom can operate independent of departments.

As one example, the School of Life Sciences at ASU created six flexible faculties from five different departments with differing cultures, modes of working, and resources. The merged school produced 11 separate degree offerings, giving a broad and comprehensive menu to students who wish to either generalize or specialize in their undergraduate careers. There is no direct relationship between the six faculties and the 11 degree offerings. Individual faculty with specialties needed for a particular course

are spread across the school. For example, there are microbiologists in at least four of the six faculties and conservation biologists in at least three out of six.

So if there is a need for a course in microbiology, the associate director for undergraduate programs cannot go to a single faculty leader. Instead each year he sits down with each faculty leader to discuss the teaching portfolio of each of the 100+ faculty members, and then he tries to even out teaching loads, address all curricular needs, and plan for increases in enrollment.

For many decades prior to the formation of the school, reviews had found inefficiencies in the delivery of the undergraduate curriculum. The creation of the school eliminated these inefficiencies and has been praised by recent reviewers. Of course, the advising staff is critical to the success of this approach, since they must understand the complexities of advising students in 11 different degree programs.

Many universities fund departments based on majors or credit hours, which encourages the duplication of required courses across departments. Examples include statistics and methods courses; mathematics courses designed for particular majors, with little difference in content; writing courses; and other courses that could be taught more generally and more efficiently without the disincentives created by departmental interests. At ASU we fund course enrollments, with money going to whichever unit paid the person teaching the course, regardless of topic. This treats interdisciplinary and disciplinary teaching the same. This model enables interdisciplinary schools such as the School of Sustainability, which crosses all units on campus, to teach its courses.

In the traditional system, undergraduates do not understand the department structure and often get lost between departments or caught in the wrong ones. To make things easier in the new one, ASU has expanded its advising system to include E*Advisor, which can tailor a program of study to an individual's interests, to support the institution's 250 majors. (E*Advisor was described in an article in the July/August 2006 *Change*.)

No student can truly "explore" all of these majors. Instead, the technology helps students assess their interests and abilities and offers possible majors that might suit them. Student paths to a degree can be presented to them individually on line, and they are advised into a new major as soon as their performance, or their own interests, indicate they are currently enrolled in one in which they are not likely to succeed. This improves not only student satisfaction but retention and graduation rates. At Florida the four-year graduation rate increased 20 percent after 14 years of the program, and the six-year graduation rate increased 12 percent over the same period. At ASU, the increase in retention so far has been 2.5 percent after the first year.

The information that the system collects can also allow precision enrollment management. The university can guarantee seats in classes when students need them, as programs specify when courses are needed. None of this requires departmental intervention, and the organizational structure provides little incentive for duplication or inefficiency.

Faculty Work

Some academically qualified administrator must assign faculty work. By making academic units larger and more interdisciplinary, the unit administrator bridges more traditional units, but the work is the same. Earlier ASU had created the School of Earth and Space Exploration by combining the Departments of Geology and Astronomy, the School of Human Evolution and Social Change, some faculty from the Department of Anthropology, and some faculty from the Department of Sociology. The university also created the School of Family and Social Dynamics from the Department of Family and Human Development and some faculty from the Department of Sociology. These units, formed before the budget crisis, did not save money—that requires intentionality. Indeed, in some cases the staffs of the units were merely combined, continuing duplication.

More recently, ASU has created the interdisciplinary units listed in Table 1, in which the original units are also identified.

TABLE I. ACADEMIC REORGANIZATION AT ARIZONA STATE UNIVERSITY

New Unit	Former Units
School of Government, Politics and Global Studies	Department of Political Science and School of Global Studies
School of Design Innovation	Department of Industrial Design, Department of Interior Design, and Department of Visual Communication Design
Herberger Institute for Design and the Arts	College of Design and Herberger College of the Arts
W. P. Carey School of Business	W. P. Carey School of Business, School of Global Management and Leadership and Morrison School of Management and Agribusiness
School of Social Transformation	Departments of Justice and Social Inquiry and Women’s Studies, plus programs in African and African-American Studies and Asian-Pacific American Studies
School of Historical and Critical Inquiry	Departments of History, Philosophy, and Religious Studies
School of Sustainable Engineering and the Built Environment	Department of Civil and Environmental Engineering and Del E. Webb School of Construction
School of Electrical, Computer and Energy Engineering	Departments of Electrical Engineering and part of Department of Computer Science and Engineering
School of Biological and Health Systems Engineering	Departments of Bioengineering and Biomedical Informatics
School of Computing, Informatics and Decision Systems Engineering	Department Computer Science and Engineering and Department of Industrial, Systems and Operations Engineering
School of Life Sciences	Departments of Biology, Plant Biology, Microbiology and some faculty from Departments of Philosophy and History
School of Nursing and Health Innovation	Departments of Nutrition and Exercise Science and School of Nursing
Disestablished College of Human Services	Units in this college went to other colleges
College of Technology and Innovation	Six departments merged to three

These new interdisciplinary academic units are headed by a school director or dean, who has the same responsibilities department chairs had previously for faculty hiring, faculty evaluation, and the assignment of faculty work.

As mentioned, in some of the units faculty members are organized into “faculties,” not departments. For example, prior to the creation of the School of Life Sciences, there were separate departments for biology, plant biology, microbiology, and molecular and cellular biology. Now, the School of Life Sciences has the following faculties: biomedicine and biotechnology; cellular and molecular biosciences; evolution, ecology, and environmental science; genomics and evolution; human dimensions of biology; and organismal, integrative, and systems biology. The objective was to form a structure that could be easily reorganized around big programs and engage in use-inspired research.

Unlike departments, the faculties are designed to be flexible and to respond rapidly to this evolving area of science. The creation of a department is normally a formal process requiring university or system board approval, but changing the number of faculties or their membership requires no approval from the university. In the School of Life Sciences, each faculty member belongs to a primary and a secondary faculty to avoid creating new silos. Every year the school looks at the faculties it has and evaluates their viability—does it need more or fewer; does it need to change them?

Faculty in the new units have all found synergies by interacting with colleagues in new ways, leading to new degree programs, organizational units, and research projects and configurations. Examples include the science, technology, and society graduate degree; the graduate degree in the environmental life sciences; the Center for Biology and Society; and the Center for Social Dynamics and Complexity. Digital culture that cuts across design and the arts was enabled by the merger of two colleges. Another merger of department and programs, in this case into the School of Social Transformation, came from a faculty initiative to approach some important issues from a variety of perspectives. Moving the Departments of Nutrition and Exercise Science into

the School of Nursing produced a new unit that focuses on wellness and the prevention of disease in combination with health care. The reorganization of the Ira A. Fulton School of Engineering into focus areas around grand challenges has led that faculty to work together on research in a more meaningful way. Anecdotal evidence suggests that students recognize that engineering and technology provide the keys to solving the major problems facing the planet, and this inspires more of them to become engineers. The National Academy of Engineering supports this approach and now offers grand challenge scholarships to students (<http://www.grandchallengescholars.org/>).

The point is not that these particular combinations are necessarily the best in every institution but that the reorganization that produces appreciable savings also may lead to improvements in the quality and intellectual vitality of the programs that result from it.

Budgetary Implications

A much more effective use of university resources is one of the consequences of the optimal academic organization described here. This is significant whether the university faces the challenges of major revenue reductions or opportunities for additional investment in improvement. The elimination of small colleges at ASU saved approximately \$500,000 of recurring expenses for each unit eliminated, and the total saved from the re-organizations in Table 1 was \$13.4 million.

What is true at ASU is very likely to be true for higher education in general. While the total potential for savings is difficult to identify precisely, since academic expenses are lumped together in IPEDS reports under the “academic support” category, the potential saving made possible by merging large numbers of units likely rises into the millions.

Any budget savings from academic consolidation are significant, because the majority of the expenditures in colleges and universities are on the academic side, as shown in Figure 1. Academic expenditures (including student support) consume 82.4 percent of the tuition and state revenue at public colleges and universities And most of this expense is for people, as shown in Figure 2.

FIGURE 1. TUITION AND STATE SUPPORT AND EXPENDITURES PER FTE

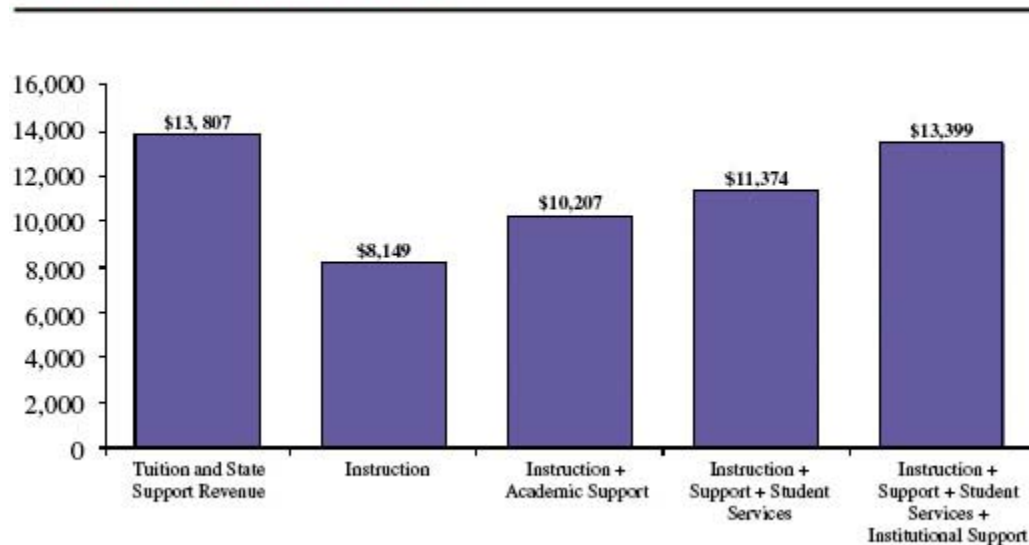
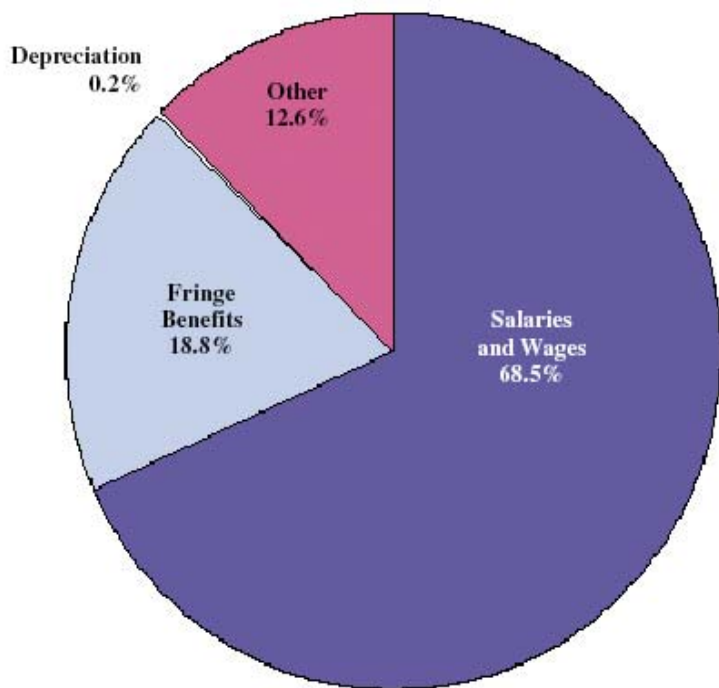
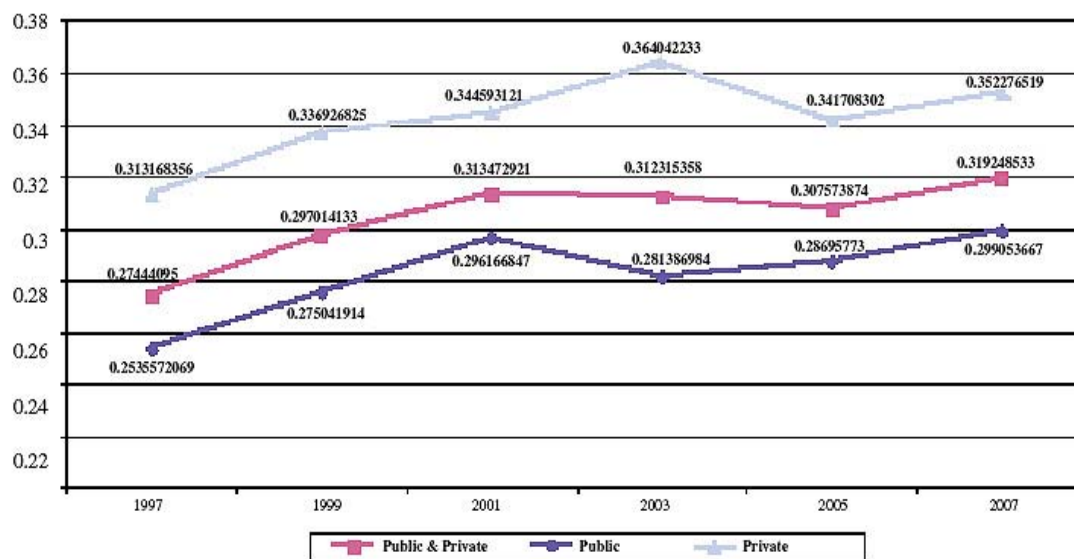


FIGURE 2. BREAKDOWN OF INSTRUCTIONAL EXPENDITURES AT PUBLIC INSTITUTIONS



Other strategies besides reorganization have been used to reduce academic expenditures. Tenure-track and tenured faculty represent the core of any institution; they produce the research and scholarship, develop the curriculum, participate in faculty governance, and carry a significant part of the teaching mission. But since they are also difficult to cut in times of budget crisis and more expensive than contract faculty, a common strategy in recent years has been to increase the proportion of contingent faculty in colleges and universities. This trend is shown in Figure 3.

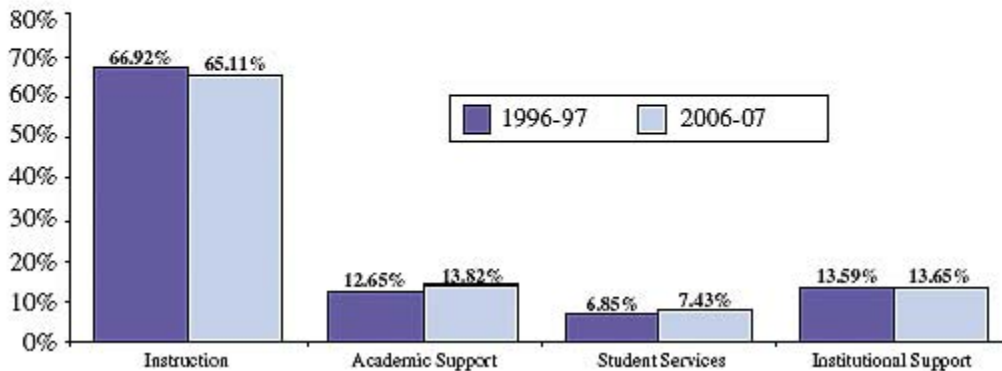
FIGURE 3. PERCENT OF FULL-TIME FACULTY NOT TENURED/NOT ON TENURE TRACK



Other methods of reducing direct expenditures on instruction include increasing the teaching productivity of faculty by increasing

class size and/or by using technology in large classes (see Twigg, 2003); using tenured faculty only for course design and updating and employing less expensive faculty or student assistants for course delivery and grading (see Fried, 2008); offering fewer electives; or increasing teaching loads for those faculty who are less productive in research, thus reversing the academic ratchet (Massey & Zemksy, 1994). These techniques have led to decreased direct expenditures on teaching over the last 10 years, as shown in Figure 4.

FIGURE 4. SHARE OF SALARIES AND WAGES AT PUBLIC FOUR-YEAR INSTITUTIONS



But even in times of budget crisis, we must protect the academic core and maintain quality. Some classes must be small and cannot yet be taught via technology, and the highest level of course development in terms of content requires skilled and expensive faculty. At some point, increasing class size, using contingent faculty, and implementing other efficiencies reduces quality. The method of academic administration described above, on the other hand, provides a way to reduce expenditures as well as enhance academic quality by facilitating faculty work across disciplines and emphasizing student success.

All of the new interdisciplinary schools formed at ASU saved money by reducing staff duplication. At the Herberger Institute for Design and the Arts, for example, instead of two deans, two finance or business offices, two admissions offices, two directors of undergraduate education, and two directors of graduate education, there is now only one of each. The amount of increased workload for the remaining dean, financial officer, program director, and so on is not sufficient to require additional staff expenditures; much of the work of academic administration can be extended relatively easily to increased numbers of students and faculty. To the extent additional work requires additional personnel, an administrative assistant is still less costly than an additional dean or chair, with his or her accompanying office and office staff. ASU's relatively simple combination of design and the arts into the new Institute for Design and the Arts, for instance, saved \$1.5 million in recurring dollars.

One common suggestion for reducing expenses on the academic side of the budget is to eliminate programs. But at ASU, all degree programs are still in place following these re-organizations. Degree programs do not cost money—people do. Unless an expense-reduction mechanism eliminates people, academic program eliminations do not save money. Perhaps more important, unless a new program requires the addition of people, it does not increase costs. Adding programs with the same number of faculty and staff increases productivity.

Making it Work

For this free-flowing academic environment to function effectively and to protect faculty who work in many units, faculty assignments and responsibilities require careful definition. The critical dimension of the new organization is a focus on the individual strengths of faculty and the optimal deployment of those strengths in academic activities.

ASU has instituted a system using academic memoranda of understanding between the two (or more) units that share faculty members. These MOUs, signed by responsible faculty and administrators, explicitly define expectations and the FTE split, including funding from each source, the percentage of indirect cost recovery to each unit, and the division of research recognition. The MOUs also establish:

- Evaluative procedures for making joint recommendations regarding annual performance review; salary adjustments; and promotion, tenure, or reappointment reviews.
- Expectations regarding research or creative activity.
- Teaching/instructional responsibilities, including classroom teaching, mentoring of graduate and undergraduate students, service, and resource implications (e.g., space, buy-out of teaching, etc).
- The duration of the agreement and the periodic schedule for reviews to identify any changes that may be required.

Fluid Structures for Fluid Research

Brew (2008) found that academics actually have more fluid identities than is suggested by pure disciplinary identification, with many defining their primary intellectual identity by their research. This finding resonates with my own experience. When, as head of the Department of Psychological Sciences at Purdue, I once led a discussion of where to affiliate the department—with the School of Humanities, Social Science and Education (where we were), or Science—it turned out that the physiological psychologists wanted to go into the School of Science, the industrial/organizational psychologists wanted to join the School of Business, our personality/humanist psychologist wanted to affiliate with the School of Humanities, and so on. That discussion illustrated that the department itself was an arbitrary administrative artifact, not an intellectually defined unit.

If one views the university as organized around the individual faculty member and student, both research and education can be tailored to those individuals by taking advantage of the potential of technology. Each faculty member actually needs journals and books that pertain to the specific requirements of his or her work. As one example, although I was trained as a psychologist, I now study psychology of eating. My main journal is *Appetite*, an interdisciplinary journal of factors affecting ingestion, and my main conference is the Society for the Study of Ingestive Behavior.

Online journal publication may provide a way to achieve a customization of research resources. Ideally each of us should be able to subscribe to journals in a way that gets us only the articles we need. Moreover, because the journals are too slow to change with our changing interests, we can anticipate continued increases in bypassing the slower academic journal publication cycle. In an ideal future, faculty could choose to subscribe to a certain number of articles from any source, allowing them to expand the reach of scholarly publications without the requirement to purchase the entire journal. We are just beginning discussions of how we might manage this at ASU.

Open-source publishing, blogs, and other Internet-enabled venues will continue to change the nature of archival scholarship. All of these new forms also weaken the traditional control of intellectual life by the narrowly defined disciplines and their academic departments. Although there are interdisciplinary journals, the ever-changing combinations of disciplines and widely varying structure of intellectual inquiry suggest that our publication outlets need to be more fluid, as do our academic organizations.

Better Structures for a Better Future

Over the last few years many have bemoaned the fact that universities are too rigid to accommodate rapid changes in knowledge. Most of this difficulty stems from an outmoded organizational structure that centers on the academic department. This traditional structure is not easy for undergraduates to negotiate. They often have difficulty finding a major or understanding the available choices. This structure also interferes with graduate education, as students now need to be educated more broadly with the skills to work across disciplines. Finally, it inhibits the many faculty who need to work on a problem with colleagues from other disciplines and who want to be more flexible in methods and approaches than a traditional disciplinary perspective would support.

The traditional structure also suboptimizes the university's resources, because it breeds wasteful competition, an inefficient use of resources, and a rigidity that discourages rapid responses to challenges and opportunities. Many federal agencies expect universities to help solve the "grand challenges" facing the planet, and many faculty and certainly students are ready to respond. Changing the traditional departmental structure to an organizational model focused on individual faculty grouped into easily modified clusters that match academic and intellectual interests will facilitate education and research and, at the same time, save a lot of money.

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<http://www.changemag.org/Archives/Back Issues/July-August 2009/full-intellectual-budgetary.html>

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The Campus Of The Future

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To better compete, a few bold leaders are rethinking their schools from the ground up.

by [Stefan Theil \(/authors/stefan-theil.html\)](/authors/stefan-theil.html) August 09, 2008

Michael Crow is overseeing one of the most radical redesigns in higher learning since the modern research university took shape in 19th-century Germany. Since taking over as president of Arizona State University in 2002, he's not only doubled the budget to more than \$2 billion a year, hired dozens of world-class researchers and rapidly raised the academic profile of what used to be a mediocre school; he's also transforming the way Phoenix-based ASU sees itself—and helping reinvent the university for the global age.

For starters, that means running the school like a CEO, raising fresh capital, bringing in new corporate partners and restructuring dramatically. Crow has begun abolishing traditional departments, lumping pieces together into custom-built "transdisciplinary" institutes. The idea, which he first tested when building Columbia University's Earth Institute in the 1990s, is to promote innovation and real-world problem-solving by getting experts to rub shoulders and think outside their disciplines. Thus ASU's new College of Nursing doesn't just focus on bedside care, but has architects, policy experts and business professors working together on health-care innovation. Crow's ambitions even extend outside the academy: he hopes to boost his university's impact on the economic development of Arizona and the region. The brand-new School of Sustainability features professors from 35 disciplines studying urban development in Phoenix and across the Southwestern United States, bringing in expertise on subjects ranging from desert-water ecology to energy-saving building design.

It's all part of a fundamental rethinking of how universities should function in the 21st century, a process led by Crow and a small number of like-minded pioneers such as NYU's John Sexton and Olin College's Richard Miller. (Not shy about his ambitions, Crow calls his ASU model "The New American University.") Locked into an increasingly fierce global race for students, professors and resources, schools are realizing they need to distinguish themselves to survive. More and more, that means moving students away from specialized academic training and toward more integrated approaches to complex, real-life problems. It also means building on a process that began in the 1980s and '90s to help their schools play an ever more direct role in driving economic and technological progress in society at large.

In the old days, professors concentrated on teaching and their personal research. They didn't care much about what was going on in other departments, let alone outside the campus gates. "There was a wall between the university and society," says David Audretsch, who studies the economic impact of universities at Germany's Max Planck Institute. "Universities didn't play much of a role in the economy." Starting in the 1980s, however, schools like Stanford and MIT became epicenters of

the emerging knowledge economy, creating new disciplines like biochemistry and molecular biology; fostering spin-offs and start-ups, and bolstering research budgets by partnering with industry—one of the reasons, says Audretsch, for America's consistently higher economic growth rate in the 1990s. In the sciences, engineering, medicine, business, and economics the barriers that had isolated the university from society came tumbling down.

Today it's become common for universities to help solve real-life problems and push economic growth. But a few are taking it to the next level. At Stanford, Roberta Katz, vice president for strategic planning, says her university's mission is to increase engagement by completing the breakdown of "segregated academic silos." Stanford has created dozens of new multidisciplinary centers and programs, changing not just curriculums but even the architecture of new buildings in order to promote teamwork and cross-fertilization. The new Bio-X bioscience center, for example, features joint labs, flexible layouts for quick reconfiguring, and lots of social spaces for group brainstorming. "Research in a purely academic vacuum was probably never sufficient," says Katz, "but particularly not in this day and age." Climate change, aging societies, global security—none of these issues, she says, can be addressed by working in the confines of traditional academic departments.

Even in Europe, the Middle East and Asia, where schools are often weighed down by slow-moving bureaucracies, universities are fast adapting. In Ireland, for example, Dublin City University—which was founded less than 30 years ago (unlike nearby Trinity College, which dates to 1592)—has been given a clear mandate to move Ireland up the ladder of the knowledge economy, says DCU head of strategy Gordon McConnell. Today, companies like Intel and Samsung run research labs in the middle of the campus, brought there with the help of Ireland's Inward Development Agency. At first, professors balked at what they considered blatant commercialization. But this direct link to some of the companies that helped drive the "Celtic Tiger" has given students a tremendous head start when looking for jobs.

More radically, in Saudi Arabia, when King Abdullah University of Science and Technology opens its doors in 2010, it will not only be the world's sixth richest university, with a \$10 billion endowment; it will also boast the globe's most revolutionary university structure—namely, no academic departments at all. All work will be done in only four interdisciplinary research institutes, focusing on biosciences, materials science, energy and the environment, and computer science and math.

It's not just universities' structures that are being reengineered. Students themselves are being offered radically new, international learning experiences. In the past, when schools like Georgetown or Cornell set up satellite campuses abroad, they acted like franchise operators—spreading the brand and generating cash but not providing new opportunities for students at the home campus to study abroad. Now that's changing. NYU's Sexton, for example, plans to use NYU's foreign campuses to internationalize the curriculums everywhere, rotating students among NYU's branches in New York, Abu Dhabi, Tel Aviv and Florence, as well as to affiliates in Berlin, Shanghai, Singapore and Buenos Aires. And we're not just talking about traditional semesters abroad. If Sexton has his way, entire future classes at NYU will graduate immersed in multiple languages and cultures, based on numerous stints overseas that have been integrated into their curriculums.

Students will profit from two other major rethinkings underway, concerning admissions and tuition. Olin College of Engineering, founded in 2001 in Needham, Massachusetts, has not only abolished academic departments and tenure for professors. It's also abolished tuition for all of its 300 students, financing teaching expenses through its \$460 million endowment. The idea is to give

students more freedom in choosing their careers without having to worry about paying off debt. Back at ASU, meanwhile, Crow promises to keep admissions inclusive even as the school's academic rating rises. He says the ultraselective admissions policies of schools like Harvard and Yale mean they merely refine youngsters whose success was already virtually guaranteed. Training those less sure to get ahead is far more valuable, he argues. And new studies back him up, showing that achievement differentials—that is, the "value added" to human capital by attending college—are actually higher at good-quality schools with less selective admissions than they are at the Ivies. "Not moving to more selective admissions is the most radical thing we're doing," says Crow. He's not the only one thinking in such terms; Stanford's Katz says she too is reevaluating the admissions strategy.

Of course, not everyone's a fan of these developments. Some professors have criticized Crow for turning ASU into a "corporate university" that focuses on spin-off revenue instead of academic learning. And there's a tension, says Max Planck's Audretsch, between universities trying to help the overall economy and their function as reservoirs and generators of basic learning. "The knowledge economy requires we get more out of our universities while keeping them great and not turning them into vocational colleges," he says. Stanford's Katz warns that amid all the moves to promote interdisciplinary thinking, there is a risk of connecting too many dots and losing sight of the need for solid data and science. Yet Crow is no more radical than the innovators who helped create the modern university in Germany in the 19th century, fusing teaching and research in new ways. If he can keep things in balance like they did, today's schools, students and the societies they serve could all profit from the process.

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