CHAPTER 14

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

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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-

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; Gammage *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 hidebound 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 instil 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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