

Building Synergies

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We live in challenging times — with a sputtering economy, budget deficits, and bitter political divisions — yet it is through such challenges that sometimes we most clearly see our potential and the way forward. Over the past year, we in the United States have navigated an emotive political process in setting the stage for a new healthcare system for our citizens. The goal of the new healthcare system is an important one: to provide for the long-term health and viability of the residents of the United States. It is also time for us to assess who will provide for the long-term health and sustenance of our national economy, our standard of living, and our global leadership.

I submit that our universities — and most especially our public universities — play the role of improving and sustaining our nation's long-term health. They perform the fundamental basic research that leads years down the road to a healthy and viable economy. In this presentation, I will discuss the pivotal role that universities play and why it is so important to keep them strong and vital. My view is that the best way to do this is to build and exploit synergies.

The Role of Research Universities. At their core, research universities have a primary responsibility to educate. They educate students to be productive members of the workforce, to contribute to the vitality of the nation, and to be tomorrow's leaders. We teach students to be lifelong learners and innovators. Innovation drives our economy and creates high-paying jobs, yet is often based upon education and research that occurred decades earlier. In particular, the foundation for much of our current economy is basic fundamental research performed many years earlier without

immediate payoff. It stands to reason that what we do now in basic fundamental research will be the key to innovation and prosperity decades into the future. The prosperity of our grandchildren and great grandchildren will depend upon the seeds of innovation that we lay today — in our universities.

During the past year at the University of Kansas, Chancellor Bernadette Gray-Little commissioned task forces to study issues of learning and discovery. They laid the framework for KU's current strategic planning effort, which we are undertaking this academic year. Our goal in the learning realm is to craft an outcomes-based curriculum for the 21st century — one that engages students in an active manner and helps them develop both the practical skills to succeed in today's complex world as well as the foundations to lead tomorrow's.

The second focus in our strategic plan recognizes that premier research universities such as KU play a crucial role through groundbreaking discovery that

advances the frontiers of knowledge. In this presentation, I will use the terms “research” and “research scholarship” to mean the array of creative scholarly activities, spanning from scientific discoveries in the laboratory to compositions and performances in the studio. Chancellor Emeritus of the University of North Carolina at Chapel Hill, James Moeser, stressed during his presentation the importance of supporting and enhancing research scholarship comprehensively in all parts of academia — Fine Arts, Humanities, Social Sciences, Physical & Life Sciences, Engineering, Education, and the professional schools. His thoughts complement those of Richard Florida, who writes about the powerful force that a comprehensive university plays in drawing creative people together and thus enabling innovation (Florida, 2003). Solutions to the grand challenges we face in society — energy, health, sustainability, and human relations — will require deep expertise from multiple disciplines. As an example, advances we make in bioinformatics and in unlocking the secrets of the genome and living systems, combined with nanoscience innovations that allow us to miniaturize embedded devices, will open up unparalleled new opportunities for treating diseases and individualizing patient care. Success in the 21st century will require creative and programmatic thinking that transcends disciplinary lines.

Starting in 1995, we have experienced a dramatic increase in economic productivity in the U.S., a majority of which can be attributed directly to the groundbreaking innovations brought about through information technology (Jorgenson, Ho, & Stiroh, 2005). It is important to note that many of the underlying advances in IT

were made decades earlier. For example, the technology of the Internet is based upon the notion of packet routing — which allows you to take a message that you want to communicate to another part of the world or to another computer and break it up into little packets that you can send across a vast network and then reassemble at the other end. Packet routing and other key networking technologies were developed in the 1960s, and the Internet was piloted and developed largely in the 1970s. Yet, the positive effect of information technology on the economy was not fully realized in a significant way until the 1990s.

One of the fundamental roles and responsibilities the Federal government has is to nurture and sustain basic fundamental research. The reason is clear: the horizon of fundamental research stretches too far into the future to rely on corporations to fund it. Corporations operate in a competitive dog-eat-dog world, driving them continually to focus on the short term. For that reason, the Federal government has the primary responsibility to fund fundamental research and spur innovation. The amazing advances made by this country after World War II were catalyzed by the establishment of national Federal agencies that fund basic fundamental research, such as the National Science Foundation, the Defense Advanced Research Projects Agency, and the Office of Naval Research. Such responsibility is the reason why both parties of the U.S. Congress wholeheartedly supported and passed the America COMPETES act in 2007 and its reauthorization in 2010. The COMPETES act seeks to double funding, over a seven-year period, for the National Science Foundation and other agencies that promote fundamental research.

The Fundamental Importance of Synergy to Research Scholarship.

This presentation is entitled “Building Synergies” because synergy is fundamental to research and, consequently, society. As James Moeser elucidated, many challenging problems that confront society — such as sustaining both economic vitality and a healthy environment, meeting the energy challenges of the future, exploiting information without falling prey to it, and resolving centuries of animosity in the Middle East — are inherently cross-disciplinary, requiring deep and synergistic advances from several disciplines. The great minds of the preceding centuries like Newton, Galileo, and Descartes did not see themselves as purely mathematicians, physicists, or philosophers. Rather, they were members of a community of academics; their inspirations and interactions nourished one another. In the same way, modern-day researchers who are experts in their individual disciplines will need to work together, inspire one another, and build synergies in order to conquer today’s grand challenges.

In the last century, as traditional academic disciplines crystallized and fields became more specialized, some of the valuable interactions and cross-fertilization that drove much of early discovery were lost. On the other hand, this sort of specialization by discipline has brought forth an explosion of deep and fundamental discoveries, creating a truly golden age of learning. The driving forces mentioned earlier — IT, nanotechnology, and genome sciences — have each sprung from those fundamental disciplinary discoveries. Therefore, I feel it is important to embrace a dual philosophy of excellence

— excellence in cross-disciplinary collaborations as well as in core disciplines. These two goals are quite synergistic. The most successful cross-disciplinary collaborations often occur among researchers with deep but distinct areas of expertise who, in the course of their collaborations, make state-of-the-art contributions to their respective core disciplines. Indeed, the feedback and insights gained from cross-disciplinary collaborations can inspire exciting new directions in the core disciplines and contribute to their renewed vitality. In the course of our strategic planning this coming year, we will focus on ways to remove hurdles and facilitate important research conversations and collaborations, especially along cross-disciplinary themes.

A Broadened View of Research Scholarship.

Traditional measures of research, such as grant funding and prestigious awards, will be key metrics that we will seek to boost. Many of the presentations at this retreat discuss how to advance these and related measures of research scholarship.

The purpose of this presentation, however, is different, and instead I will focus on non-traditional approaches to grow the research pie. I will especially emphasize those synergistic approaches that may “draw in” faculty members not currently research-active or that may excite currently funded faculty in important new ways. One approach involves broadening the definition of research by encouraging and valuing different forms of creativity, which some individuals may be more adept at and, as a result, may embrace.

One of the responsibilities I would like to see leaders in higher education embrace is to transform the culture of our

institutions so that faculty members *value* and *are valued for* new forms of creativity. We should not limit creativity to traditionally valued forms of research, namely, those that go through the formal peer review process of archival journals or books. Instead, let us borrow from that traditional process some of its key elements — peer review and judging quality — and find creative ways to unleash faculty and student creativity to discover amazing new forms of knowledge and wisdom. This broader view relates to another fundamental responsibility that universities, and most especially public universities, have: to apply the fruits of their labor — knowledge — for the direct benefit of society. This integral connection to the community provides yet another example of synergy — traditionally referred to as “service” or “outreach,” and increasingly referred to as “engagement.”

Engagement is a term that means different things to different people. In his presentation, Steve Warren talked about research engagement at KU, where the term engagement is used to mean research involvement and activity. The task force on retention and graduation focuses largely on the value of engaged learning, that is, those activities involving active learning, service learning, and experiential learning; in fact, it uses the term “engaged” or a word of the same root 86 times! In contrast, the engagement I am talking about here in this presentation is all about connection to the community — the third leg of the stool for public universities. Engagement to me means a partnership between the university and the outside community. I use the term community in the broad sense to mean any or all of the local region, state, nation, and world.

Engagement is most effective when it embraces scholarship and becomes what Boyer calls “scholarly engagement” (Boyer, 1996), it truly melds into and reinforces the other two principal university responsibilities of research and learning. Scholarly engagement is, at its core, scholarship. The following characteristics of scholarly engagement are very similar to those of more traditional research scholarship, but have a direct link to public impact:

- breaking new ground and having application to public issues,
- contributing fundamental new insights and knowledge,
- applying scholarly methods,
- founded on solid theoretical and practical bases,
- peer-reviewed by both experts and by the community, and
- disseminated to academia and the community by publication and other artifacts such as patents, products, novel training methods, and new programs.

Scholarly engagement can take several research forms:

- entrepreneurship, in which discoveries made in the laboratory or faculty office are translated into new companies and products to improve human life.
- K–12 precollege partnerships that involve researchers, teachers, and students to develop novel teaching methodologies and strategies to excite students about learning, especially in the STEM fields,

- innovative community projects and service learning activities that address challenging issues of the day, and
- social entrepreneurship.

Below are a few specific examples of scholarly engagement at the University of Kansas that we will use as building blocks as we move forward:

- Steve Barlow is a professor of speech / language / hearing sciences and disorders. His work with at-risk premature newborns led to inventions designed to assess and promote a normal pattern of sucking behavior. This innovation enables the premature infants to feed naturally before discharge from the neonatal intensive care unit. His NTrainer System technology is being developed for commercialization locally by KC BioMedix of Shawnee.
- Arienne Dwyer is an associate professor of linguistic anthropology. She is one of the best-known and most respected scholars working on the languages of inner Asia, especially Chinese minority languages. Much of this work has involved extensive and difficult field research along the eastern Silk Road. She regularly advises national and international agencies and organizations on China and central Asia, language vitality assessment and the creation of multimedia archives.
- Jerry Dobson is a professor of geography who is serving this year as a Jefferson Science Fellow at the U.S. State Department. In that role, he is an advisor on global policy, especially as it involves his research focus: developing cartographic and statistical tools to study population density and related issues. Dobson is also president of the American Geographical Society.
- Faculty and students in Studio 804 at the School of Architecture and Urban Planning responded to the devastating 2007 tornado in Greensburg, Kansas by designing and constructing a sustainable prototype building for the city. Dan Rockhill, a distinguished professor in Architecture, directs the project. The LEED Platinum-certified arts center in Greensburg opened in June 08.
- Lisa Friis is an associate professor of mechanical engineering and track director for biomedical product design and development in the Bioengineering Research Center. She is also an entrepreneur. Her synthetic lumbar spine model allows surgeons to test spinal implants prior to back surgeries. In 2006, Friis was named to the charter class of the KTEC Pipeline program, designed to nurture a select group of young entrepreneurs.
- Val Stella is a distinguished professor in pharmacy and a serial entrepreneur. He is a world-renowned expert in the field of improving drug stability and solubility. His research work led to the discovery of Captisol, an agent used to safely dissolve drugs for injection. Under his guidance, three successful companies have spun off from KU: CyDex, CritiTech, and ProQuest.
- Our UKanTeach program is a model of K-12 outreach, pairing students with master teachers, to increase the supply of graduates who become teachers in middle school and high school, especially in the STEM fields. Combined with the Center for Science Education and the Center for Research on Learning, we are positioned to make significant advances in improving learning outcomes for middle and high school students.

In my own experience, I began a project in scholarly engagement at Purdue in late 2003 when the recently released National Research Council ratings were being planned. At that time, we were faced with a plan by the NRC to develop ratings based upon fields that cut across departments. As dean of the College of Science, I was concerned that faculty members rating a particular field would look at what was happening in that field in a given department, but potentially miss all the related activities in other relevant departments across campus. Therefore, we designed and implemented the Purdue University Research Expertise (PURE) database to link together individuals in all the various fields. It is a tool for potential students, collaborators, legislators, and corporate partners to find out who is doing what. The research challenge was to maintain the database automatically without need for individual updating. It has subsequently morphed into INDURE (Indiana Database for Research Expertise) funded by the state government and available for use on the World Wide Web (www.indure.org, 2010).

Other Advantages of Synergy. Junior faculty members are increasingly becoming entrepreneurial. (I use the term “entrepreneurial” here in a broad sense to mean imaginative and resourceful in a variety of ways.) If two lines of research are equally interesting from an intellectual point of view, many early career faculty members naturally choose the one with the perceived greater capacity to have a positive impact upon society. The Secretary of Commerce Gary Locke recently announced the creation of a National Advisory Council on Innovation and Entrepreneurship, drawing members from academia, industry, and venture groups with a charge to connect great ideas with great company builders and to develop

breakthrough technologies. At the same time, he raised the question of whether federal funding for university research should perhaps be tied to the institution’s ability to produce more immediate, tangible economic benefits (Locke, 2010), illustrating another practical real-life advantage to broadening the notion of research scholarship in universities.

At public universities, contributing to the state economy in very tangible ways — by creating new jobs and companies and improving the work force — can lead to productive partnerships with the state. During Martin Jischke’s term as president at Purdue in the last decade, the economic benefit to the state was tangible, and as a result, the Indiana state legislature decided to incentivize further activity. In particular, it initiated a program to provide extra funding to Purdue based upon the amount of external research funds raised at the university. This explicit partnership contrasts with the earlier situation at Purdue in the 1990s, when state funds were restricted from use for research activities.

Texas has a similar program to incentivize research funding called the Competitive Knowledge Fund. In Kansas, the Kansas Bioscience Authority has played a major role in boosting life science efforts, particularly through the tremendous cancer effort that Barbara Atkinson discussed in her presentation. Chancellor Bernadette Gray-Little mentioned the sales tax initiative passed by the voters of Johnson County that is supporting both KU and K-State in major ways to partner with Johnson County Community College. More and more, states are beginning to realize the important roles universities play in spurring economic activity.

Another important form of synergy in research is the partnerships universities have with corporations. These partnerships can

help universities in multiple ways, first, by building support for research from the Federal government as it is the primary funder of research and public universities are the major beneficiaries. About 60% of research and research funding is attributable to public universities (McPherson, Gobstein, & Shulenburg, 2010). A few years ago, some members of Congress began questioning the value of funding research as they aspired for more accountability. Of course, basic fundamental research does not generally give the kind of immediate payback they desired. Yet in 2007, Congress achieved bipartisan support and passed the America COMPETES legislation. The key factor was the strong urging by the leaders of major corporations, such as those in the Task Force on the Future of American Innovation, which includes companies like Microsoft, Google, IBM, Intel, Procter & Gamble, Northrop Grumman, and Texas Instruments, among several others. The Republican administration of Pres. George W. Bush took particular notice of what the business community said was important and as a result became an ardent supporter.

I think such efforts can work well at the state level. State support is not specifically for research, but it supports the faculty and students who do the research. We in universities have a vested interest to ask state legislatures for more money, no matter how powerful the argument (and it is very powerful!). But how much more powerful would it be if the leading figures in the state — in business, agriculture, medicine, and entertainment — took strong public stands and directly urged state legislators to prioritize the funding for higher education?

Synergy with corporations also manifests itself in direct research collaborations. We at universities have a huge potential to collaborate with corporations. In his

presentation, Harvey Perlman discussed Nebraska's new Innovation Campus on the former state fairgrounds. Many corporations have downsized in the last 20 years, often eliminating their research arms or their longer-term research, and such decisions are coming back to haunt them. Universities are natural partners for corporations, and the opportunities are not limited to merely engineering, science, or agriculture. They also include communications, liberal arts, law, and business.

There are several good examples at the University of Kansas of synergistic research involving corporations, and the potential is substantially larger than the current reality. KU is collaborating with ConocoPhillips to jointly develop innovative technology to improve oil efficiency. ConocoPhillips is contributing \$400,000 per year to the initiative. The research is based upon patent-pending nanotechnology developed by three faculty members in Chemical and Petroleum Engineering.

The nanotechnology being applied to the ConocoPhillips challenge of oil production is actually a spin-off of research conducted to control the release and solubility of drugs, a research field where KU is a recognized leader. Additionally, as of 2009, Archer Daniels Midland is partnering with KU on biorefining research to explore ways to use renewable resources in fuels, key chemicals, plastics, and other common materials. The goals are to develop products that can reduce petroleum consumption and develop new markets for agriculture. In 2009, the Kansas Bioscience Authority approved an investment of \$1.2 million that will match a \$1.2 million commitment from Archer Daniels Midland for work with KU's Center for Environmentally Beneficial Catalysis. The project expands upon research that has been

under way for the past four years at KU into biorefining, the use of biomass to produce feedstock for a variety of industrial processes. The Archer Daniels Midland research will focus on multiple areas: converting carbohydrate feedstock into a form of engineering plastic known as BDO; converting vegetable oils to lubricants and other industrial chemicals; eliminating the need for a petrochemical that is used in food and beverage packaging; and the development of biofuels. In addition to the \$2.4 million from Archer Daniels Midland and the Kansas Bioscience Authority, KU is providing \$334,000 of in-kind support for the project. Distinguished professor Bala Subramaniam is leading the project at KU.

As dean of the College of Science at Purdue, I gave strong support to and allocated resources to develop what became the GeoMathematical Imaging Group (GMIG), led by a brilliant applied mathematician Dr. Maarten de Hoop. GMIG is an industry-funded research group consisting of the world's largest energy corporations. GMIG researchers conduct state-of-the-art research on inverse imaging with applications to oil and gas exploration. The GMIG partners — who are natural competitors — have non-exclusive royalty-free licenses to the research

performed, much of it basic foundational research, which has been a real boon to both the university and the corporations.

Conclusions. Synergy truly plays a fundamental role in research scholarship in a number of ways and at a variety of levels. Synergy improves and enhances cross-disciplinary collaborations that are necessary to address the grand challenges facing society. Synergy engages our local, state, and national communities through scholarly engagement. Synergy also allows us to collaborate with Federal and state governments and to partner effectively with corporations. And one of the greatest synergies of all is the potential to work globally with colleagues across the world to apply our collectively rich diversity of backgrounds and perspectives toward the solution of problems that affect us all. To take full advantage of these opportunities, we need to remove barriers for synergistic collaboration. We need to provide infrastructure, to develop a culture that values different forms of creativity and scholarship, including nontraditional, and to create productive partnerships, whether it is with communities, government, businesses and corporations, foreign nations, and, of course, other universities.

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